

DCMME



DCMME's

new study

abroad program

Krannert's Manufacturing Center

Bridging Industry, Students, & Faculty

Dear DCMME Friends,

You have in your hands the DCMME Annual Report for 2021-22, an academic year of many firsts which we were able to bring out the best in our students, faculty, staff, partner companies and alumni. Clearly, we could not have done it without your assistance, so thank you from all of us at DCMME.

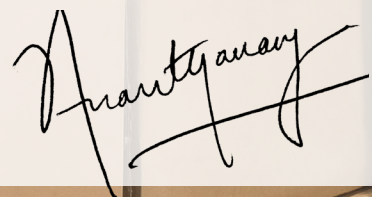
Our center projects included working with INDOT to optimize fleets of heavy trucks, snow routes, and facility locations, analyzing economic effect of active transportation in the healthcare industry, projects identifying digital transformation trends, and working with the Department of Defense to develop simulation models to investigate the benefits of additive manufacturing and how it can be best used. Each of these projects enabled our students to be funded, gain valuable experience solving real problems, learn new skills and provide content that we shared with all of our partners. Our goal is to nurture this ecosystem of learning. We continue to work with local companies on developing the advanced manufacturing ecosystem, funded by the Purdue WHIN grant from the Lilly Endowment. Thank you to all of our industry partners and students for enabling this excellence.

Our Fall 2021 conference was titled "Manufacturing Opportunities with the Global Electric Vehicle Transformation", and was held back on campus at the Purdue Memorial Union. Our speakers covered topics related to the expansion of electric vehicles manufactured by General Motors, the

benefits that electric vehicles will bring as well as the potential challenges and downsides, and the change from ICE to EV.

Spring 2022 brought a first of many years to come with our Business in Peru Study Abroad program kicking off. This course is a two-credit management level class hosted by GSCMI and Tlogistica of Lima, Peru. Students had the opportunity to work on real-life international business problems and provide solutions to companies in Peru to implement. The subjects included supply chain, manufacturing, and operations to name a few. In addition to a rich learning experience the students were exposed to cultural activities as well as a weekend trip to Machu Picchu. We are anxious to continue this program and relationships with Tlogistica and other Lima, Peru companies and universities. I hope this DCMME Annual Report conveys our continued enthusiasm for manufacturing, and how our partner companies alongside our students, faculty and staff create opportunities for our students to learn through experiential projects, and learn through listening and interacting during conferences. We look forward to a continued journey with you to celebrate manufacturing opportunities. Please contact us if we can be of assistance to your companies. So, thank you for being a collaborator and we look forward to continued collaboration.

Best regards,



EXPLORING BUSINESS IN PERU

"...An incredible opportunity to travel to a new place, learn about a new culture, and work with local people to understand how the economy will transform technologically over the next generation." --Luke Mercer

The first of many...

The Business in Peru program kicked off this year following a year delay due to Covid. This course is a two credit management level class hosted by the GSCMI Center and Tlogistica of Lima, Peru. The program targets Krannert and IE graduate and undergraduate students to provide them with the occasion to work on real-life international business problems and provide solutions to companies in Peru. Projects are implemented by the industries involved and are related to the subjects of supply chain, manufacturing and operations to name a few. In addition to a rich learning opportunity, students are exposed to cultural activities as well including a weekend trip to Machu Picchu. This program is designed to further enhance student classroom learning. GSCMI is partnering on the trip with Eduardo Huerta-Mercado, a '00 grad of the Krannert MBA program, current director of Softeon LATAM, and director of INvent Technologies.

