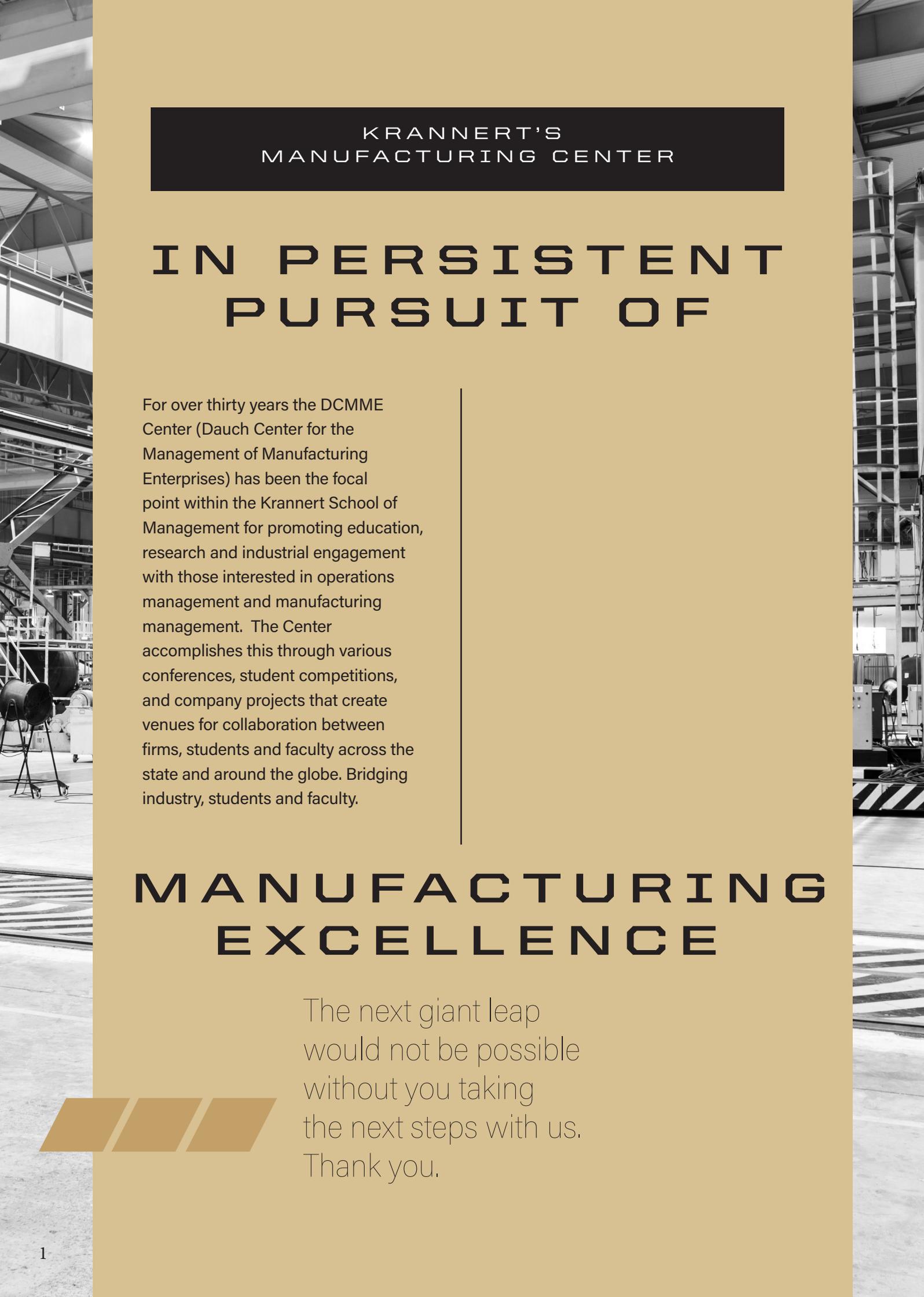


DAUCH CENTER FOR MANUFACTURING

DCMME

Annual Report 2020

A black and white photograph of an industrial facility, likely a manufacturing plant, with various structures, pipes, and equipment visible. The image is split vertically, with the left side showing a closer view of machinery and the right side showing a taller structure with a ladder.

