

GLOBAL SUPPLY CHAIN MANAGEMENT INITIATIVE

GSCMI

Annual Report 2020



The next giant leap
would not be possible
without you taking
the next steps with us.
Thank you.





KRANNERT'S
SUPPLY CHAIN CENTER

IN PERSISTANT
PURSUIT OF

For over ten years the GSCMI (Global Supply Chain Management Initiative) Center has been the focal point within the Krannert School of Management for promoting education, research and industrial engagement with those interested in supply chain management. The Center accomplishes this through various conferences, student competitions, and company projects that create venues for collaboration between firms, students and faculty across the state and around the globe. Bridging industry, students and faculty.

SUPPLY CHAIN
EXCELLENCE



A SENSE OF COMMUNITY PROJECTS

Purdue Research Shows Economic Benefits of Installing Conduits along Indiana Highways to Expand Broadband

Out of Indiana's 92 counties, researchers identified 35 counties where the economic impact would be greatest, potentially adding \$3.6 billion (or 80 percent of the total) to the state's GDP. They also identified five industries — manufacturing, health care, information, retail trade and educational service—that would benefit the most, generating 80 percent of the total economic impact.

The research was conducted for Indiana Department of Transportation (INDOT) as part of a project to assess the potential benefits of constructing conduit infrastructure on right-of-way along state highways. The conduits would be leased to information and communication technology (ICT) companies for fiber-optic cables that expand broadband internet coverage in the state. The state government would benefit from leasing revenues as well as the economic impact of broadband expansion. The researchers' findings were published in a report released this spring titled "Benefit Analysis of Installing Fiber Optics on INDOT projects." The report was prepared by Ananth Iyer and Steve Dunlop of Krannert School of Management, Samuel Labi of Lyles School of Engineering, and Thomas Brady Jr. of Purdue University Northwest, along with MBA candidate Eki Amijaya, and PhD candidate Abdullah Nafakh. As part of the project, the researchers reviewed previous studies on the economic impact of broadband development. Among them was a report entitled "Job Creation from Rural Broadband Companies" by Robert Gallardo and Indraneel Kumar of Purdue Center for Regional Development, which found that rural broadband initiatives would create 1,282 new jobs with an output of \$363 million in Indiana.

Having high-speed internet is particularly important for the manufacturing and information industries, according to the INDOT report. These industries require download speeds of 1,000 MB per second, and upload speeds of 500 MB per second.

The researchers cited examples of the various ways that broadband internet could benefit individuals and businesses

in Indiana. More farmers and agri-businesses can adopt internet-connected technologies that allow them to automate farming processes. Computer costs at libraries could be lowered if more people have broadband access at home. Broadband would allow more people to work from home, saving them the stress and cost of commuting. It would also enable people in rural communities to access healthcare through telemedicine, saving them long drives to clinics and hospitals.

The report also examined the costs and requirements of installing conduits for fiber-optic cables along state highways. The conduits are typically buried at a depth of 3-4 feet, though they can be carried on overhead lines. The report presented costs of conduit installation in Indiana and other states, including labor, materials and equipment use.

To determine the economic impact of broadband investment, the researchers used contribution factors for each industry based on a 2016 research paper titled "The Impact of Broadband and Related Information and Communications Technologies on the American Economy" by Kevin Hassett and Robert Shapiro. To calculate the total impact on Indiana's economy, the researchers developed a general formula that incorporates the broadband contribution factor per industry, the natural growth per industry per county, and the adjusted mean income per industry per county.

A Purdue University study has found that broadband investment in Indiana, involving the installation of conduits along state highways to carry fiber-optic cables, could boost the state's economy by \$4.5 billion.

Using the Pareto principle, which states that, for many events, roughly 80 percent of the effect comes from 20 percent of the causes, they determined that Indiana could achieve 80 percent of the economic gain by installing conduits that provide broadband to 35 counties. The top three counties, Marion, Hamilton and Lake, would themselves boost the state's GDP by more than \$1.1 billion.

