CHANCELLOR’S LETTER

In today’s world, we are connected digitally in ways we hadn’t imagined even a few years ago. It’s not just our mobile devices, home electronics, and energy meters that are connected.

We are now part of a rapidly growing internet of things where sensors and connectivity function as a digital nervous system. Industrial automation, smart homes, and the monitoring and sharing of our health status are just a few examples of the ways in which technology links with information, giving individuals and companies the ability to change quickly and effectively.

The new Connected Systems Institute on the UW-Milwaukee campus focuses on the industrial internet of things (IIoT) – those things that use sensors to gather data from equipment, machines, and manufactured products through secure data networks.

Harnessing this new wave of technology, the institute helps Wisconsin companies accelerate innovation, meet evolving marketplace demand, and drive economic growth. And our expert scholars and researchers do this collaboratively with industry partners such as Rockwell Automation, Microsoft, and the Wisconsin Economic Development Corporation.

UW-Milwaukee is perfectly positioned to lead such a collaborative undertaking. We are located in a crucial industrial and manufacturing hub, have extensive corporate partnerships, and are the home base for internationally recognized faculty who have extensive expertise in IIoT-related disciplines.

Best regards,

Mark A. Mone, PhD
Chancellor, University of Wisconsin-Milwaukee
WHAT IS A CONNECTED SYSTEM?

The immense amount of data and data analytics enabling the industrial internet of things (IIoT) is driving what many believe is the next industrial revolution – where cyber-physical systems cooperate with human workers and each other in real time.

But the optimization potential of connectivity is not yet fully realized. While some aspects of the smart factory have been embraced by companies, barriers to a completely connected enterprise remain. How can companies knit together the various pieces to create a network built for ultimate efficiency and safety? How do they use the collected data? How do they ensure cybersecurity?

To find solutions, UWM has launched its Connected Systems Institute (CSI), a multidisciplinary collaboration with Rockwell Automation, Microsoft, the Wisconsin Economic Development Corp. (WEDC) and other industry leaders. The institute’s faculty, including those from academic partners like the Milwaukee Area Technical College and Gateway Technical College, work with industrial members statewide to develop talent and make discoveries that lead companies to greater productivity through IIoT technologies.

VISION & MISSION

VISION

The Connected Systems Institute will be an internationally recognized collaboration between industry and academic leaders focused on the industrial internet of things.

MISSION

Building on research in engineering, computer science, and business, we will help companies achieve greater efficiency, responsiveness, and security; provide unique test bed facilities covering end-to-end systems; and prepare the highly skilled and knowledgeable workers needed to grow our economy in the digital age.

VALUE PROPOSITION

• To conduct applied research promoting greater efficiency, responsiveness, reliability, security, and agility in connected systems.
• To provide simulation and emulation capabilities and manufacturing test bed setups covering end-to-end, from suppliers to customers, in our unique state of the art facilities.
• To educate and train a highly skilled workforce in industrial internet of things-related disciplines.
LOCAL & GLOBAL IMPACT

Inspired by discussions with executives at Rockwell Automation and Microsoft, the University of Wisconsin-Milwaukee established a comprehensive institute that connects academic researchers with industry partners to conduct advanced research related to the industrial internet of things (IIoT), train talent with expertise in IIoT suites and products, and give members access to new markets.

With 75 billion devices connected to the internet by 2025, the work of the Connected Systems Institute has the potential to transform how business is done.

Research shows that while many manufacturers embrace the idea of whole-enterprise connectedness and use data in certain areas of their plants, they wish to know more about optimizing and linking information across all their business functions. They also must implement the culture change that connectivity requires.

The benefits of connected systems go beyond manufacturing. The models that CSI is developing will harvest a huge volume of data pulled from many sources to extract specific information on demand. Applications that will change the way we live include:

- Smart manufacturing
- Asset management
- Smart transportation systems
- Smart buildings
WHY UW-MILWAUKEE?

UWM’s faculty research expertise in IIoT-related disciplines and organizational management, location in a key industrial and manufacturing hub, and strong corporate ties put the university in a unique position to lead this collaborative effort. UWM’s relationship with Microsoft, headed by alumnus Satya Nadella, provides another advantage, given the number of local companies that use Microsoft products for connectivity.

