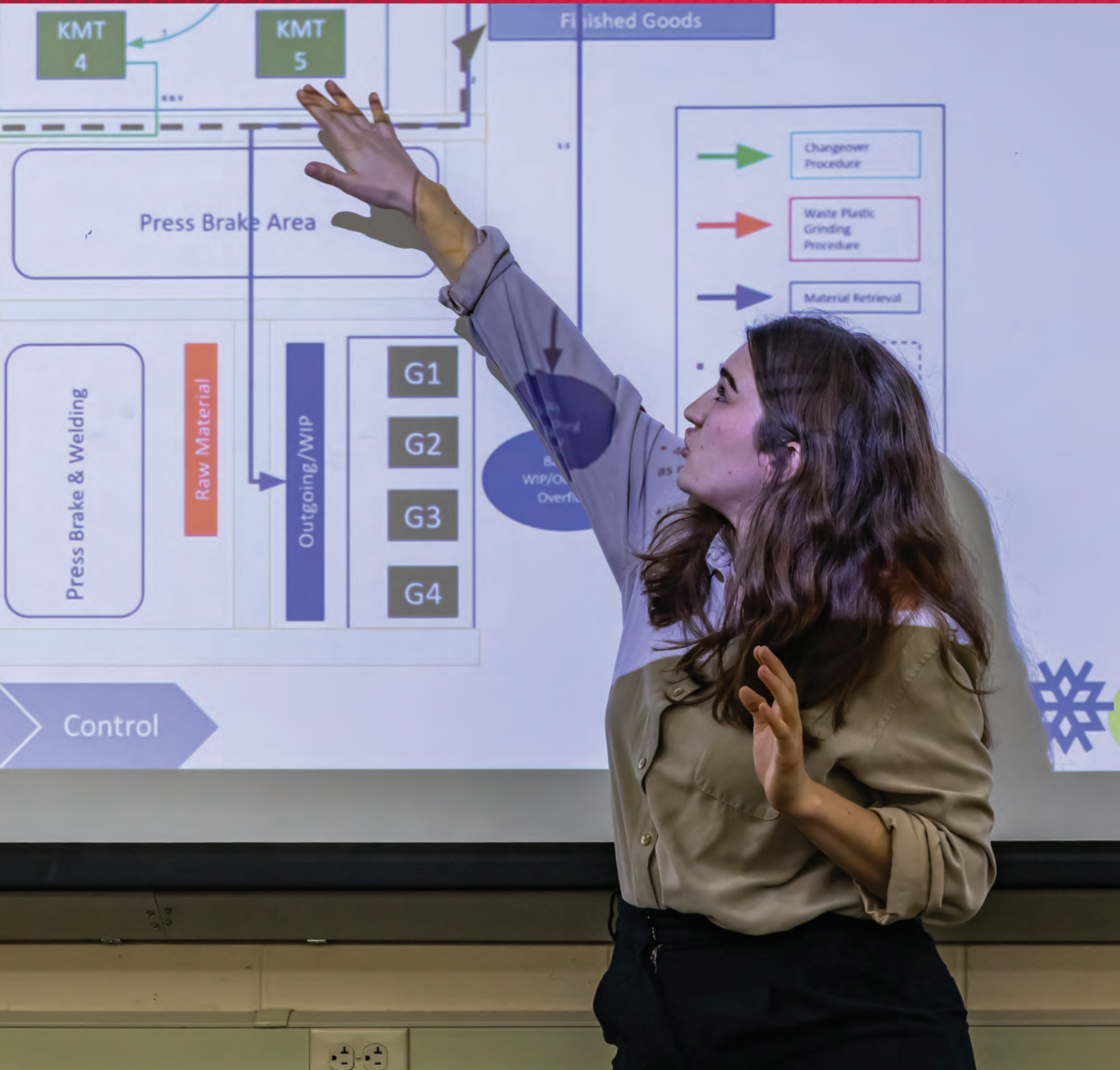




DEPARTMENT OF

# INDUSTRIAL AND SYSTEMS ENGINEERING





## Greetings from Madison!

The spring semester is always a busy and exciting time on campus, and this year is no exception.

Our undergraduate program is growing! This spring we've seen a marked increase in the number of students joining our program, and we are up for the challenge of providing them with a world-class experience in higher education.

