CHANCELLOR’S LETTER

Automation has been the initial step in each Industrial Revolution and it’s no different today. Digital connections have changed our lives in ways we hadn’t imagined even a few years ago. Artificial intelligence is changing the way we interact with these connected systems. Running on powerful, self-learning software platforms, these systems have the power to monitor unlimited numbers of sensors and data, to perfectly tune their response to ever changing conditions. In many ways, these systems have surpassed human capabilities. And this is just the beginning.

A time of great disruption is also a time of great opportunity. Harnessing this new wave of technology, requires knowledge, skills and partnership with a large ecosystem. The Connected Systems Institute was established to help Wisconsin companies accelerate innovation, meet demand for skilled workforce, and drive economic growth through market disruption.

The CSI is supported by industry partners such as Rockwell Automation, Microsoft, Dell, Cisco and the Wisconsin Economic Development Corporation. Together, this team and the UW-Milwaukee are perfectly positioned to lead such a collaborative undertaking. We are located in a crucial industrial and manufacturing hub, have extensive corporate partnerships, industry relationships and are the home base for internationally recognized faculty who have extensive expertise in IIoT-related disciplines.

Please join us.

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

The Connected Systems Institute is the trusted resource for research, collaboration, education, thought leadership and community outreach – focused on the advancement of enabling technologies collectively known as the Industrial Internet of Things (IIoT).

MISSION

The CSI supports and guides enterprises through their Digitalization Journey with an array of tools ranging from a research lab test bed through education programs, workshops and certifications. It is dedicated to enabling small and medium businesses access to the IIoT, and to preparing highly skilled and knowledgeable workers in all things related to smart manufacturing. It’s a community of practitioners with a common mission to change the world one IOT project at a time.

VALUE PROPOSITION

- Access the most current applied research of digitization tools such as sensors, AI, cybersecurity, 5G, machine vision, time sensitive networking, cloud and edge computing, and more to promote greater efficiency, responsiveness, reliability, security, and agility in connected systems.
- Participate in manufacturing test beds in our lab to develop and test manufacturing solutions; use the test bed facilities for simulated work environments to test and train your workforce.
- Access a full suite of industry specific education inclusive of People, Process and Technology topics to prepare your workforce for the future.
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.

“...Our vision is that the Connected Systems Institute serves as a trusted source for research, collaboration, education, thought leadership, and community outreach. We’re a center of excellence focused on advancing all aspects of manufacturing best practices including technical topics surrounding IT/OT convergence, and the IIoT as well as the science of reliability associated with optimized Production, Asset and Maintenance Management.

— MARY BUNZEL
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.

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> **– 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.

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> **– KAUSHAL CHARI**  
> 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.
Upcoming Webinars and Workshops

<table>
<thead>
<tr>
<th>Automation</th>
<th>Value Proposition/CSI 101</th>
<th>Physics Based Digital Twin</th>
<th>Data Network</th>
<th>IT Cybersecurity</th>
<th>OT Cybersecurity</th>
</tr>
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<tbody>
<tr>
<td>Cloud Programming</td>
<td>Data Driven Controls</td>
<td>Workflow</td>
<td>Machine Learning for Intermediate</td>
<td>Right Sensor, Right Application</td>
<td>Women in Reliability &amp; Engineering</td>
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<tr>
<td>Manufacturing Execution Systems</td>
<td>KPIs in Manufacturing</td>
<td>Asset Management</td>
<td>Uptime Elements</td>
<td>Definitions of a Connected System</td>
<td>Machine Learning for Visualization</td>
</tr>
<tr>
<td>Sensors: Hardware to Data</td>
<td>AI in predictive Maintenance</td>
<td>Change Management</td>
<td>Design for Reliability</td>
<td>Cloud Programming for Dashboarding</td>
<td>Effects of Digitalization on People &amp; Workforce</td>
</tr>
<tr>
<td>Robotics &amp; Mechatronics for Connected Systems</td>
<td>AI in Manufacturing</td>
<td>Data Network for 4G/5G</td>
<td>Industrial Automation protocols</td>
<td>Machine Learning for Quality Check/Control</td>
<td>Assessing the Progress of Digitization</td>
</tr>
</tbody>
</table>

A GLIMPSE OF WHAT’S TO COME

MARCH 2020
New Executive Director Named

MAY 2020
CSI Webinars & Workshop Series Begins

SUMMER 2020
Advanced Manufacturing Testbed Delivery and Integration

FALL 2020
CSI Grand Opening
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

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...

<table>
<thead>
<tr>
<th>ACCESS TO TALENT</th>
<th>APPLIED RESEARCH</th>
<th>A BETTER BOTTOM LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hundreds of students learn transferable skills each semester.</td>
<td>• Industrial Internet of Things</td>
<td>• Increased productivity</td>
</tr>
<tr>
<td>• Professionals earn certifications in areas such as machine learning and cybersecurity.</td>
<td>• Data analytics</td>
<td>• Better asset management</td>
</tr>
<tr>
<td>• Veterans receive high-skilled training as they transition back to civilian life.</td>
<td>• Cybersecurity</td>
<td>• Reduced downtime</td>
</tr>
<tr>
<td></td>
<td>• Artificial intelligence</td>
<td>• Quicker delivery to customers</td>
</tr>
<tr>
<td></td>
<td>• Data and sensor networks</td>
<td>• Collaboration with industry partners</td>
</tr>
<tr>
<td></td>
<td>• Predictive maintenance</td>
<td></td>
</tr>
</tbody>
</table>

JOIN THESE CONTRIBUTING 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>Membership Contribution *</td>
<td>$500,000/yr or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$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>
</tr>
<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>
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<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>
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<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>
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<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>
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<tr>
<td>Exclusive one-day member session to discuss specific connectivity needs</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
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<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>
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<tr>
<td>Priority scheduled use of facilities and equipment§</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>X</td>
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<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>
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<tr>
<td>Named CSI Catalyst Grant Program</td>
<td>✓</td>
<td>X</td>
<td>X</td>
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<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>
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<tr>
<td>On-site CSI Executive Education</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
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<tr>
<td>CSI-sponsored research contracts</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
<td>fee-based</td>
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<tr>
<td>Professional MS program on Connected Systems</td>
<td>fee-based</td>
<td>fee-based</td>
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<tr>
<td>UG Certificate on Connected Systems</td>
<td>fee-based</td>
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</tr>
</tbody>
</table>

See footnotes below.

* 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 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 (UGRC), Water Equipment & Policy (UGRC), 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.