



National  
Science  
Foundation

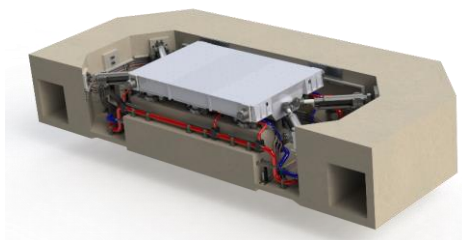
University of California at San Diego



UC San Diego  
JACOBS SCHOOL OF ENGINEERING  
Structural Engineering

# *IT Resources, Cybersecurity, Instrumentation, and DAQ*

*Koorosh Lotfizadeh, UC San Diego*



***NHERI@UC San Diego User Training Workshop***

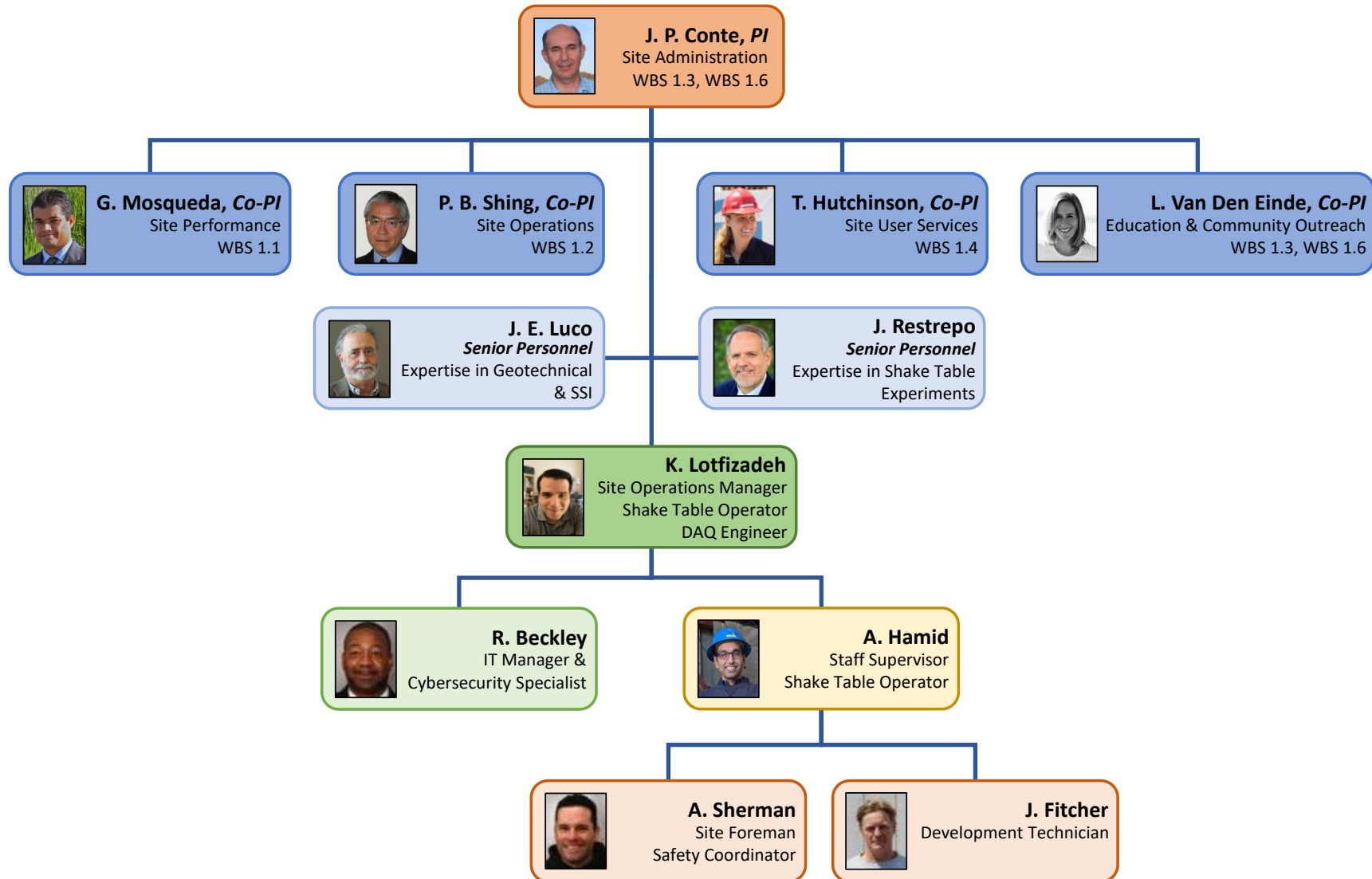


***December 16-17, 2021  
University of California, San Diego***



## ***NHERI Operations Personnel***

# NHERI Operations Organization Chart



# *IT Infrastructure and Cybersecurity*

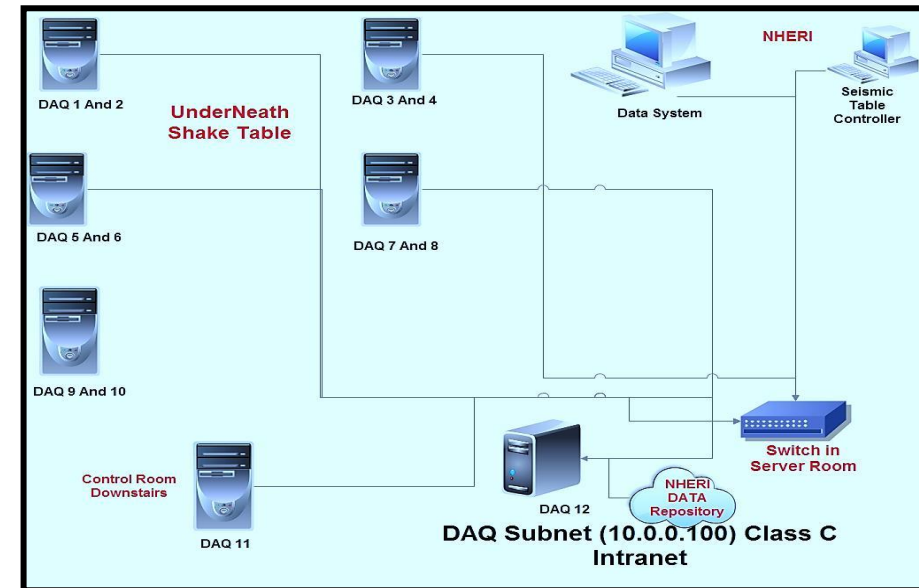
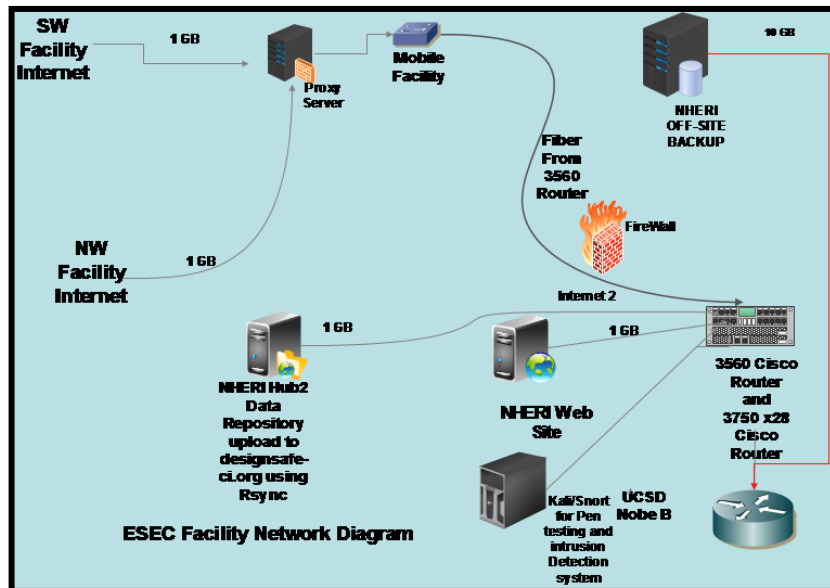
# IT Infrastructure and Cybersecurity

- UPS to provide “clean” power to DAQ and provide buffer in event of power outages
- Off-site data backup for redundancy
- Cyber security audits
  - Weekly audits by UC San Diego IT security department
  - Network vulnerability scanning and penetration testing
- Security cameras and locks for physical security