The economic impact on Indiana's 120 cities would be about \$2.4 billion, according to the report. The Pareto analysis shows that 35 cities would contribute more than \$1.8 billion.

PROJECTS

Purdue Project Seeks to Synchronize On-Demand Laundry Service Operations to Offer Faster Service

On-Demand Laundry Service

Hotels, restaurants and other businesses, as well as individuals, are increasingly turning to on-demand laundry services to have their linen washed or dry-cleaned. Using an app, they can have their laundry picked up, cleaned and returned within a day or two. The turnaround time is a critical aspect of the service. Offering faster service can give a laundry service company a competitive edge and attract more customers.

But what would it take for an on-demand laundry service provider to be twice as fast as before, switching from a turnaround time of 48 hours to 24 hours?

That's what an on-demand laundry service provider (LSP) wanted to find out when it sought help from a team of researchers at Purdue University's Krannert School of Management. The project focused on the LSP's dry-cleaning operations in the Chicago area and was performed by students and faculty with support from the LSP and its parent company.

The LSP's customers drop off their laundry in lockers

and boxes around the city and use an app to schedule a pickup. Drivers in vans pick up the laundry and take it to a cleaning facility. A two-day turnaround time is guaranteed, as long as the order is placed by 8 a.m. By decreasing the turnaround time to 24 hours, the LSP hopes to improve customer experience, generate more revenue, decrease the number of missing items and encourage worker efficiency. The project's objective was to synchronize the pickup and delivery of laundry with the cleaning process to ensure a competitive 24-hour turnaround. The Purdue team made two visits to the dry-cleaning facility, analyzed current operations, identified bottlenecks, created a simulation that calculated the required capacities to finish an order processing in one shift, and studied various scenarios for synchronized pickup and delivery operations. The team proposed a list of actions that would increase the efficiency and quality of the laundry service.

One of the main recommendations is for the company to adjust pickup locations to synchronize them with loading at its dry-

cleaning facility. It's important for the first van arriving at the facility each morning to deliver a large enough load to minimize idle time before the next van arrives, and for each load to not vary greatly in size, so resources can be efficiently scheduled.

Another recommendation is to focus on ways to reduce travel by using a cross-docking facility. The vans currently follow long routes that take four to six hours to complete. By dropping off loads at a cross-docking facility, they can reduce the number of trips back and forth to the dry-cleaning facility and finish their routes earlier.

A third major recommendation is to adjust the schedule of workers at the dry-cleaning facility so that the ideal number of workers are available to quickly process loads as they arrive, while minimizing idle time and reducing overall costs. The Purdue team hopes to be involved in implementing the recommended steps and participating in the successful launch of a 24-hour turnaround time at the on-demand laundry service company.

PROJECTS

PURDUE STUDY EVALUATES IMPROVEMENTS TO INDIANA'S REST AREAS

Rest Area Study

Could rest areas in Indiana be upgraded to include electric vehicle charging stations, high speed internet service, interactive touch screen displays and parking lot sensors?

Those are some of the innovative and sustainable solutions being considered as the Indiana Department of Transportation (INDOT) seeks to improve services and increase revenues at the state's 28 rest area facilities.

Researchers at Purdue University's Krannert School of Management have conducted a study for INDOT that evaluated potential solutions, showing their benefits as well as any drawbacks. Among their findings: The cost of installing an electric charging station can be recouped after 420 vehicles get a full charge, while the monthly cost of high speed internet service can be recouped if 50 travelers use the service for one hour each.