KRANNERT'S MANUFACTURING CENTER

IN PERSISTENT PURSUIT OF

For over thirty years the DCMME Center (Dauch Center for the Management of Manufacturing Enterprises) has been the focal point within the Krannert School of Management for promoting education, research and industrial engagement with those interested in operations management and manufacturing 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.

MANUFACTURING EXCELLENCE

A decorative graphic consisting of three parallel, slanted rectangular bars in a light brown color, positioned to the left of the text.

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

LETTER FROM THE DIRECTOR

We are pleased to present the DCMME Annual Report (DCMME refers to the Dauch Center for the Management of Manufacturing Enterprises). Despite the pandemic, we have been working to engage with projects, collaborating with companies and government organizations, and leveraging the skills of students, faculty and staff to both educate and deliver value. We are excited to announce several projects, showcase our conference speakers, describe new grants and provide links to our activities.

The center continues to focus on leveraging technology to enable smart manufacturing that enables sustained competitiveness. Our ideas were included in a book published by center collaborators (Iyer, Dunlop, McLeod and Vasher) on Amazon Kindle, that focused on a TP³ framework, leveraging technology to impact people, products and processes. Our projects included using no-code apps within companies to monitor equipment and people, a project to use Bluetooth tags to ensure social distancing and quarantining, a project that uses bill of lading datasets of US imports to explore Onshoring opportunities, a project focused on tracking product within large warehouses, another using natural language processing to analyze data, and yet another using mathematical programming to generate capacity markets for local sourcing. In short, we believe that the New Normal in Manufacturing involves leveraging technology to emerge even more competitive. Our Smart Lean Engagement Center, housed in Stewart Center, continues its role as a hands-on lab to showcase emerging technologies, from augmented reality to light guide devices, 3-D printing to drones for internal use, and video analytics to sensors. Applied projects to improve operations performance continue to thrive at the center. One of our projects, funded by the Lilly Endowment, is part of WHIN or Wabash Heartland Innovation Network. Working with 280 companies in the region, we have developed a Supply Chain Tool that is in beta deployment. The tool is a digital database of capabilities of companies and is organized in an Amazon Web Service cloud server that can be accessed from an SQL database of linked tables. We have already started sharing this tool with Local Economic Development officials and aspire to grow this tool's use to increase local economic impact.

DCMME staff and faculty are continuing to grow the peer to peer networks of these companies to enable sustained learning, both from us and from each other. All of these efforts are part of our vision of a smart manufacturing eco-system in the WHIN region. We are determined to learn from our engagement and use our students, faculty and staff as catalysts for the sustained manufacturing competitiveness of our region.

Other projects sponsored by the Indiana Department of Transportation, the US Department of Energy as well as others are all examples of opportunities for students and faculty to engage in the learning and enhancing of skills for our students. We have worked on novel economic opportunities for Indiana rest areas that synchronize with the transportation vision, developed a strategy for conduit projects along highways that impact economic development, are working on winterization and on last mile planning for the future and more. Our projects with the Department of Energy have focused on rare earth recycling, forecasts of critical material demand and supply and economic models of research projects funded by the department of energy.

From all of us here at Krannert, thank you for being part of DCMME – your participation with the center enables us to nurture the passion for manufacturing that we hope to instill in our students. You can assist us by attending our conferences, talking to our students or faculty, emailing us with suggestions, calling us to chat about ideas or even perusing our website. Please be on the lookout for even more content in our website.

We welcome the opportunity to share this Annual report with you and invite you to join us in a photo-journey with us. We hope you will celebrate the many industry and government representatives, students, staff and faculty who help us keep the center growing. As you learn about the current activities at the center, we invite you to share ideas, comments and opportunities with us. All it takes is a phone call to Steve Dunlop (765-494-7800), or an email to dcmme@purdue.edu to start the collaboration. We will work with you to create solutions for your question using our team of graduate students and faculty. The upside for all is that great ideas are the core to student learning, business competitiveness and faculty research. We understand that problems and their solutions do not fall into neat functional area boundaries, so our Krannert faculty engagement across disciplines will ensure that we address problems with the breadth that is appropriate.