One such effort involves expanding our curriculum, specifically offering additional courses in the growing field of data sciences. In addition, we've engaged the help of local alumni and professionals in a special effort to provide feedback on professional presentation skills to students in our junior and senior design courses. We're also supporting a record number of members in student organizations, including our IISE student chapter and our ISyE Connections peer mentor program. And it's paying off—our fantastic student organizations were recognized for excellence at their annual national conferences in the fall.

Our research programs are also thriving. Over the last few months, our faculty members have received prestigious honors and generous grants across virtually all our research areas, including optimization, machine learning/AI, health systems and human factors. This spring, Professor Emerita Pascale Carayon, who is internationally renowned for her expertise in applying human factors to the healthcare system, was elected to the National Academy of Engineering. This is one of the highest honors for engineers, reserved for those who have made significant contributions to their field of expertise. It's a great time to be in industrial and systems engineering at UW-Madison!

In other good news, funding for the construction of a new engineering building was officially approved by the state of Wisconsin in March. This important development will enable the College of Engineering to enroll around 1,000 additional undergraduates. With that growth will come changes to our curriculum, our faculty membership, and our leadership.

This summer, my tenure as department chair will end, and I will return to the faculty. I have enjoyed my time at the helm of this incredible group of faculty, staff, and students, and I'm eager to continue contributing to our collective success through my own teaching, research, and service to society. The next department chair will be announced later in the spring semester, and I have no doubt the department will be in great hands going forward.

Thank you for taking the time to read about some of the great things happening here in ISyE. Whether you are an alum, a peer, or a supporter, we are grateful for your continued interest in our department and for your support.

On, Wisconsin!

**Laura Albert**

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Cover photo: Senior Ava Schmidt presents her group's work on behalf of Madison-based appliance manufacturer Sub-Zero Group, part of a department priority to enhance student communication skills. Photo: Tom Ziemer.



## Accelerated Engineering Master's Programs

Our accelerated engineering master's programs allow graduates to get the jobs they want by obtaining an advanced degree in as little as one year. Delivered on campus and designed to be finished in 12-16 months, learners can choose from 12 programs in 7 disciplines.

[go.wisc.edu/eng-accelerated](https://go.wisc.edu/eng-accelerated)



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Photo: Tom Ziemer

## Data science courses instill skills, responsibility

When industrial engineering students hit the job market, employers are after candidates who can comfortably manage, analyze and act on data.

Our department has heard that feedback—from alumni and employers alike—loud and clear. And it's responded by creating an array of courses in recent years to impart those in-demand skills to both undergraduate and graduate students.

ISyE's set of data science courses introduce students to modern tools and techniques, while also presenting the type of systems-level viewpoint that's a hallmark of an industrial engineering education. In the past few years, ISyE has created four courses that blend technical skill with the broad perspective that's essential to responsibly using data:

- ISyE 210: *Introduction to Industrial Statistics*
- ISyE 521: *Machine Learning in Action for Industrial Engineers*
- ISyE 562: *Human Factors of Data Science and Machine Learning*
- ISyE 649: *Interactive Data Analytics*

The department has also partnered with the Department of Electrical and Computer Engineering to develop a fifth course, ISyE/ECE 570: *Ethics of Data for Engineers*.

All five are open to students from across the college, regardless of engineering major (with completion of prerequisites). A common theme runs across them: Less time on theory, more on learning by actively applying techniques to practical problems.

"If you have seen this material in action, you know that it works," says Amanda Smith, an assistant teaching professor and associate chair for undergraduate affairs who developed *Introduction to Industrial Statistics*. "I think students will care more about learning it, because they will see that it is relevant to what they are going to be doing."

Students in *Interactive Data Analytics*, an evolution of a course developed by Emerson Electric Quality & Productivity Professor John Lee, learn the programming language R and create a data visualization around a topic of their choosing.

"Data visualization is one of the major ways in which you translate data into information that can be acted upon," says Assistant Professor Tony McDonald, who taught the course in fall 2023. "Data visualization tends to be a step that either gets skipped or has minimal attention put on it, because of the way that machine learning algorithm development has become so

automated. In many cases, those skipped data visualization steps are ones that could have prevented poor deployment outcomes for machine learning-based technology."