The study was conducted by co-principal investigators Steve Dunlop, Ananth Iyer, and Olga Senicheva, along with students Andrew Colbert, Dutt Thakkar, and Hannah Pratt. INDOT operates 28 rest area facilities at 17 locations (11 locations have buildings on both sides of the interstate). While INDOT cannot commercialize or privatize the rest areas, it hopes to find sustainable sources of revenue while upgrading services to travelers and promoting tourism and commerce in Indiana. To guide the implementation of any upgrades in stages, the Krannert researchers created a ranked list of solutions that would provide

sustainable sources of revenue. The list includes (1) electric vehicle charging stations; (2) high speed internet service; (3) interactive touch screen displays; (4) Indiana Originals; (5) parking lot sensors; (6) pharmaceutical vending machines; (7) express laundry service; (8) solar energy solutions; (9) semi-truck platooning; and (10) compressed natural gas stations.

Installing a 240V electric charging station would cost about \$550, with a maintenance cost of about \$300 per year. Drivers would pay \$3.90 per 100 miles to fully charge each vehicle. Recouping the installation cost would require 420 vehicles to be fully charged, with another 77 vehicles needed to cover the annual maintenance cost.

"Overall, this project has high potential for long-term profitability, especially as the number of people driving electric vehicles continues to increase," the researchers say in their study. Providing high speed internet would cost about \$250 per month, generate \$5 per hour in revenue and "vastly increase the modern appeal of rest areas," the researchers say. Offering this service in small, quiet spaces within rest areas could appeal to business customers or consumers who want to watch or download media content.

Interactive touch screen displays would allow rest areas to show available parking, services provided, and traffic updates. Revenue could be generated by offering downloadable content such as movies and games, educational activities for children, and space for advertisements.

Indiana Originals is a community of consumers and business owners working together to create healthier, stronger communities and more jobs in Indiana. A partnership between INDOT and Indiana Originals would promote local businesses at rest areas while generating advertising revenue.

Parking lot sensors can detect a car's presence in a parking space and alert drivers on parking availability through highway displays or GPS systems. Revenue can be generated by truck drivers and other motorists who want to reserve a parking space in advance.

To further evaluate the proposed solutions, the researchers created a rest area survey that can be used to gauge travelers' interest in potential improvements.



PROJECTS

Study Shows Potential Impact of Autonomous Vehicles in Indiana

Self-driving vehicles

As self-driving or autonomous vehicles become more viable, Indiana Department of Transportation is making plans to accommodate them on its highways. It has collaborated with Purdue University on a study that shows the significant impact that autonomous vehicles could have on Indiana's transportation and manufacturing industries.

The study, entitled "Developing a Business Ecosystem around Autonomous Vehicle Infrastructure in Indiana," and led by Ananth Iyer and Steve Dunlop of Krannert School of Management, explored not just the benefits of having fleets of self-driving vehicles on the state's highways, but also the drawbacks, such as the loss of jobs for professional drivers. As part of the study, the researchers conducted a survey that showed the potential impact of new transportation technologies on Indiana companies. Most companies responding to the survey expect autonomous vehicles to have a greater economic impact on them than platooning, electric vehicles and drones.

Autonomous vehicles are expected to reduce crashes caused by human error by more than 90 percent, decrease commuting time and improve productivity, and be more energy-efficient and sustainable. But autonomous vehicles would

also be costly to implement, as current systems would need to be replaced. AVs would also make it harder to assign responsibility for crashes, increase cyber security risks, and require major changes at auto manufacturing plants. To minimize the impact on driving professions, the study suggests a planned transition that would enable drivers to find other positions, taking advantage of the knowledge and skills they already possess.

The study shows how platooning – linking two or more trucks in a convoy using connectivity technology and automated driving support systems – could significantly increase the capacity of highways. At 55 miles per hour, five-vehicle and 10-vehicle platoons would increase capacity by 350 and 550 percent respectively.

To realize the benefits of platooning and other techniques that exploit automated driving systems, highway administrators will need to explore designated lanes such as high-occupancy, managed and express lanes.

Autonomous vehicles would improve Just-in-Time deliveries for a wide range of industries, reducing their transportation costs. The study expects shipping and logistics companies to adopt autonomous vehicles early, as they would benefit greatly from reduced labor costs.