# IT Infrastructure and Cybersecurity

- NHERI@UC San Diego EF equipped with gigabit LAN
- Secure high-speed Wi-Fi available throughout facility
- Two independent networks for security
  - General facility network connected to the internet for users, accessible from anywhere
  - DAQ and video local network, restricted to key personnel and not accessible from the outside



# *Realtime Monitoring of Subsystems*

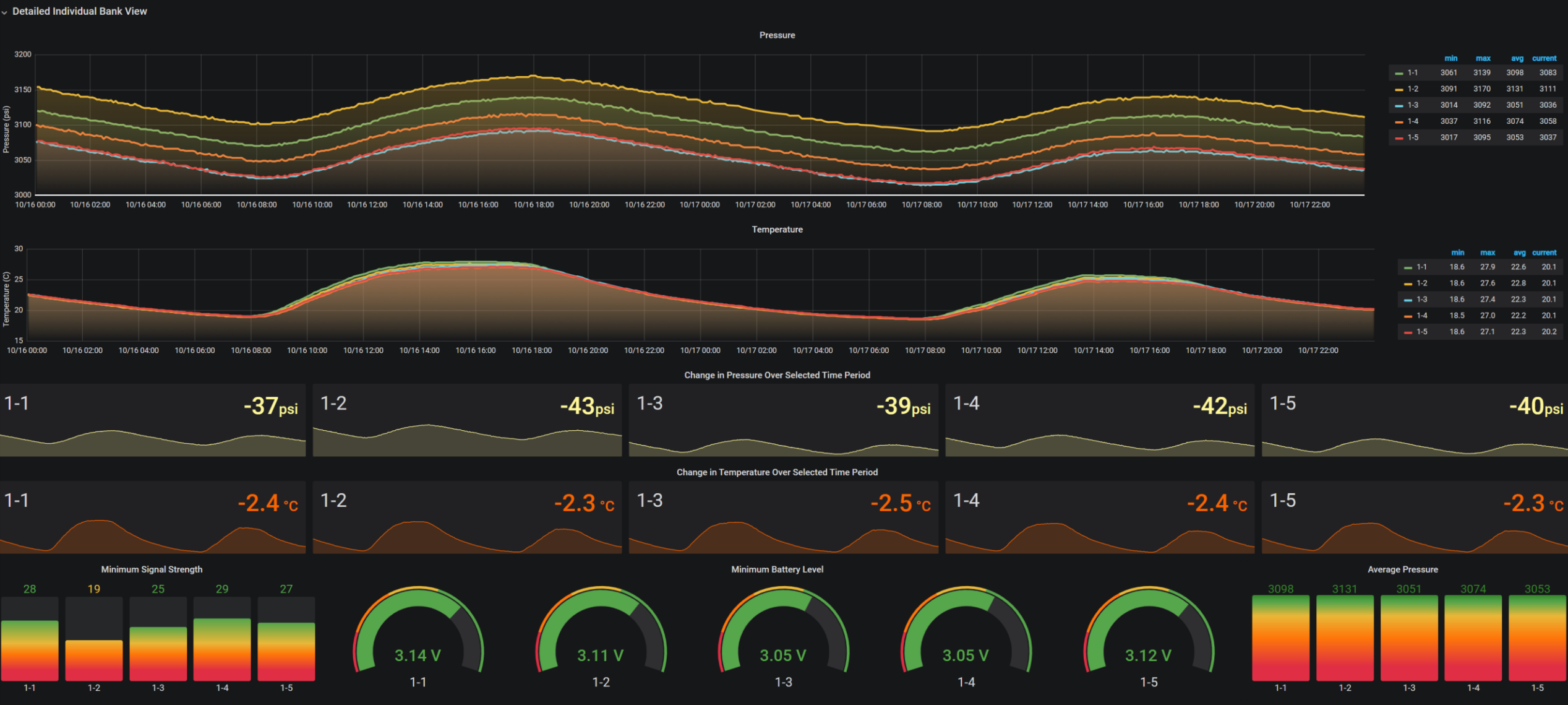
# Accumulator Bank Pressure Monitoring

- Accumulator banks
  - 75 bottles total, 15 skids with 5 bottles each
  - 130 gallons each
  - 3000 psi minimum Nitrogen pressure in each bottle in idle condition
- Pressure changes throughout the day with ambient temperature fluctuations
- Wireless real-time monitoring of pressure and temperature in each bottle
  - Equipped with wireless Sensonode Gold
  - Data captured by wireless gateway and passed to SQL server
  - Web-based user interface for local or remote monitoring