That spirit of viewing data with intention and consideration of both its flaws and potential ramifications is at the core of *Ethics of Data for Engineers*, the capstone of the college's new undergraduate certificate in engineering data analytics. Those ideas are also central to Lee's *Human Factors of Data Science and Machine Learning*, which delves into questions of representative sampling, bias, fairness, trust and more through case studies featuring leading tech companies.

"These algorithms should be designed with sensitivity to human values and the consequence for their application in the world. Which I think is so easy to lose sight of when you're creating something and you're just happy when it runs," says Lee. "It's so easy to forget the 10-20% of the cases where it doesn't work well. Then also thinking about, why are we doing this? What is the purpose of this? Going beyond, can we do it technically? But thinking about, why are we going down this path? What is the benefit to people and society?"

## Jail staff attitudes may influence opioid use disorder treatment

Buprenorphine, methadone and naltrexone are the leading medicinal treatments for opioid use disorder, dulling cravings and offering a foothold in the path to recovery.

But for incarcerated individuals with opioid use disorder, access to those medications is inherently controlled by a given prison or jail's personnel.

A multidisciplinary team of UW-Madison researchers set out to find whether staff attitudes toward medications for opioid use disorder affected treatment services in a subset of prisons and jails.

Perhaps not surprisingly, in a paper published in the journal *Drug and Alcohol Dependence Reports*, they found that staff opinions did correlate with actions: Facilities whose staff members reported positive attitudes toward all three medications had higher rates of screening and diagnosing individuals with opioid use disorder and referring them for treatment. Meanwhile, prisons and jails with staff who expressed positive attitudes toward naltrexone but negative attitudes toward methadone were less likely to screen, diagnose or refer individuals for treatment, as well as less apt to provide the medications or refer individuals for treatment after their release.

"We hypothesized that there was something going on like this, perhaps not to the extent," says Assistant Professor Gabriel Zayas-Caban, the senior author on the paper. "We wanted to just provide data support for it."

Study lead author Aly Pfaff (BS '19 in biochemistry, MS '23 in epidemiology), who completed the work as part of her graduate work in the Department of Population Health Sciences, analyzed survey data from 43 jails and prisons in 14 states. That data emerged from a large study led by the Center for Health Enhancement Systems Studies (CHESS), which is housed in ISyE.

Zayas-Caban, whose research group previously analyzed the effectiveness of a local substance use disorder treatment diversion program, was eager to collaborate with CHESS and found an ideal lead researcher in Pfaff, whose master's program advisor was Amy Cochran, an assistant professor of population health sciences and math and Zayan-Caban's wife.

Pfaff had already been looking into questions around the accessibility of opioid

use disorder treatment when Cochran mentioned the project.

"I quickly learned that there were a lot of barriers—not just attitudes, but financial barriers, staffing barriers. But I kept coming back to attitudes," says Pfaff, who now works as a research cyberinfrastructure specialist in the Center for Health Disparities Research at UW-Madison. "I kind of always thought



that has to impact it somehow, but I couldn't really find a lot of studies that had actually quantified or assessed that."

Previous studies have shown that treatment with medications for opioid use disorder can lower incarcerated individuals' risk of both overdose and heroin or injection drug use after their release. Individuals who receive medications while incarcerated are also more likely to continue treatment upon release.

"My hope is that there are more studies like this, that this is the tip of the iceberg," says Pfaff. "I think there has to be some sort of behavioral change at an individual level, also perhaps at an institutional level."



Photos: Tom Ziemer

## Preparing undergrads to communicate with confidence

A team of engineers presents the results of a project, trying to sum up three months of work in just 30 minutes, under the watchful eye of a C-level executive.

That's the scene awaiting UW-Madison engineering students after graduation. But it's one our department has begun creating for our undergraduates while they're still in school.

Since fall 2022, the department has invited members of its industrial advisory board—alumni who are now leaders in manufacturing, healthcare, tech and other sectors—to visit its senior design capstone course and offer feedback on student teams' final presentations.

It's part of a broader effort within ISyE to enhance its students' communication skills, based on feedback from alumni.