The University of Wisconsin-Milwaukee has been recognized as one of the nation’s top 131 research universities by the Carnegie Classification of Institutions of Higher Education for the depth and breadth of its research. Areas of strength include freshwater science, energy, engineering, and health. The university also is a leader in entrepreneurship, with students in all disciplines learning how to identify opportunities for businesses or services, talk to customers, and test and refine their ideas.

“Connectivity is unbelievably broad in its scope. If you were able to organize all the data streams in the IIoT, it would reveal patterns that point to strategies for increasing efficiency, productivity, and safety.”

– ADEL NASIRI
Interim Executive Director, UWM Connected Systems Institute
RESEARCH

The institute is a place where teams of researchers and industry members explore connectivity and integrated decision-making in ways that enhance products, offer knowledge-based strategies, and optimize processes. A key challenge will be integrating individual science, engineering, and business models with multiple kinds of software, so they are compatible and function on a global scale.

UWM’s world-class faculty contributes expertise in diverse fields that include sensors, cybersecurity, advanced manufacturing, supply chain management, and information management and business intelligence.

In the institute, all the components of connected systems come together. Using an architecture of four main elements – users, functions, networks, and applications – institute members will investigate algorithmic and physical models, including hardware, software, and various configurations of both. Through applications, researchers can account for a wide range of user behavior and goals.

“IoT is fast becoming a key strategy for companies of all sizes, yet there still exists a gap in cloud skills and training to develop connected solutions. The Connected Systems Institute helps bridge that gap by combining advanced research with training for the next wave of innovation with IoT.”

– SAM GEORGE
Director of Azure IoT, Microsoft
The institute’s distinctive areas of study include:

- **Digital Twin** – Digital representation of the Advanced Automation Testbed, which will simulate sensor data and aging in real time.
- **Data and Sensor Networks** – Study of our data and sensor networks, which are needed to gather data and deliver it to our cloud-based analytics platform.
- **Data Analytics** – A platform that ingests data from the data and sensor networks, so the data are processed in real-time to display Key Performance Indicators.
- **Machine Learning Development & Integration** – Creation of an AI or ML algorithm to improve KPIs in an industrial system.
- **IT/OT Cybersecurity** – Research aimed at developing techniques that identify weaknesses and vulnerabilities, and how to remove them while allowing the system to operate safely and securely.
- **ERP Integration** – Design of a tri-directional link between the test bed, SAP, and our Microsoft Azure data layer, which will allow analytics-influenced commands from SAP to directly change orders on the test bed.

The applied research also helps shape the curriculum, so students are familiar with recent technological developments.

The institute’s research will leverage the next wave of technology, enabling significant advances in productivity, efficiency, and sustainability across a variety of complex systems, from manufacturing to health care. It will form a foundation for educating the engineers who design and operate these systems – vital skills that are needed now.

– **BRETT PETERS**
Dean, College of Engineering & Applied Science

To harness the full potential of IIoT, firms need a talent force that can effectively and collaboratively integrate engineering and strategic business knowledge and skills. UWM’s CSI will help companies develop managers who can drive change and innovation in dynamic, competitive, and technological environments.

– **V. KANTI PRASAD**
Dean, Lubar School of Business
WORKFORCE TRAINING

The rise of the smart enterprise is happening as large numbers of veteran workers retire. Younger employees must prepare for the next wave of automation – Industry 5.0 – which will use more sophisticated forms of artificial intelligence.

Moving to a connected system requires a significant culture change for companies, affecting how employees behave, the way they think about their work, and how they are rewarded.

It currently takes several years for new employees to learn how their jobs affect other parts of the company. One goal of the Connected Systems Institute is ensuring that college graduates start their careers armed with that understanding. UWM faculty teach courses in:

- Connected enterprise basics (for both business and engineering students)
- Automation and safety
- Business intelligence and e-commerce
- Big data and data analytics
- Data and sensor networks
- Machine learning

- Adaptive controls
- Supply chain management
- Cybersecurity
- Digital twin
- Organizational change
- Robotics and mechatronics
- Python programming

And education isn’t just for college students. UWM offers an executive training course designed to help managers explore the benefits and challenges of IIoT-connected systems and learn how to exploit the systems for strategic advantage. Expanded executive training programs are being developed that will prepare managers to navigate the culture shift that accompanies fundamental structural change.