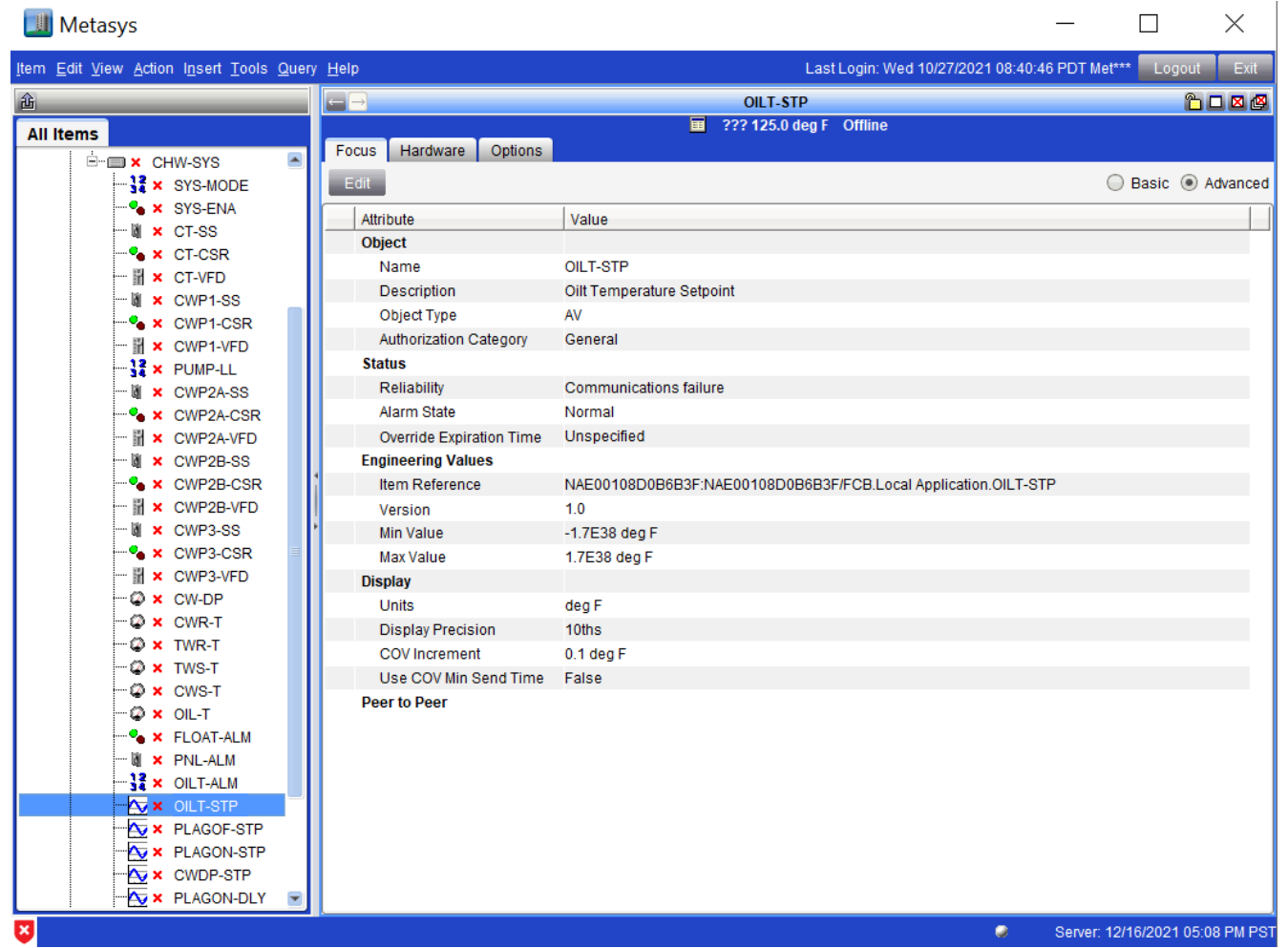
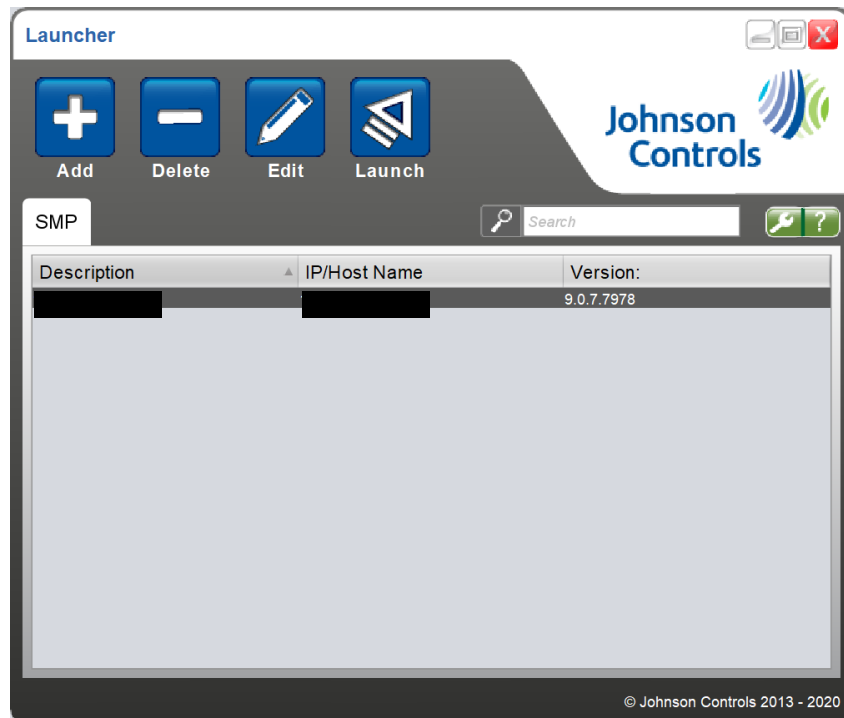




