If you’re a crew member on an Ingram Barge Company towboat, you spend 28 days straight navigating, maintaining engines and auxiliary equipment, or working as a deckhand — carrying and lifting equipment and tools in all kinds of weather, day and night.

This hard work isn’t a 9-to-5 job either: Crew members usually work two six-hour shifts each day and have two-six hour rest periods off. But how much sleep and relaxation can workers get during these rest periods, and how does this impact their fatigue levels when they’re on the clock?

Ingram CEO Craig Philip had considered that question but didn’t know how to go about answering it. “Most of the transportation modes need to have people working 24/7,” he says. “You have people who are going to be on the job when their bodies don’t want to be. Operators in every transportation mode struggle to come up with their best possible work schedules.”

Then, at Northwestern’s Transportation Center, Philip met Fred Turek, the Charles E. and Emma H. Morrison Professor of Biology in the Judd A. and Marjorie Weinberg College of Arts and Sciences and director of the University’s Center for Sleep and Circadian Biology. Philip’s concern with the sleep quality of towboat crews turned into a research study conducted by Turek with funding first from Ingram and then from the American Waterways Operators.

“Operator fatigue is very important to the transportation industry,” says Hani Mahmassani, director of the Transportation Center and William A. Patterson Distinguished Chair in Transportation. “It affects both the safety and the economics of their business, so much so that we had an entire industry sponsor this research.”

It’s through interactions like that of Philip and Turek that the Transportation Center and industry are inextricably linked; without the center as an intermediary, Philip might not have found Turek, and vice versa. They serve as an example of how industry partners with the Transportation Center on cutting-edge research.

“The challenging issues of transportation tend to come from the real world. The best transportation research is relevant, identifying and ultimately solving real problems,” Mahmassani says. “Most transportation research entities have a strong engagement with government. We have that, but it’s our industry engagement that really makes us special.”

**INDUSTRY INGRAINED IN CENTER’S HISTORY**

When the Transportation Center — a leading interdisciplinary education and research institution dedicated to the long-term improvement of domestic and international systems for the movements of materials, people, energy, and information — was created in 1954 as one of the first of its kind in the country, it was organized largely by industry leaders. The Patterson Endowment that significantly supports it was named for William “Pat” Patterson, the founding chairman of United Airlines and one of the Transportation Center’s original organizers. Construction of the center’s building in 1999 was funded through corporate and private donations, such as that by the Chambers Family Trust, the legacy of Jerry Chambers, who founded the firm that became Clipper Express. Seventy high-level industry people from across the nation are members of the center’s Business Advisory Committee (BAC), which provides information and strategic guidance about research, student internships, and annual contributions.

Through the center, companies partner with one
of the more than 50 faculty members from across the University — from areas such as engineering, economics, management, neurobiology, and social sciences — on transportation research. Connections may be made, for instance, when a BAC member hears a lecture by a Transportation Center faculty member and contacts him or her, or at one of the “industry days” where faculty members visit with a BAC company to learn about its transportation problems. Companies may ask the center to perform research of interest to them, or they may fund research a professor is already performing. The company often provides the data needed for professors to perform the research.

When Philip and Turek partnered on the sleep study, Turek and his colleagues spent five months in 2009 studying the sleep of workers on five towboats. They found that some crew members spent about 4.5 hours in bed and got as little as 3.7 hours of sleep during the six-hour break.

Recent studies showed that performance levels depend on the total number of sleep hours per day, so crew members ostensibly could perform the same whether they slept for six consecutive hours or had six hours of sleep split into a four-hour “anchor” sleep period one time and a two-hour nap later. The researchers encouraged crew members to develop “novel napping strategies” that included having the longer anchor sleep at night, when the body’s circadian biology wants it to sleep, and napping during the day to reach at least seven hours of sleep.

Some crew members slept longer thanks to the researchers’ intervention, but the data set was too small for the researchers to reach any significant conclusions. They decided that further studies should be done to get a larger sample of sleep schedules and to determine why some crew members slept longer than others. Researchers hope this information will provide data to develop interventions to improve sleep and reduce fatigue for towboat operators across the industry.