We look forward to another year of successful collaboration. From all of us here at DCMME, thank you for your contributions to the center.



Dr. Ananth V. Iyer
Center Director
Department Head and Senior
Associate Dean
Susan Bulkeley Butler Chair in
Operations Management



A SENSE OF COMMUNITY

PROJECTS

DCMME partners with a vast variety of companies and organizations to establish best practices in manufacturing and to strengthen our region. We are in this together.

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.

Another 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



"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

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

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.

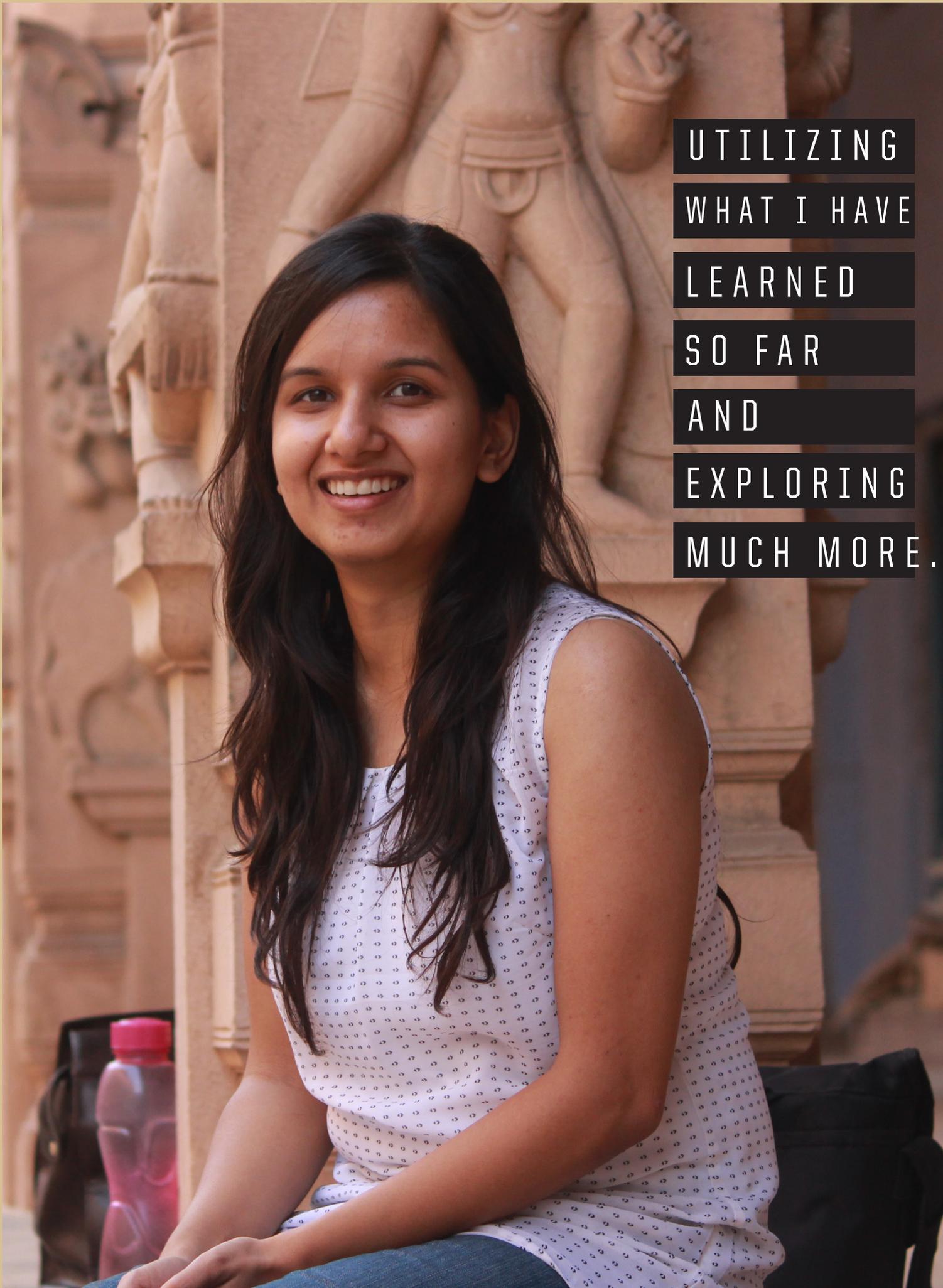
We also make proactive introductions, for example: (1) a company needing a surface-active anti-microbial cleaner/treatment was put in direct contact with another local company; (2) a company needing a business partner to grow global sales of its equipment was put in touch with a potentially perfect OEM; (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
AND
EXPLORING
MUCH MORE.