# Accumulator Bank Pressure Monitoring

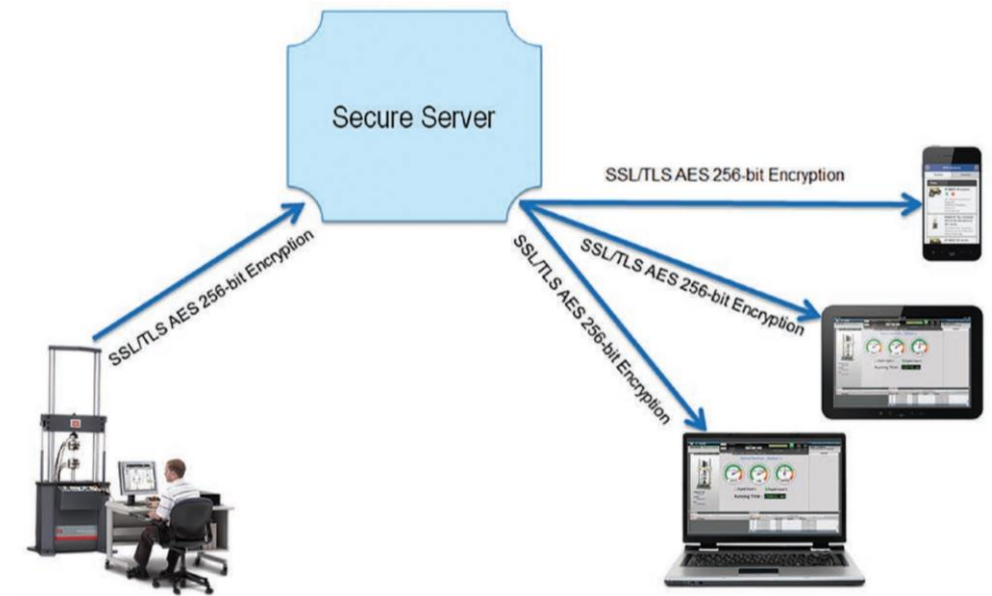


# Cooling Tower Monitoring



# MTS Echo Health Monitoring

- Real-time health monitoring of HPUs
- Protect system performance
  - Minimize system downtime
  - Minimize likelihood of expensive catastrophic events
- Monitor various critical metrics
  - HPU temperature
  - Heat exchanger water saturation
  - Fluid contamination
  - Current and energy consumption
  - High-pressure and return filtration effectiveness
- Secure server infrastructure, highly scalable
  - SSL/TLS AES 256-bit encryption



Courtesy: MTS Systems Corporation

# *Instrumentation and Data Acquisition System*

# Instrumentation and Data Acquisition

## ➤ Objectives

- Provide quality management system
- Provide nationally and internationally recognized testing data and reports
- Maintain a calibrated sensor and equipment inventory

## ➤ Documentation

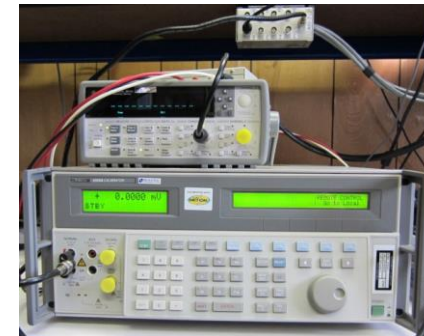
- Documentation master log file
- General documentation
- Standard operation procedures
- In-house calibration procedures
- Sensory inventory
- Equipment inventory
- Calibration reports



Accelerometers



Accelerometer linearity



Reference equipment



Displacement transducers



# Instrumentation and Data Acquisition

## ➤ Instrumentation available:

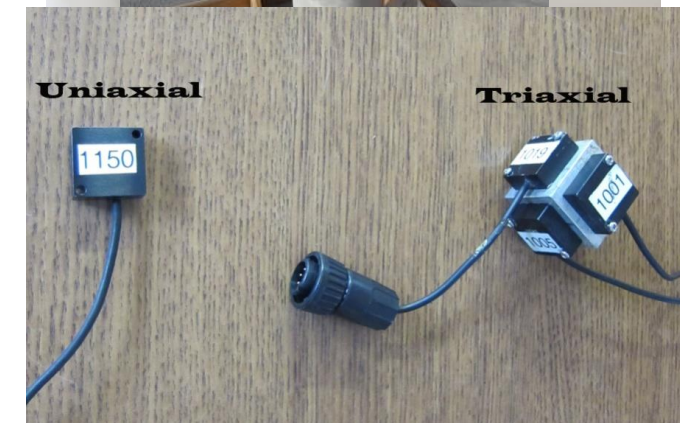
- 205 MEMS-Based Accelerometers ( $\pm 5g$  and  $\pm 10g$ )
- 142 Linear Displacement Transducers (2 to 20 in)
- 119 String Potentiometer Displacement Transducers (2 to 60 in)
- 4 Load Jacks
- 31 Load Cells (up to 20,000 lbs)
- 32 Soil Pressure Transducers