"You can throw up a slide that has all the numbers in the world, but if you can't tell someone what it means, what good is it?"

says Andrew Thompson, who joined West Monroe, a consulting firm in Chicago, after graduating in December 2023.

Thompson was part of a group of five students who spent the fall 2023 semester working with Sub-Zero Group, the Madison-based appliance manufacturer, to optimize its plastic door liner manufacturing operations.

Each semester, seniors in ISyE 450 partner with a range of companies and nonprofit organizations to apply their technical skills to their clients' real problems. They create swimlane diagrams, identify pain points and root causes, use Pugh Matrices to compare potential solutions, run computational models to forecast improvements, and more.

Another group of students helped Specialty Care Free Clinic, a Madison nonprofit that provides specialty healthcare to uninsured, low-income patients, to modernize its volunteer scheduling system.

"Ultimately, their success comes down to their customer satisfaction," says Terry Mann, a senior lecturer in ISyE who teaches the course. "I want them to meet their client's needs more so than hit a rubric."

And part of meeting a client's needs is delivering recommendations in an understandable, digestible manner that balances details with big-picture results. Which is why department industrial advisory board member Mindy Rapp (MS in manufacturing systems engineering '96) sat in on a class session and offered guidance like not trying to cram too much information into a 30-minute presentation.

"Messaging truly matters," says Rapp, the chief operating officer of Menomonee Falls, Wisconsin-based ScanPac Manufacturing. "You can take the same information, the exact same information, and how you message it makes a big impact."



Submitted photo

## Optimal growth: Kwon finds path in industrial engineering

Amid the difficulty of a turbulent first year of college, David Kwon stumbled upon one piece of good fortune.

He had signed up for ISyE 191: *The Practice of Industrial Engineering*, purely because it was an introductory course that fit into his schedule. With family health issues in South Korea weighing on him and an impending mandatory military service commitment as a dual citizen hanging over his head (most male citizens of South Korea are required to serve), Kwon had endured a bumpy start to his time at UW-Madison.

In addition, Kwon had discovered he didn't enjoy his chemistry lab, which made him question his choice to major in chemical engineering. In ISyE 191, though, he found himself intrigued and excited by the malleability of industrial engineering, the seemingly unending number of business settings in which he could apply skills from the discipline.

There was just one problem: Even in his favorite class, he still floundered.

Five years later, after fulfilling his military duties and rededicating himself as a student, Kwon is excelling and weighing whether to

pursue a PhD in operations research or take a job in industry after graduating in May 2024.

"He's really detail-oriented and puts a lot of effort into really understanding things—beyond just to do well," says Assistant Teaching Professor Amanda Smith, who's taught Kwon in four different courses, including ISyE 191. "He really wants to understand why things work the way they do, why we do things the way we do them. He really goes to that deeper level."

Kwon credits his 20-month stint in the South Korean military, during which he was a signalman squad leader, handling communications for his unit through numerous live mortar ranges, with helping him to mature and to appreciate the opportunity in front of him in college.

"I really came to crave academics," he says. "I'd been studying my whole life from K-12, but now that I stopped, I kind of felt the importance of it."

After returning to Madison in 2021, he discovered he had a knack for mathematical optimization. ISyE 323: *Operations Research-Deterministic Modeling* has a reputation as the most difficult of the required courses

for industrial engineering majors, one that students often put off taking until their senior years. But, with the help of Smith and teaching assistant Eric Stratman, a PhD student, Kwon says the complex mathematical modeling clicked for him.

That's one of the reasons he frequently encourages first- and second-year students to take courses with Smith, whom he calls "the best teacher I've had in my life."

Kwon is spending his spring 2024 semester as an industrial engineering intern at Disneyland, rekindling his childhood love of *Cars* and *Toy Story* while working on ways to optimize the park's operations. He's applied to graduate schools but is also considering pursuing a career in industrial engineering, operations research, and consulting.

Wherever he winds up, it's a very different path than the one he was on five years ago.

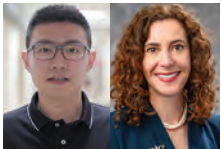
"I want to become a person who can provide mathematically backed solutions," he says. "That's the best part of industrial engineering, being applicable to all sorts of industries and all sorts of roles. Nothing is limited."