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 DCMME 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 a 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. 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.





“

Be curious.
Be humble.

LEADING THE WAY

YANG WANG

Clinical Assistant Professor
of Management

Q&A with DCMME professor

Q What has been one of your favorite experiences at Purdue so far?

A Purdue provides a lot of case competitions, career fairs, and internship opportunities to students. I really enjoyed being the judge or mentor during those events. I am also eager to share with students more personal experiences outside of the classroom.

Q What do you like about Krannert?

A Purdue and Krannert provide faculty and students a wonderful multi-disciplined environment. Faculty from different colleges can collaborate together; students can also participate in projects from other colleges. For example, I am working with multiple students from Industrial Engineering and Computer Science.

Q What do you currently teach?

A I am teaching various undergraduate and graduate courses. For example, Python Programming, Database Management, Management of Organizational Data, Management Information System, and Industry Practicum.

Q What are your current research interests and focus?

A I am mostly interested in the economics of information systems and technology, particular topics such as social media and social networks, user-generated content, and online display advertising. In terms of methodologies, I am combining methodologies such as econometrics with more recent machine learning methods in the application of information systems studies.

Q What have you worked on with the DCMME center?

A I have mentored a couple of projects starting from summer 2019. Students work on different large-scale real data starting from web scraping, data cleaning to data visualization, and some more advanced analytics such as sentimental analysis, similarity analysis, etc.

Q What value do you see to the students, industry, and faculty with engaging with DCMME?

A DCMME provides students some excellent work opportunities. By working on the projects, students could

1) Apply what they learned in the class on the real world large-scale data; 2) Have the opportunity to work with industry partners who could give students more training before they go on to a professional career. Industry partners are very

“

Purdue and Krannert provide faculty and students a wonderful multi-disciplined environment.

satisfied with our work because our work offers new insights on how to improve or enhance their operations.

Q What are some hobbies that you enjoy?

A I like to go travelling around with my family.

Q What is one of your favorite lessons you would like to pass along to students?

A Be curious. Be Humble.



DCMME CONFERENCE

**MANAGING
MANUFACTURING
AGILITY**

**PRACTICAL
SOLUTIONS**

—
**FOR TODAY'S
TOUGHEST
CHALLENGES**

Speakers Share Expertise on Manufacturing Agility at DCMME's Fall Conference

The football player was instantly recognizable to any Boilermaker fan in the room. Bryce Brumm displayed photos of the player's rigorous training regimen as he spoke about agile manufacturing at the 2019 fall conference of Krannert School of Management's Dauch Center for the Management of Manufacturing Enterprises (DCMME),

"This person is squatting 600 pounds and weighs 180 pounds," said Brumm, president of Standard Industrial Supply in Winamac, Indiana.

"Training is part of agile manufacturing. You've got to be able to do multiple processes. Catching the ball, running the ball, returning punts. Basically if it's not a defensive play, this player is on the field."

Brumm joked that he had found a random football player on the internet, triggering laughter in the room. As a Purdue alumnus and diehard football fan, he was unable to resist using Boilermaker star Rondale Moore as his model of agility.

Brumm contrasted the wide receiver to a hockey goalie with bulky pads, a protective mask and a wide stick.

"He really has a very limited range of motion, and he has one

goal: stop the puck. That's his objective."

The hockey goalie is like a 1,500-ton press with a long setup and changeover time. "It's very good at what it does, not agile at all, more traditional manufacturing," Brumm said. Moore, on the other hand, is like a robotic press brake cell that can be set up in 90 seconds. "Very agile, very quick," Brumm said.