## ➤ GPS System:

- 3 Receivers Operating at 50 Hz
- RTD\_NET Software by Geodetics

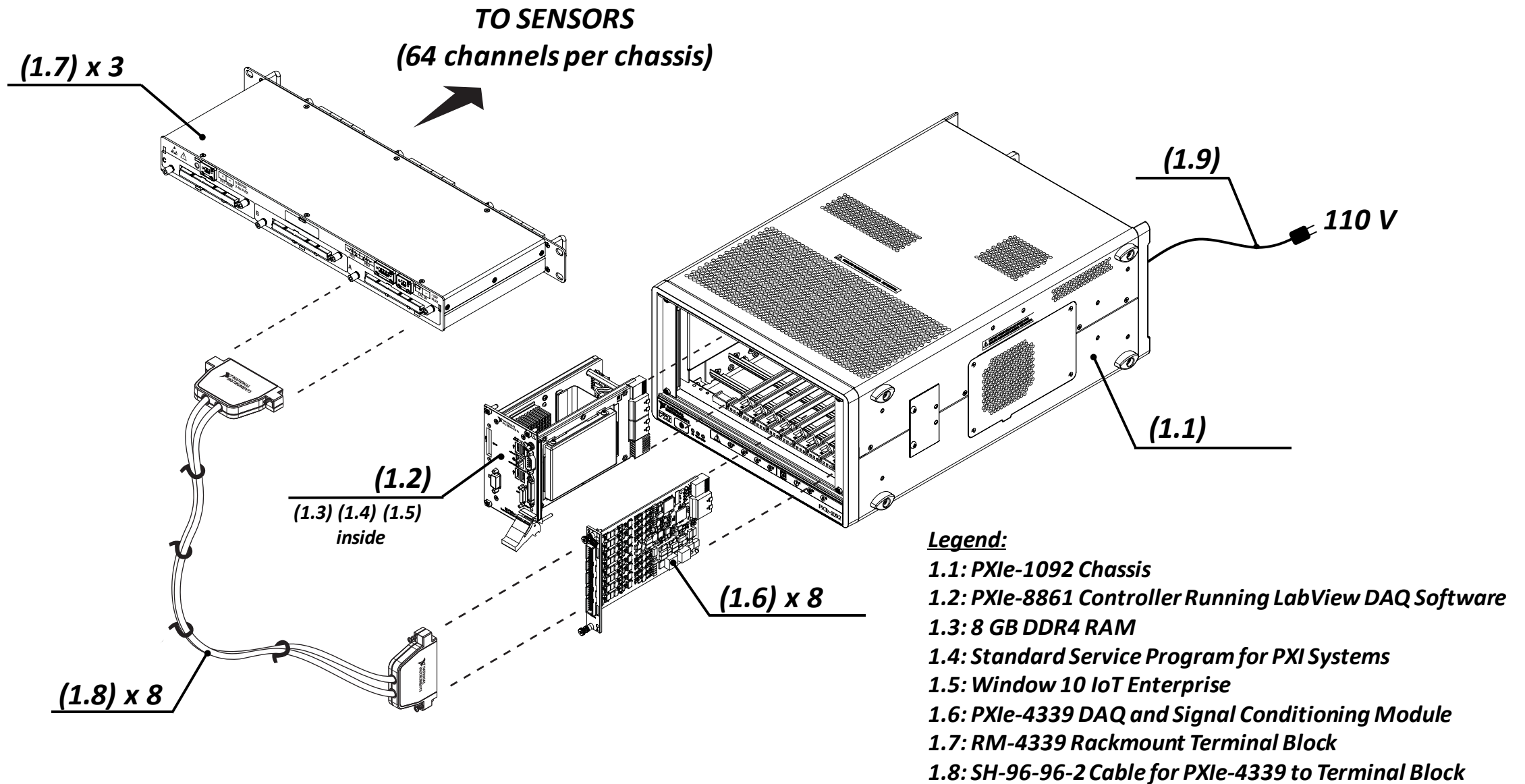
## ➤ Cameras:

- Drones (DJI Phantom 4 Pro)
- GoPro Cameras (4K and 1080p)
- End-to-end Live Video Streaming Production System



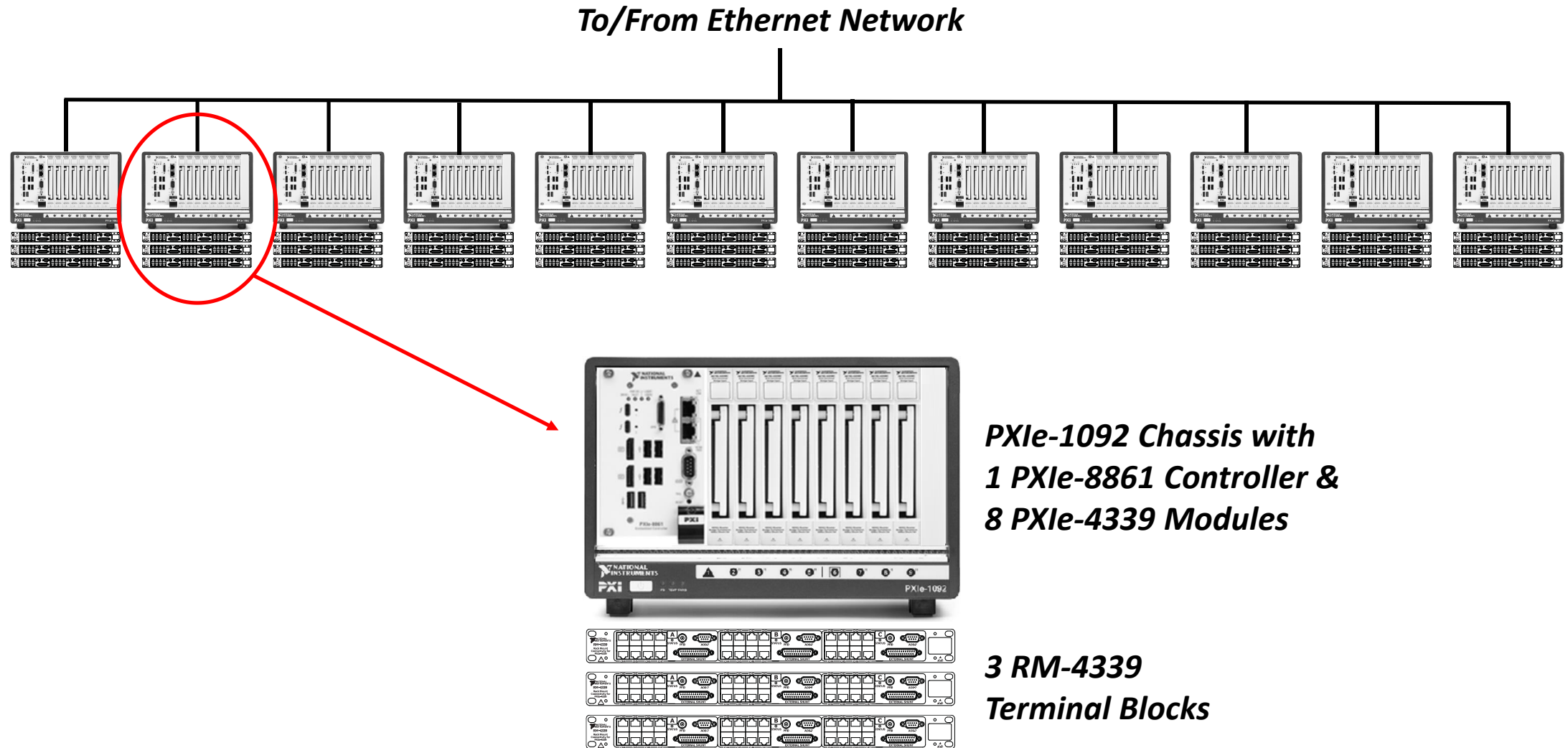
- Old DAQ system was obsolete with many non-functional channels
- One of three selected by the University for MRI
- Highly competitive, we were granted MRI for new state-of-the-art DAQ
  - Acquisition of a High-Performance Data Acquisition System to Enable Experimental and Computational Research on the System Level Response of the Built Environment
    - PI: Lelli Van Den Einde
    - Co-PIs: Joel Conte, Veronica Eliasson, Machel Morrison, Jose Restrepo
    - CMMI #: 2020745
    - \$868,148 (Total) = \$607,704 (NSF) + \$260,444 (UCSD Cost-Sharing)
- Data Acquisition System:
  - Expected lifespan of 15+ years
  - 12 DAQ “Nodes”
  - 64 channels in each node
  - 24 bit analog to digital resolution
  - 25 kS/sec simultaneous sampling per channel
  - Readily scalable
- Will enable NHERI@UC San Diego to continue the collection of invaluable seismic response data, at yet a higher level of resolution and accuracy