## Faculty News



Associate Professor **Alberto Del Pia** earned the 2023 Egon Balas Prize from the Institute for Operations Research and the Management Sciences' (INFORMS) Optimization

Society, as well as the 2023 INFORMS Computing Society Prize for a series of papers at the intersection of operations research and computer science.



Professor **Kaibo Liu** received a \$1 million grant from the U.S. Department of Energy for a research project

that aims to provide technical solutions to unique cybersecurity challenges in future microreactor fleet. Professor and David Gustafson Department Chair **Laura Albert** is a collaborator on the project. Liu also received a four-year, more than \$700,000 grant from the United States Office of Naval Research for a project to develop artificial intelligence techniques to aid predictive maintenance.



Professor **Ranjana Mehta** received a \$1.2 million grant from the National Academies of Sciences, Engineering, and Medicine's Gulf Research Program to address worker

fatigue in the offshore energy sector. Mehta also received a \$150,000 grant from NASA study the neural effects of spaceflight on astronauts.



Assistant Professor **Hantang Qin** received a two-year \$500,000 grant from the National Science Foundation (NSF) to lead a new project to develop a novel manufacturing

platform to fabricate 3D photonic structures, which could be useful for future quantum computing technologies. Qin also received an NSF Innovation Corps grant to support his lab's work developing a portable electrohydrodynamic inkjet printer for use in in-space manufacturing and antigravity 3D printing.



Duane H. and Dorothy M. Bluemke Professor **Rob Radwin** won the A.R. Lauer Safety Award from the Human Factors and Ergonomics Society in

recognition of his outstanding contributions to human factors in the broad area of safety.



Vilas Distinguished Achievement Professor **Shiyu Zhou** received a more than \$300,000 NSF grant to lead a project to develop

new methods for monitoring product quality and machine health in multistage manufacturing systems.



The INFORMS *Journal on Computing* selected a paper by Assistant Professor **Carla Michini** and Harvey

D. Spangler Professor **Jeff Linderoth** as a featured article for its January-February 2024 issue.

## Student News

Undergraduate **Naomi Lewis** earned an Alliant Energy Errol B. Davis Jr. Achievement Award. The awards, presented by the Universities of Wisconsin and the Alliant Energy Foundation, recognize the outstanding academic and community-service efforts of students from traditionally underrepresented groups who are pursuing a degree in business or engineering at UW-Madison or UW-Platteville. Lewis is president of the UW-Madison chapter of the National Society of Black Engineers.

Graduate student **Anna Linden** received recognition as a "Student Member with Honors" from the Human Factors and Ergonomics Society, while graduate student **Anna Konstant** received the Occupational Ergonomics Technical Group Student Travel Award.

## Carayon earns prestigious NAE honor

The National Academy of Engineering has elected Professor Emeritus Pascale Carayon as one of its new members.

Carayon, who retired from UW-Madison in 2021 after a 30-year tenure during which she built a reputation as an internationally renowned expert in applying human factors to the healthcare system, is one of 135 new members of the NAE's 2024 class.

NAE membership is one of the highest honors for engineers, reserved for those who have made significant contributions to engineering research, practice or education.

Carayon, who along with Professor Emeritus Michael J. Smith developed the influential Systems Engineering Initiative for Patient Safety (SEIPS) model for analyzing healthcare systems, is also a lifetime National Associate of the National Academies of Sciences, Engineering, and Medicine.

Stephen Wright, the George B. Dantzig Professor of Computer Sciences at UW-Madison and an affiliate faculty member in ISyE, is also among the new members.





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## Excitement is building

Our engineering campus is getting a facelift. With formal approval of state funding for a new 395,000-square-foot building, we're continuing our growth initiative.

The seven-story building will span parts of the existing Engineering Mall and the space currently occupied by 1410 Engineering Drive (which will be demolished), and feature refreshed green space and indoor and outdoor gathering spaces.

The \$347 million facility, funded through \$150 million in private giving and \$197 million from the state of Wisconsin, will be a catalyst for research while allowing the college to educate many more exceptional students.

Explore more, follow along with the building's progress, and support the project at [engineering.wisc.edu/new-building](http://engineering.wisc.edu/new-building).



All images by Continuum Smithgroup. Artist's concepts of the new building.