Primary industries in Indiana that would benefit from autonomous vehicles include manufacturers such as Wabash National and Cummins, as well as transportation and logistics companies such as Schneider National and FedEx. Secondary industries are technology companies that could provide infrastructure and technology for implementing autonomous vehicles, such as Pelton and Delphi Technologies.

While preparing for autonomous vehicles, the study recommends that INDOT initiate projects to test connected vehicle (CV) technology such as dedicated short-range communications (DSRC) and 5G cellular technology. CVs communicate with other vehicles and can provide data to improve traffic flow.

The study notes that autonomous vehicles will require substantial investments in infrastructure and may also cause losses in revenue from gas taxes, parking fees, traffic tickets. INDOT will need to explore a Vehicle Miles Travelled (VMT) fee and other potential revenue streams to make up for this.

For AV and CV to succeed, the study recommends that INDOT develop partnerships with a wide range of industries and communicate the benefits of these technologies. INDOT

may need to act more like a mobility provider, in addition to being an infrastructure provider. INDOT could also partner with major research universities to create testing areas for autonomous vehicles and to train drivers to use AV technology.



STARTING LOCAL FOR LARGE IMPACTS



1-ON-1 BUSINESS PLAN

"We really appreciate the opportunity given to DPG with this project; we're already seeing dividends via contacts through the app."

--Gabe Widmer, Director



Purdue University has partnered with WHIN to fuel prosperity in Wabash Heartland. By engaging with individual learners and leveraging learning organizations across the counties, we expect to be both effective and efficient. Our goal is to support the development of smart people, smart processes (including business), and smart technologies in these companies.

In this last year, our team proactively engaged with local companies on over 600 occasions. Our original objective was to find 25 companies that would engage with us. We currently have over forty companies that engage with us routinely where we or they are the pro-active lead in making contact. These engagements have led to projects including case-study projects, participation in workshops and conferences and delivery and presentation on numerous occasions throughout this year, most recently via webinar workshops. Engagements have led to changes in operating performance, up-ticking in management



"This process is an excellent way to systematically analyze the plant floor material and work flow to ensure infection risks are identified and mitigated. Without it we would be flying blind."

--Mike Gulbranson

methods, initiatives to improve recruitment and on-boarding experience and business-to-business activities. As we have more success-narratives from these engagements, these will feed into companies that may be amenable to increased engagement but need third-party evidence to give them confidence and trust in what we are delivering.

We have also been liaising actively with the Economic Advisors in the LEDOs and Chambers for over two and a half years, partnering with them to encourage participation of companies and to appraise these advisors of our growing platform of support for businesses, based both upon our comprehensive gap-analysis project and further inputs from many types of engagement. One of the case-study projects with Dayton-Phoenix Group exemplified a general need where local companies have problems attracting quality people (the number #1 issue for WHIN companies). This project was designed to showcase how to produce an attractive and user-friendly web-based portal for recruitment. The site was designed to easily translate into a digital application which can make it much easier to screen and attract the right candidates. It also serves to make explicit (deploying short worker-videos) why the company is a more attractive place to work.

One of our Regional Development Groups sought help in retaining good staff. As a direct result, largely advised by our knowledge and experience of what works elsewhere, Rowe Truck Enterprises (RTE) launched an event involving workers' families (including 72 children). Valuing staff helps staff attendance. Additionally, junior members of the family may be attracted to come to work with their parents after graduating school. RTE brought families for a day of interactive and educational fun to find out and be proud of what the employee does for the business. As a result of the COVID-19, we adapted the Value Stream Mapping (VSM) methodology to include a process to analyze and mitigate the infection risk. This revised methodology is VSMI. We contacted one of our local companies, Dayton-Phoenix Group who had sent one of their employees that had attended a VSM class to see if they would pilot the new VSMI process. He quickly agreed and used

the methodology to diagram his company's plant floor to identify several infection risks and to implement countermeasures.