But a robotic press brake comes with a hefty price tag, so Standard Industrial recently opted for a less advanced press brake at a more manageable cost.

"No matter how fast you get at this, it's still just one brake," Brumm said. "So agile to me means don't leave common sense at the door. Look at your options."

Brumm was among eight speakers at DCCMME's fall conference, sharing their expertise on the theme of "Managing Manufacturing Agility" and other topics with

students, faculty, staff and industry representatives in Room 206 of Stewart Centre. Manufacturing agility is the ability to synchronize manufacturing capability to deliver on a mix of orders, with different margins and lead times, to maximize profitability.

Tim Lawrence, senior vice president of operations at Hill-Rom Holdings, a global medical technology company, explained the company's strategy deployment through the concept of "True North" - the direction the company wants to follow. The company sets high goals in four areas: people, delivery, quality and cost.

"We are very competitive, we are very intense, we don't want mediocrity, we don't want status quo," Lawrence said.

Having a disciplined operating system is imperative, he said. Among the benefits: abnormal results can be detected easily.

"You have to see abnormal conditions on the shortest interval of measure," he said.

Agile manufacturing requires



employees to be receptive to change, but not everyone responds the same way, said Angus McLeod, Purdue's education consultant for the Wabash Heartland Innovation Network (WHIN).

"Whether it's two minutes or two months, people get through change by making small steps and succeeding on a sequential basis," he said.

Communication and feedback are important when bringing about change, as are technical skills training, problem-solving skills training, and coaching for supervisors and managers.

Standards and systems such as 5S and ISO 9000 can help create a work culture of change that promotes agility, McLeod said. "It creates the discipline but it also creates that environment of continuous change at the small level that enables the bigger leaps of change that need to be made for agile manufacturing," he said. Mike Ryba senior manager, RPA Practice Lead, Centric Consulting, spoke about the benefits of robotic process automation (RPA) in eliminating what he called "repetitive mundane high-volume tasks" and freeing up employees to focus on vital tasks, such as communicating with customers. It's important to first improve processes before implementing automation.

"If we automate a bad process, you're just going to get the same bad results, just a lot quicker," Ryba said. "It doesn't really help you at all. You're still going to have to fix those issues."

John Funcheon, president of Kokusai Inc., compared agile manufacturing with lean manufacturing.

"I see a lot of similarities between the two," he said. "Lean and agile are both ultimately focused on one thing: increasing business sustainability in high-cost manufacturing."

He combines the best aspects of lean and agile manufacturing to produce what he calls "inline manufacturing," which features an assembly line with work cells. The benefits include shorter lead times, lower costs and better quality.

Natalie Heustis, manager of employee initiatives at Skillful Indiana, described the benefits of skills-based hiring and how it can help employers expand their pool of available talent.

Among the recommendations is to define competencies clearly and remove credentials from job postings whenever possible.

"I want to emphasize this is not devaluing education," Heustis said. "It's clarifying what skills an individual is taking away from those learnings."

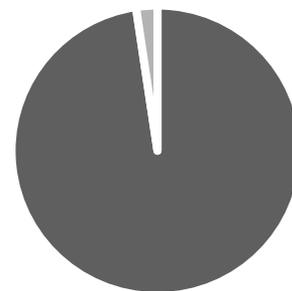


IT'S BEEN A STRONG YEAR

We look forward to further growth in the year ahead.

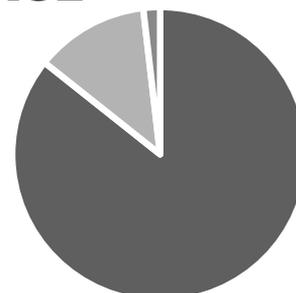
Our future goal is to enhance our global reputation for thought leadership in competitive manufacturing. We see a bright future leveraging emerging technology (3D printing, video analytics, IOT, sharing economy) for business success. Accomplishing this goal will require leveraging Krannert's faculty expertise and its students to engage with resources across Purdue, alumni and companies.

REVENUE



■ grants ■ gifts

EXPENSE



■ projects ■ operations ■ engagement center

DCMME

Annual Report 2020