Notice of Intent, MS in Connected Systems
University of Wisconsin-Milwaukee

Proposed Degree: Master of Science in Connected Systems
Department: Industrial and Manufacturing Engineering (EME)
School/College: College of Engineering and Applied Science (CEAS)
Mode of Delivery: Face to face (with a few courses offered face to face and online)
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Manufacturing Engineering

Program Description
The Industrial and Manufacturing Engineering at the University of Wisconsin –Milwaukee proposes a new Master of Connected Systems Program. The proposed program curriculum is multidisciplinary encompassing courses in the College of Engineering and Applied Science (CEAS), Lubar School of Business (LSB), and School of Information Science (SOIS). The courses will be project-driven and certainly, as needed they will be team-based. The proposed program will be key to strengthen the already thriving partnership with UWM's Connected Systems Institute (CSI) and local industries. Course case examples and projects will leverage the use of the software and hardware (particularly the testbeds) in the CSI. The program will stimulate industry-funded course projects and most importantly thesis and dissertation projects which will contributes towards UWM's goal of maintaining its R1 status. Before the impact of the Covid-19 pandemic enrolments, our MS in Industrial Engineering concentrations, graduated about 24 students per year. We envision that this new interdisciplinary MS program will attract more students, especially engineers who are working in the southeast Wisconsin region. They are our target group, in addition to our graduates from the Bachelor of Science in Industrial Engineering program, who will be encouraged to apply for the accelerated BS/MS track.

Structure of the Proposed Program:
The department hopes to enroll 20 new students per year during the first two years and 30 students per year subsequently. For students to be admitted into the program, they will need to demonstrate proficiency through courses, exams and industry-related experience in Linear algebra, Statistics, English and Computer Literacy. Those without will need to take at least 6 credits in UWM before admission into the MS program. These remedial courses will not count toward the MS degree.

This 30-credit program will be completed in a year (if full-time) or two years (if part-time). The program's requirements entail 18 credits of core courses as follows: (i) three 1-credit stacked courses in introduction to digital manufacturing (CEAS and LSB); (ii) three 1-credit stacked courses on automation, networking, and security (CEAS); (iii) four 3-credits courses in data acquisition and management (already offered in LSB), machine learning (already offered in CEAS), process and workflow management (already offered in LSB); (iv) a 3-credit capstone project. The remaining 12 credits (four 3-credits courses) will be electives which can be selected from one (if a student chooses to specialize in an area) or a mix thereof, from three main

categories namely, enterprise resource management (ERP)/supply chain, cybersecurity in manufacturing, mechatronics/robotics and digital twins and artificial intelligence/ machine.

Learning Outcomes of the MS in Connected Systems Program (same as the current college-wide MS Program):

a. Apply advanced knowledge of mathematics, science, and engineering to solve complex problems.
b. Use modern tools or techniques to solve complex problems, conduct research, and analyze and interpret data.
c. Demonstrate proficiency and competency in the area of specialization.
d. Identify, formulate, and solve complex problems with an original and/or significant contribution to the field.
e. Demonstrate a familiarity with research in a related or complementary discipline.
f. Use quantitative methods appropriate to the field of research.
g. Understand academic, professional, and ethical responsibility.
h. Communicate effectively via technical writing and oral presentations.

Existing or anticipated resources required to deliver the program:
The proposed multi-disciplinary program will leverage courses that already exist in the College of Engineering and Applied Science, the Lubar School of Business and the School of Information Science. Of the 30 credits, only 1-credit of the required courses and 6 credits (2 courses) of the electives will be created. It is noted here that even without the additional 2 new elective courses, the MS program will be able to sufficiently offer the required credits for degree completion. Hands-on learning will be key to this MS program. The combined hardware (computer labs, automation drives, and CSI testbeds), and software in CEAS, LSB and SOIS, will be sufficient to provide the required hands-on learning.

This program is being created with the consultation of the Interim CSI Executive Director, the CSI Industry Advisory Board, the CSI Academic Advisory Board, and the IME Industry Advisory Board. All the faculty teaching the existing courses and those identified for the new courses are committed to the success of the MS-Connected Systems program. There are plans to recruit three faculty members, (i) a professor of advanced manufacturing (in CEAS), (ii) a professor in the area of Internet of Things and (iii) a Rockwell Automation Endowed Chair of Supply Chain Management (LSB). These three faculty members will be part of the faculty offering courses, advising students and spearheading industry-related research initiatives.

External Approvals Required
The graduate programs at the College of Engineering and Applied Sciences are accredited by the Higher Learning Commission. Accreditation will be sought during the next

Lubar School of Business is accredited by the Association to Advance Collegiate Schools of Business (AACSB). Currently, however, this MS will not be within the scope of our AACSB accreditation.

No external approval is required before initiating the program.

Alignment with Institutional Mission

The proposed program responds to the following aspects of UWM Select Mission Statement, which can be found at https://uwm.edu/mission/:

To fulfill its mission as a major urban doctoral university and to meet the diverse needs of Wisconsin's largest metropolitan area, the University of Wisconsin–Milwaukee must provide a wide array of degree programs [...]. Fulfilling this mission requires the pursuit of these mutually reinforcing academic goals:

- *To develop and maintain high quality undergraduate, graduate, and continuing education programs appropriate to a major urban doctoral university.*
- *To attract highly qualified students who demonstrate the potential for intellectual development, innovation, and leadership for their communities.*
- *To further academic and professional opportunities at all levels for women, minority, part-time, and financially or educationally disadvantaged students.*
- *To promote public service and research efforts directed toward meeting the social, economic and cultural needs of the state of Wisconsin and its metropolitan areas.*
- *To provide educational leadership in meeting future social, cultural, and technological challenges.*

The proposed program will also fulfill CEAS mission which is *"to educate students to become creative problem solvers, conduct leading-edge research with global impacts and act as a catalyst for improved economic development and quality of life in Wisconsin."*

Need for the Program

The proposed program is response to the recent national workforce need for engineers who understand and can solve problems related to system connectivity in the era of industry 4.0. Key aspects of industry 4.0, which are incorporated into the proposed degree curriculum include internet of things, data acquisition and management, operation technology (OT) networking and security, cybersecurity, machine learning tools for business analytics, process control and asset management, and the ethical social-economical aspects of connected systems. A recent quick search of indeed.com returned upwards of 4,000 jobs in systems engineering and system analyist (searched on 02/01/22). In Wisconsin there are upwards of 850 jobs using this search most of which are in manufacturing. In addition, filling systems analysts/engineering positions, graduates of the proposed program will still be able to obtain jobs is logistics, and supply chain, automation, and data analytics.

Admission Requirements

Admission standards will be the same as current admission standards for Engineering MS program.

Similar Programs:

There are no similar MS in Connected Systems program in the greater Milwaukee region. There are, related courses which constitute parts of the proposed MS program. They include: (i) UWM-IME's MS in Industrial Engineering; recently approved UWM's MS in Data Science, (ii) a newly proposed MS in Digital Supply Chain (UWM LSB), newly created MS in Business Analytics (UW-River Falls), MS in Systems Engineering and Analytics (UW-Madison).