Even before full launch of our supply-chain portal, we were able to connect businesses, for example: A company wishing to invest in the area and seeking local suppliers of components. Another company needed an urgent second supply of aluminum castings to continue a product line. A company needing a local 50 ton mobile crane was looking right across the State of Indiana and then found one less than six miles away because of a conversation at a Regional Development Group meeting.

We also make proactive introductions, for example: (1) a company needing a surface-active anti-microbial cleaner/treatment was put in direct contact with another local company; (2) a company needing a business partner to grow global sales of its equipment was put in touch with a potentially perfect OEM; (3) a company wishing to capture revenue from owned land in a poor cell-phone reception area was introduced to a company contact establishing a 5g network locally.



"We would not have thought of it in a hundred years. Thank you for taking your time to provide ideas that may help stimulate interest in small business manufacturing operations like ours."

--Larry Wilcrou, President



UTILIZING
WHAT I HAVE
LEARNED
SO FAR



SHRUTI
SINGHAL

Alumnus Spotlight

This past year has been incredible! Studying in the US has always been an ambitious goal. Purdue made it all possible and set me on a journey that has been extremely enriching and fulfilling. A year full of challenges, emotional roller-coaster, hard work, and countless indelible memories. I met some wonderful people and made friends who were immensely supportive and encouraging. Experiencing a completely different culture was intimidating in the beginning, but I must credit the people who made it not just extremely comfortable but also inspiring throughout. There were countless opportunities to help me grow as an individual. Working at GSCMI with Dr. Ananth Iyer was one such opportunity that made me hone my skills and experience- something I had not experienced before. Doing a research project was indeed new and seemed overwhelming sometimes, but a constant encouragement from Dr. Iyer and my colleagues kept me going. He always stressed the fact that doing research can be intensive, and it requires lot of patience. Eventually, I got an in-depth understanding of end-to-end Supply Chains in the industries I had researched on. Also, I could see the hard-work coming to fruition when I observed that our findings and results were consistent with what the big consultants had to say. Besides, our results had definite rationale which made me confident about the efforts I was putting in. The project helped me strike conversations with other people as well. I would always find people interested in knowing more about the topic once I would start talking about it. Gradually, I realized that my knowledge about the subject was enough to convince people what the future could behold and how we can plan the Supply Chains better to match the demand-supply imbalance. Going forward, I aspire to continue with the same spirit and positivity. As I have always been inclined towards working in the field of medical devices and healthcare, with my next opportunity in a healthcare industry I am hoping to utilize all that I have learned so far and explore much more. **That's my giant leap.**



THAT'S
MY
GIANT
LEAP

As I have always been inclined towards working in the field of medical devices and healthcare, with my next opportunity in a healthcare industry I am hoping to utilize all that I have learned so far and explore much more.





Industry tours are hosted along with educational experiences with hands-on exposure to immerging technologies for both industry and students in the center's ever expanding engagement center.



SMART

LEAN

ENGAGEMENT

CENTER

Celebrating the vitality of manufacturing and supply chain with a hands on experience.

Learning outside of the classroom.

Technology doesn't stop progressing, and it is the responsibility of every individual to stay up with the newest technological breakthroughs. On a campus dedicated to research and learning, it is only applicable that an initiative dedicated to the management and advancement of manufacturing create an opportunity for those who wish to see the newest technologies first-hand. The Engagement Center is a place where students, professors, and even the general public can learn and experience some of the newest technologies as well as understand their applicability and usage in a manufacturing setting. The Engagement Center contains a number of different technologies.





GSCMI CONFERENCE

PRACTICAL
SOLUTIONS

|
FOR TODAY'S
TOUGHEST
CHALLENGES

From Coronavirus to Geopolitical Unrest, Speakers at Spring Conference Address Global Supply Chain Risk

It was late February, before the full extent of the coronavirus pandemic was felt in America, but Rosemary Coates had already gauged the impact of the outbreak on American companies. "The coronavirus is going to have unprecedented effect on their supply chains," said Coates, speaking at the 2020 GSCMI Conference in Purdue Memorial Union's North Ballroom. The pandemic has indeed had a colossal impact on supply chains, beginning with the disruption of manufacturing in China and continuing in the United States and other countries.