Other UWM programs that will be tied to the Connected Systems Institute include:

- A joint master’s degree in engineering and business
- Undergraduate and graduate certificate programs
- Ongoing professional development
- Workshops and short courses

The Connected Systems Institute is a multidisciplinary program that will enable students to learn skills not only in technology but also in business, and the breadth of courses and research at UWM makes it a perfect fit.

– BLAKE MORET
President and CEO, Rockwell Automation
FACILITIES

The institute will occupy over 10,000 square feet in the east wing of the UWM Libraries, a highly visible, central location on campus.

State-of-the-art test beds and labs within the facility will set the Connected Systems Institute apart from other university-industry consortiums studying IIoT connectivity.

Plans call for four on-campus test beds to be used in research and education. These test facilities will give industry partners the means for experimental validation, providing different views of the multi-dimensional space of IIoT.

While many existing IIoT facilities have narrower scopes, UWM’s facilities will be designed to test solutions in four consecutive steps, across all stages of workflow.

Lab 1 will use coordinated simulation engines that are partitioned across the full range of IIoT functions starting from the lowest level – individual machine functions – and investigate software using multi-tiered data.

Lab 2 will continue with soft components, adding the functions of sensors, actuators, and embedded systems.

Lab 3 test beds will build on modeling from the previous two labs by including conversion processes with on-site equipment that will be capable of completing tasks ranging from simple pick-and-place functions to assemble robotics.

Lab 4 will enable fully calibrated models to operate in parallel with an actual manufacturing plant, creating a “digital twin” that employs members’ real data to predict and validate key principles.

In addition to advanced manufacturing, researchers later will use the four labs to build connected architecture for distributed water processing systems and distributed industrial energy networks. That research could help in developing smart public infrastructure systems.
A GLIMPSE OF THE PAST

NOVEMBER 2017
Interim Executive Director named

MARCH 2018
CEO Summit held with local business leaders

MAY 2018
First cohort begins the Connected Systems Challenge, CSI’s Executive Education for managers

NOVEMBER 2018
The first event of the CSI Workshop Series – Machine Learning for Beginners held at UWM

JANUARY 2019
CSI Steering Committee is established and convenes for the first time

APRIL 2019
CSI Workshop Series – A.I. in Manufacturing held at UWM

A GLIMPSE OF WHAT’S TO COME

SUMMER 2019
CSI facility opens in the east wing of the Golda Meir Library

FALL 2019
Planning begins for the connected systems joint master’s degree program between UWM’s Lubar School of Business and the College of Engineering and Applied Science

NOVEMBER 2019
UWM will host the next CSI Workshop Series event

FEBRUARY 2020
Completion of Advanced Automation Testbed
A WEALTH OF UWM ASSETS: SYNERGIES WITH OTHER CAMPUS CENTERS AND INSTITUTES

Northwestern Mutual Data Science Institute

PURUSH PAPATLA
Co-Director

Center for Technology Innovation

ATISH SINHA
Director

Supply Chain Management Institute

ANTHONY ROSS
Director

Center for Sustainable Electric Energy Systems (GRAPES)

ADEL NASIRI
Director

Water Equipment and Policy Center

JUNHONG CHEN
Director
THE NEXT INDUSTRIAL REVOLUTION IS COMING.

To stay relevant through the digital transition, you will need highly skilled workers, access to cutting-edge technology, and strategies to increase your profitability.

INDUSTRY MEMBER ADVANTAGES

UWM’s Connected Systems Institute focuses on improving business practices through the industrial internet of things.

A CSI membership can give you...

**ACCESS TO TALENT**
- Hundreds of students learn transferable skills each semester.
- Professionals earn certifications in areas such as machine learning and cybersecurity.
- Veterans receive high-skilled training as they transition back to civilian life.