# Data Acquisition System

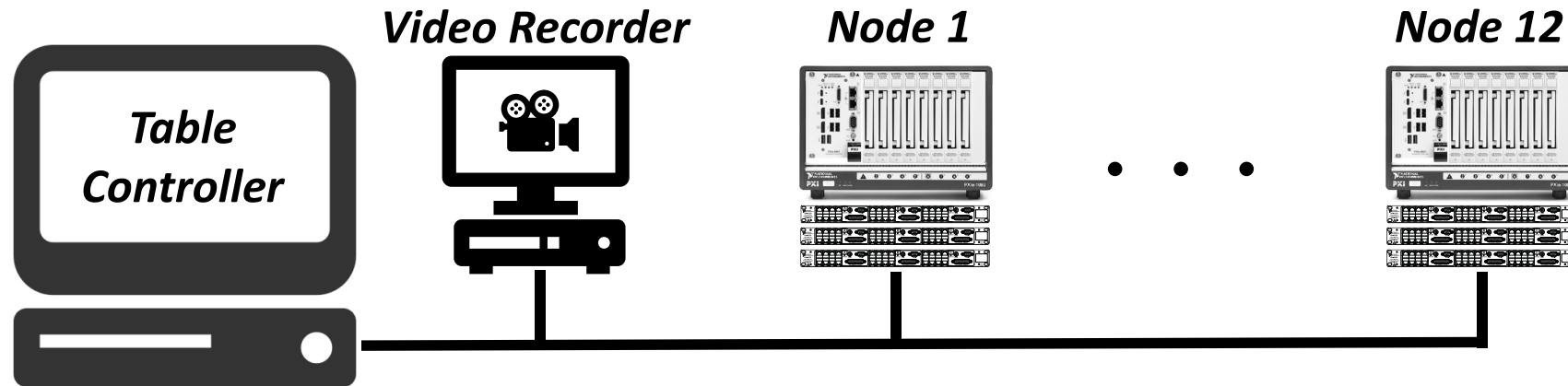




# Data Acquisition System



# Data Acquisition System



# Data Acquisition System

**LARGE HIGH-PERFORMANCE OUTDOOR SHAKE TABLE (LHPOST6)**

NSF NHERI@ UC San Diego

**General Information:**

Task Name	Trial Name	Notes
Init		

**Data Acquisition Options:**

DAQ Action None	Bias Action None
Null Action None	Shunt Action None
File Type TIME_SERIES	
Data Directory C:\Data	
Archive directory C:\Users\DAQ01\Desktop\New folder	

**Timing Options:**

Sample Mode Continuous Samples	Buffer/Finite Size 2000
Timing Type Sample Clock	Sample Rate 200
SampClk Source OnboardClock	