Coates and other guest speakers at the conference addressed not just the coronavirus pandemic, but other events and factors that contribute to global supply chain risk and the various ways companies can mitigate these risks.

The speakers included Matt Biddle, manager of enterprise supply management risk, Deere & Co.; Carmen Collier, program manager, Amazon; Michael Musleh, vice president of technical sales and purchasing, Oscar Winski Co. and Lafayette Steel & Aluminum; and Mary Slater, business excellence manager, Shell TechWorks. Coates, founder and executive director of the California-based Reshoring Institute and president

of Blue Silk Consulting, emphasized the risk to intellectual property in making goods in China.

"If you move that production out of China, the Chinese manufacturing plant isn't going to go to sleep at night and wake up in the morning and have forgotten how to make your products," said Coates, who has authored five books, including "42 Rules for Sourcing and Manufacturing in China."

To reduce the risk of intellectual property theft, companies need to be careful about what information they share with suppliers, Musleh said. "If you're going to do a whole assembly, split it up," he said. "Do not give the whole assembly prints. Give individual component prints."

Another recommendation from him: "Try to keep a portion of that business in the U.S. to keep the proprietary issues down to a minimum."

Companies need to be prepared for a wide range of events that

can disrupt their supply chains, including severe weather, labor strikes and geopolitical unrest, Collier said.

"Changes in government can cause huge swings in what's allowed and what's not allowed in supply chains."

A variety of unexpected events can affect a company's supply chain. Slater spoke about one such event, a fire that broke out last March at a petrochemical storage facility in the Houston Shipping Channel. As a result, Shell Lubricants' Houston Lubes Plant (HLP) could not receive supplies through the channel. Slater, who worked for Shell Lubricants at the time of the fire, recounted the various steps managers took to maintain production of engine oils and other products. Not everything worked out the way managers had hoped. A towboat could not be used in a timely way because the sea level was too high. Flooding in a nearby area caused unexpected delays.

"Don't assume everything will go perfectly," Slater said. "Assume it won't. You can't plan for perfection. You have to build contingencies to make sure that it works."



Anson Soderbery, associate professor of economics in Krannert School of Management and a specialist in international trade, also spoke at the conference, sharing his expertise on tariffs.

President Trump has imposed a series of tariffs on imported goods from China, India and other countries, part of his "America First" economic policy. But U.S. importers, not China, may be bearing the brunt of the tariffs. China has also retaliated with tariffs on U.S. exports. Before applying tariffs, it's important to carefully consider their impact, Soderbery said.

"It's a really hard process," he said. "You have to know deep fundamentals of every market and you have to forecast what you think will happen when a tariff gets applied."

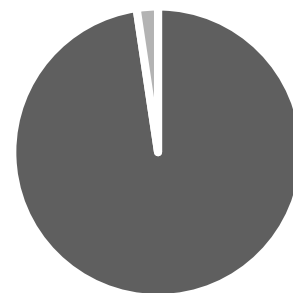


IT'S BEEN A STRONG YEAR

We look forward to further growth in the year ahead.

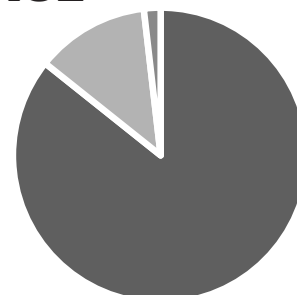
Our future goal is to enhance our global reputation for thought leadership in supply chain. Accomplishing this goal will require leveraging Krannert's faculty expertise and its students to engage with resources across Purdue, alumni and companies.

REVENUE



■ grants ■ gifts

EXPENSE



■ projects ■ operations ■ engagement center

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