**APPLIED RESEARCH**
- Industrial Internet of Things
- Data analytics
- Cybersecurity
- Artificial intelligence
- Data and sensor networks
- Predictive maintenance

**A BETTER BOTTOM LINE**
- Increased productivity
- Better asset management
- Reduced downtime
- Quicker delivery to customers
- Collaboration with industry partners

JOIN THESE MEMBER COMPANIES AND BE READY FOR TOMORROW

Direct further inquiries to:
Charles A. Mosley II
Director, Corporate Relations
cmosley@uwm.edu • 414-229-3291
# Connected Systems Institute (CSI) Industry Membership Advantages

<table>
<thead>
<tr>
<th>Membership Category</th>
<th>Founding Member</th>
<th>Sustaining Member</th>
<th>Associate Member</th>
<th>General Member</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Membership Contribution</strong></td>
<td>$500,000/yr or $2,500,000 over 5 yrs</td>
<td>$200,000/yr or $1,000,000 over 5 yrs</td>
<td>$50,000/yr or $250,000 over 5 yrs</td>
<td>$15,000/yr or $75,000 over 5 yrs</td>
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<tr>
<td>Upstream and downstream industry networking</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Quarterly CSI workshops†</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>General facility use/access</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Participation in Industry Executive Day†</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CSI Roundtable: pre-competitive research/results</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Non-exclusive license for intellectual property on pre-competitive research‡</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Enhanced voting rights on CSI Roundtable projects</td>
<td>5 votes</td>
<td>3 votes</td>
<td>1 vote</td>
<td>X</td>
</tr>
<tr>
<td>Participation in Industry Advisory Board</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Membership credit for new or existing members in CSI-affiliated organizations†‡</td>
<td>50% credit on 2 memberships for 5 years</td>
<td>50% credit on 1 membership for 5 years</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Participation in CSI Catalyst Grant Program</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
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<tr>
<td>I-Corps Site Training (4 weeks)†</td>
<td>✓</td>
<td>✓</td>
<td>fee-based</td>
<td>fee-based</td>
</tr>
<tr>
<td>Exclusive one-day member session to discuss specific connectivity needs</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Membership on CSI Steering Committee</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Participation in CSI conferences and webinars‡</td>
<td>✓</td>
<td>✓</td>
<td>fee-based</td>
<td>fee-based</td>
</tr>
<tr>
<td>Priority scheduled use of facilities and equipment§</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Virtual factory setup: mutually proprietary simulation and emulation on specific product†</td>
<td>✓</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Named CSI Catalyst Grant Program</td>
<td>✓</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>UWM CSI Executive Education (4-day program)†</td>
<td>✓</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
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<tr>
<td>UWM Career Fair with prime placement*</td>
<td>✓</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
</tr>
<tr>
<td>On-site CSI Executive Education</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
</tr>
<tr>
<td>CSI-sponsored research contracts</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
</tr>
<tr>
<td>Professional MS program on Connected Systems</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
</tr>
<tr>
<td>UG Certificate on Connected Systems</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
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</tr>
</tbody>
</table>

See footnotes below.

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*With UWM’s approval, Founding and Sustaining Members may use in-kind support for up to 50% of total membership contributions. Associate Members may substitute in-kind support valued at $500,000 for its membership contributions. Substitution of in-kind support for General Member contributions shall be reviewed on a case-by-case basis. In-kind support is generally considered to be the donation of tangible assets.

†Depending on a Member’s selected membership level, a significant portion of a Member’s contribution may be considered a philanthropic gift to UWM in support of the CSI. However, these advantages may provide a Member with a good or service that may reduce the value of its charitable gift. With its contribution receipt, UWM will provide Member with a disclosure statement, which will include a good faith estimate of the fair market value of such goods or services. This valuation may be subject to change from year-to-year.

‡CSI Affiliated Organizations include: Supply Chain Management Institute, Grid-Connected Advanced Power Electronics (UCRRC), Water Equipment & Policy (UCRRC), Center for Technology Innovation and others as may be reasonably determined by UWM.

§Additional fees or service agreements may apply.

Note: Fees for any fee-based items will be set by UWM consistent with its internal policies and practices for similar fees. The Executive Director will consult with the Steering Committee, as appropriate, on such fees.