**Trigger Options:**

Trigger Type

Trigger Type  
None

Digital Trigger Settings

Digital Source  
PXI1Slot4/PFI0

Digital Edge  
Rising

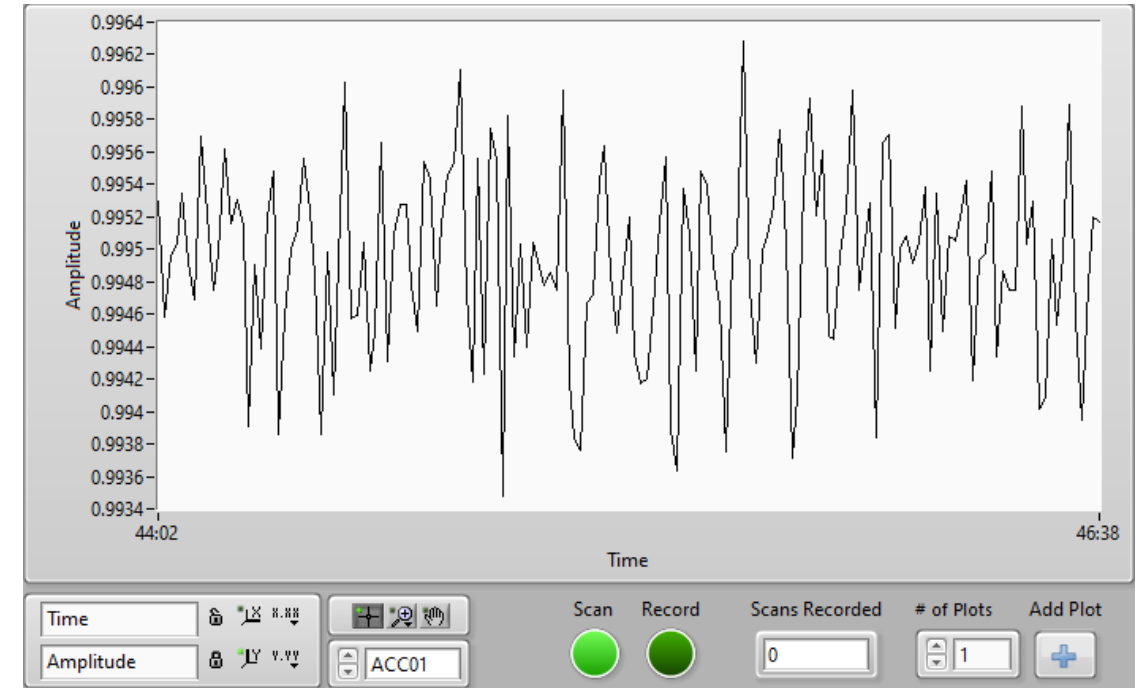
**File Directories:**

Data File	
Config File	C:\Users\DAQ01\Document...\DAQ\LHPOST6 DAQ v8\cfg_node1_PXI_KL.txt
Null File	C:\Users\DAQ01\Document...\DAQ\LHPOST6 DAQ v8\null_init.txt
Bias File	C:\Users\DAQ01\Document...\DAQ\LHPOST6 DAQ v8\bias_init.txt
Shunt File	C:\Users\DAQ01\Document...\DAQ\LHPOST6 DAQ v8\shunt_init.txt

