Connected Systems Institute (CSI): Plans and Progress

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Mission for CSI

• To conduct **applied research** promoting greater efficiency, responsiveness, reliability, security, and agility.

• To establish **unique state-of-the-art IIoT simulation/emulation/testbed/test plant facilities** covering end-to-end from suppliers to customers.

• To train **highly skilled and knowledge workforce**.
CSI Initial Focus

• IIoT within factories and plants
• Asset management
• Connectivity for product life cycle

All elements includes data science, network, visualization, and cybersecurity.
CSI Research Focus

Specific Industry: Manufacturing; Water; Oil & gas; Life sciences; Packaged food and beverage; Smart cities and infrastructure; Grid interface, energy efficiency, and smart grid.

Business Platform: Business Intelligence (BI); e-Commerce; Supply chain management; Advanced manufacturing; Organization design and culture to support integrated systems.

Networks & Control: Monitoring and controls; data science, Big data; Cybersecurity; Computing and computer science.

Devices & Hardware: Hardware for connectivity; Embedded systems, Hardware in the loop.

Basic Research: Advanced and real time sensors for IoT; Computational studies; Security algorithms and mechanisms.
CSI Educational Components

- Undergraduate and Graduate Students
- Joint Professional MS Degree between CEAS and LSB
- Management and Executive Education
- Professional Development
- Certificates, undergraduate and graduate

Connected Systems Institute Courses

- Introduction To Connected Systems (CEAS)
- Connected Systems for Business (LSB)
- Automation for Industrial Systems (CEAS)
- Business Intelligence for Connected Systems; Organizational Design (CEAS, LSB)
- E-Commerce and Advanced BI customer Relationships (LSB)
- Artificial Intelligence and machine Learning (CEAS)
- Big Data and Data Analytics (CEAS)
- Data Analytics, Visualization and Management (CEAS, LSB)
- Cyber security for Connected Systems (CEAS)
- Adaptive controls in Connected Systems (CEAS)
- Data and Sensor Networks in Connected Systems (CEAS)
- Standards, Quality, and Validation (CEAS)
- Advanced Supply Chain Optimization (LSB)
CSI Facilities

• **System Simulation Capability:** Coordinated simulation engines partitioned across the full range of IIoT functions starting from machine functions to business layer.

• **System Emulation:** Emulation capabilities with additional HIL emulators and embedded system.

• **Test Beds:** Factory like real hardware combinations as scaled process lines and industrial network pilot configurations.

• **Test Plants:** Operating calibrated reference models in parallel with actual instrumented plants and enterprise facilities.
Example test plant setup for an electronic assembly factory.
CSI Asset Management Example

Building asset management

Connected Systems Institute
“AI” Tuned Asset Management

ARCHITECTURAL FLEXIBILITY
- Highly Distributed Intelligence & Machine Learning
- Adaptive Hierarchy
- Multi-level Data Analytics

SENSING ARCHITECTURES
- Localized Intelligence & Machine Learning
- Intrinsic Integrated health and self-calibration
- Dynamic. “sensor fusion” based analytics
- Intrinsic Sensing Standards in Conversion Equipment

FUNCTIONAL ARCHITECTURES
- Application based functional sub systems personal
- Integrated Financial and real-time economics layer
- Intrinsic security
CSI Product Life Cycle Example

Vehicle battery life cycle management

BATTERY SYSTEM LIFE CYCLE PROGNOSTICS

CSI Research Approach

**ARCHITECTURAL FLEXIBILITY**
- Highly Distributed Intelligence & Machine Learning
- Adaptive Hierarchy
- Multi-level Data Analytics

**SENSING ARCHITECTURES**
- Localized Intelligence & Machine Learning
- Intrinsic integrated health and self-calibration
- Dynamic "sensor fusion" based analytics
- Vehicle auto adaptation

**FUNCTIONAL ARCHITECTURES**
- Vehicle-based functional sub-systems personae
- Integrated Financial and real-time economics layer
- Intrinsic security
- Intrinsic Vehicle Multi-interface
Productivity Modeling

Data collection and correction

Departments
1 PCBA Line
6 Drive Lines

Data Storage

FactoryTalk

Labor Utilization

Downtime

Quality

Productivity

Output

SAP

KRONOS

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Productivity Modeling
Allocated Space
CSI Offerings

1. Use of facilities and equipment.
2. Participate in and receive results from pre-competitive research.
3. Ability to conduct company specific research.
4. Non-exclusive intellectual property at no cost and exclusive IP at additional cost.
5. Professional MS program on Connected Systems.
8. Participate in CSI conferences.
9. Membership in the Steering Committee.
10. Membership in Industry Advisory Committee.
CSI Offerings (cont’d)

11. Eligible for company specific day to discuss company industrial connectivity.
12. Participate in industry executive day.
13. Membership in one or more of the CSI-connected research organizations (Supply Chain Management Institute, Center for Embedded Systems, Grid-connected Advanced Power Electronics I/UCRC, Water Equipment & Policy I/UCRC).
15. Receive proportional number of votes on research projects.
16. Option to do research projects under CSI at lower overhead rates.
17. Participate in UWM career fair and receive prime booth placement.
18. Opportunity to participate and present at CSI annual conferences and monthly webinars.
UWM Related Centers and Entities

- Center for Sustainable Electric Energy Systems
- Institute for Physical Infrastructure and Transportation
- Decision System and Artificial Intelligence Lab (DSAIL)
- Supply Chain Management Institute
- Center for Advanced Embedded Systems
- Center for Technology Innovation
- Lubar Entrepreneurship Center
- Center on Water Equipment and Policy
- Bostrom Center for Business Competitiveness, Innovation, and Entrepreneurship
- Center for Information Policy Research (CIPR)
- Consortium for Advanced Research in Gas Industries (CARGI)
- DOE Industry Assessment Center