Philip has a longstanding relationship with the Transportation Center and joined the BAC about 10 years ago. He received his PhD from the Massachusetts Institute of Technology in the late 1970s and has worked with many professors who were once or are still involved with the center, including Mahmassani. “The BAC is the best assembly of industry-oriented folks broadly involved in the transportation world that has been set up by any university in the country,” he says.

Before the Turek study, Philip worked with Karen Smilowitz, the William A. Patterson Junior Professor in Transportation and associate professor of industrial engineering and management sciences, and undergraduate students on two studies. One study looked at two locks on the Tennessee and Cumberland River systems to help gauge how barges should determine whether to divert from one river to another to avoid delays; the other looked at how many turn boats (a kind of towboat) Ingram should operate on the lower Mississippi River based on boat density in the river, costs, and benefits. “We provided a living laboratory that researchers could work in to study these problems,” Philip says.

“Craig has been very supportive of the center and its activities and continues to be a leader both in industry and, in many ways, in how industry interacts with the academic community,” Mahmassani says.

Philip says that industry likes being able to contribute to academic success. “We’re able to participate in research projects stimulated by faculty members, so we can tap into the intellectual resources of the university and give back value to its academic success,” he says.

Philip adds that giving the 2010 Patterson Lecture, an annual invited talk given by top transportation leaders, was “one of my proudest moments as a professional. To be able to add my name to the long list of very distinguished people who have given the lecture was amazing.”

BRINGING IN YOUNGER COMPANIES
When Mahmassani came to Northwestern in 2007, he made it one of his missions to revitalize partnerships with industry. He recruited Bret Johnson as associate director for strategic relations and worked to broaden BAC membership.

One of his BAC recruits was Doug Waggoner, CEO of Echo Global Logistics, who joined the committee in 2009. Echo Logistics uses technology to analyze data from a network of 16,000 transportation carriers across industries, such as manufacturing and consumer products, to provide transportation savings for companies. The five-year-old Chicago company has enjoyed explosive growth — its first quarter of 2010 showed 82 percent growth over the first quarter of the previous year.

“Echo is almost like a poster child of new business models in transportation,” Mahmassani says. “It has been very important to add companies like Echo, bring them into the fold, and keep our BAC reflecting emerging trends in industry. It has really brought new blood and excitement for our members.”

When you’re running a company, Waggoner says, it can be difficult
to step back from the day-to-day business objectives to take a broader view. “The BAC is a great networking opportunity,” he says. “It gives me a chance to meet with people in academia and be exposed to the latest, greatest thinking.”

Waggoner says since joining the BAC, he’s been interested in faculty members’ expertise in applying operations research to business problems. As a young company, Echo Logistics doesn’t have the resources in place to conduct research in such areas as revenue optimization. “We deal with a massive number of transactions involving thousands of trucking companies,” he says. “We’re sitting on a huge amount of data, and we’re not putting that data to work as well as we could. We need help evaluating it and looking for new ways to use that data to create algorithms and build better systems.”

Echo Logistics’ new business model — providing real-time information for its customers — presents challenging problems for researchers. Mahmassani and Waggoner are discussing a possible research partnership. “For professors like myself who have been working on problems of decision making in real time using real-time data, there’s a lot of very exciting technical problems,” Mahmassani says.

These industry connections benefit students as well, whether through undergraduate senior projects (such as the study with Smilowitz and her students) or through funding for dissertation research. BAC companies are frequent speakers on campus and heavily recruit Northwestern graduates. “One of the benefits is access to human capital,” Waggoner says. “Echo has hired graduates from Northwestern. We’re always on the lookout for talented young people, and we find them at Northwestern.”

Mahmassani hopes to continue to strengthen industry connections even more. “We want to be partners in the exciting experiments that industry is engaging in,” he says. “We want industry to think of the Transportation Center and Northwestern when they need people who think in new and creative ways, who can help them identify new technologies and methodologies. These partnerships are critical for us going forward, and it’s through them that we will remain a unique center.”

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