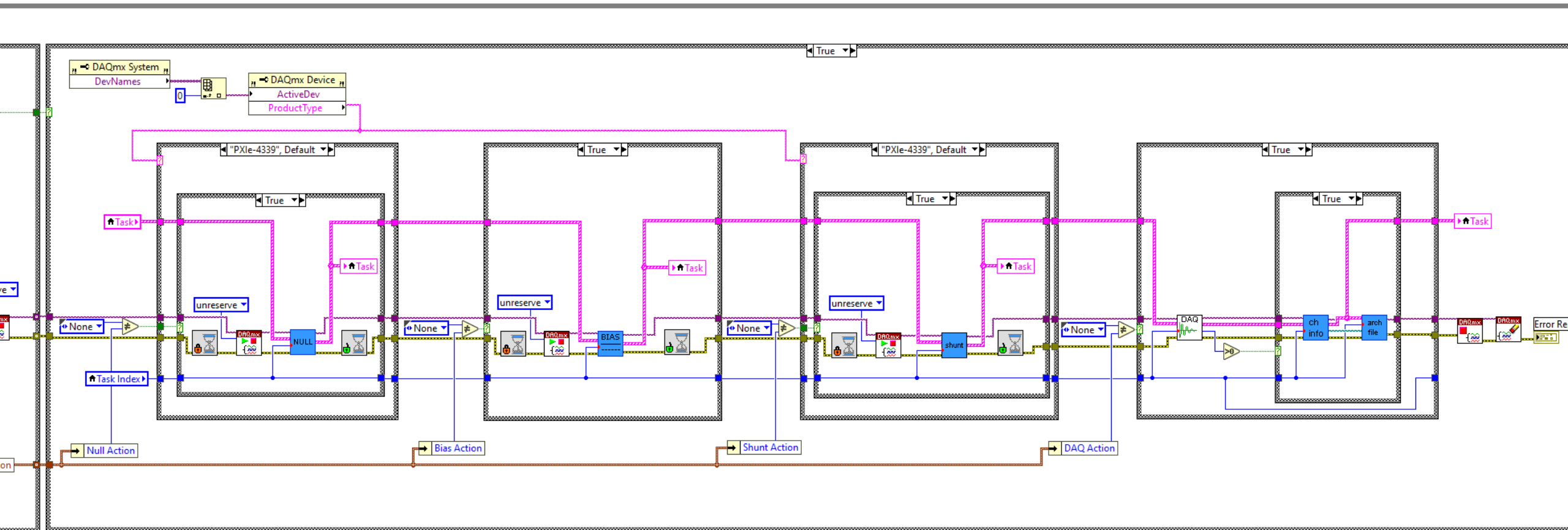
Status ☒ Description

Error Code 0

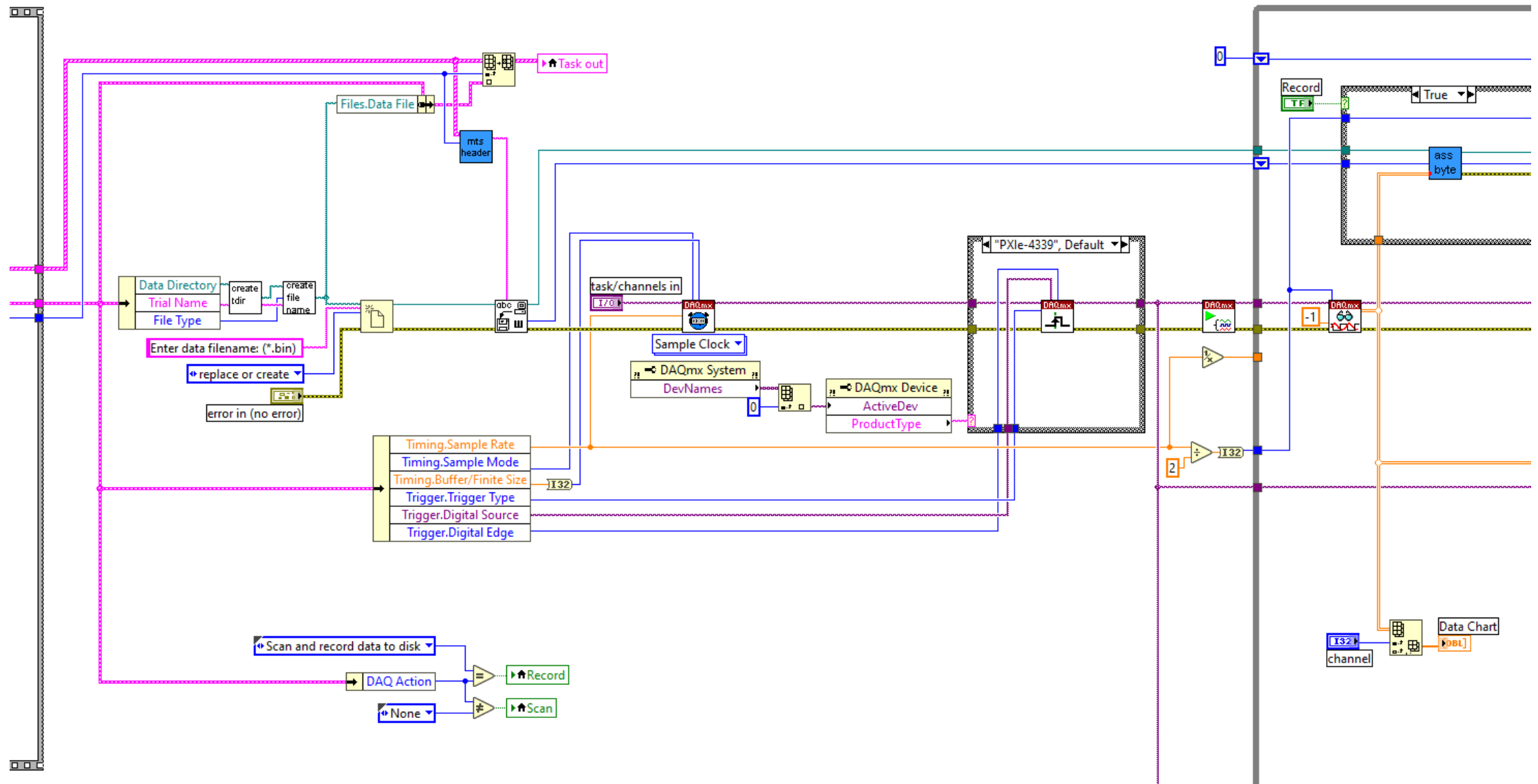
START EXIT



## *Data Acquisition System*



## *Data Acquisition System*



## ***Website and Social Media***

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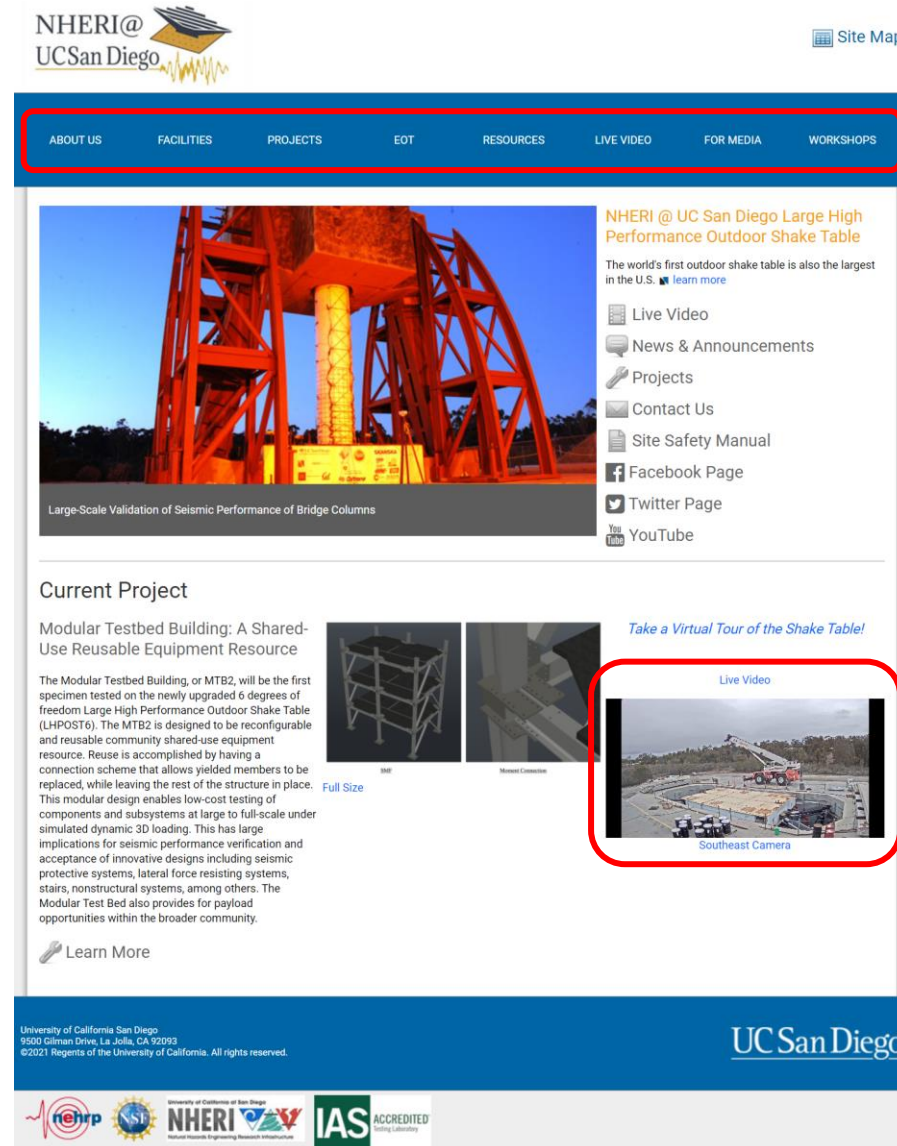
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[NHERI ESEC](https://www.youtube.com/NHERI_ESEC)



Navigation toolbar for additional information

Livestream of daily activities at LHPOST6



# ***NHERI@UC San Diego Workshop Survey***

# Workshop Survey

- Survey is completely anonymous
- Can leave your email if you would like us to contact you
- Will give us feedback to improve delivery of future workshops

[https://docs.google.com/forms/d/e/1FAIpQLSfe5UiaSgzqJJ7hvXBTG0cG0ipUsAP\\_sjo6VmdXx4m5kr0CmQ/viewform](https://docs.google.com/forms/d/e/1FAIpQLSfe5UiaSgzqJJ7hvXBTG0cG0ipUsAP_sjo6VmdXx4m5kr0CmQ/viewform)



***Thank you!***