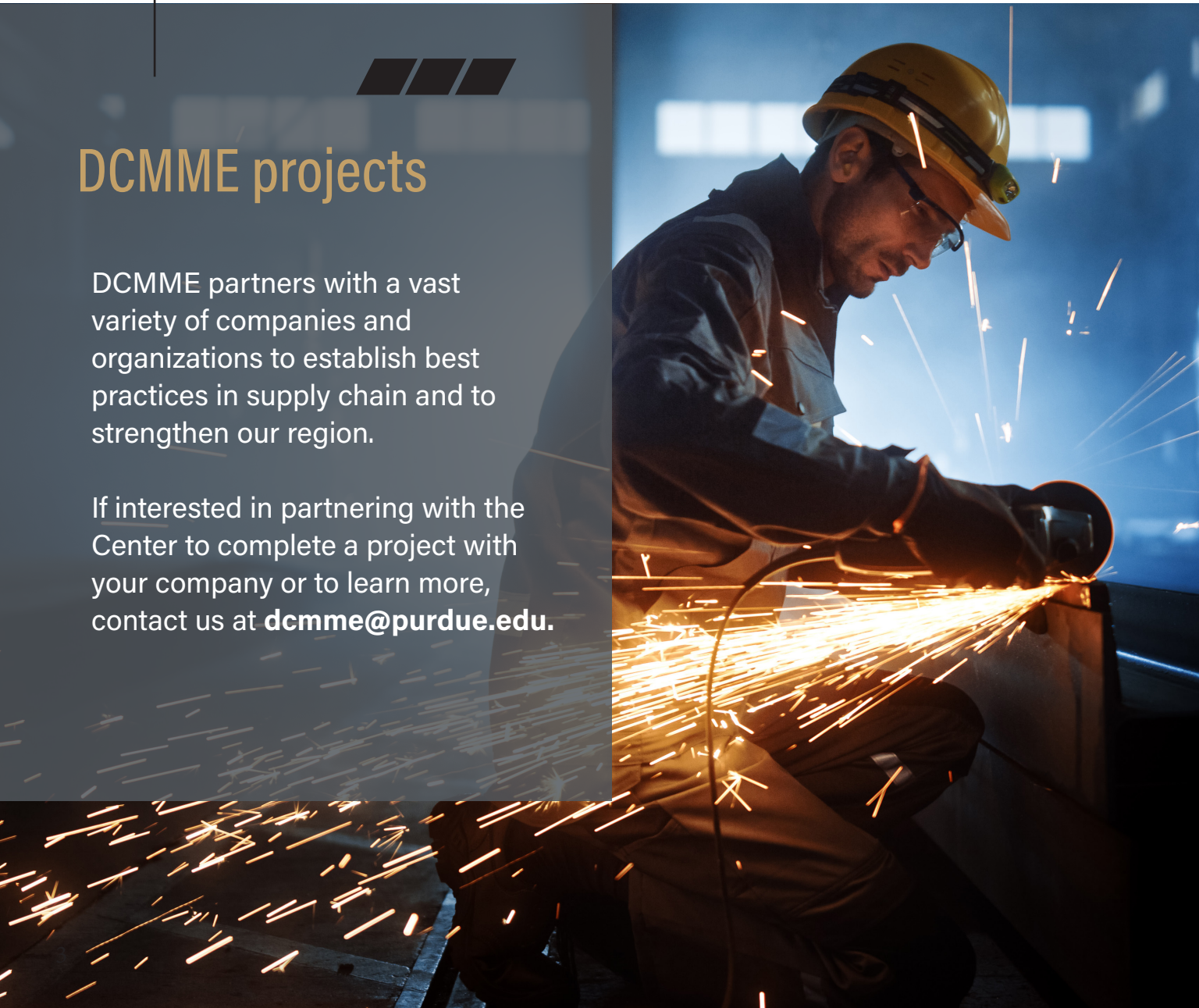




DCMME projects

DCMME partners with a vast variety of companies and organizations to establish best practices in supply chain and to strengthen our region.

If interested in partnering with the Center to complete a project with your company or to learn more, contact us at dcmme@purdue.edu.



Heavy Fleet & Facilities Optimization

The goal of the project was to optimize INDOT's fleet of heavy trucks, snow routes, and facility locations. The team worked to review INDOT's current practices and benchmarked towards practices followed by other state DOTs. The team used a data driven approach to analyze INDOT's fleet of 1100 heavy trucks and various costs related to the trucks using Minitab, Tableau and Excel. Based on this data, the team developed an optimized truck replacement strategy for trucks operating in northern, central, and southern regions of the state. The team analyzed the current snow routes for each of 101 facility locations across 6 districts in Indiana and developed a spreadsheet-based mathematical optimization model to obtain the optimal facility location and optimal snow routes such that the deadhead miles driven are minimal.

The team submitted a draft final report with snow route analysis for 1 facility location for review to the INDOT. After approval the team continued to model the remaining units and submitted it as part of

the final report. The team prepared the snow route optimization with 4 different approaches comprising of combinations of optimal routes and facility locations. The team further developed a dashboard to show the optimal results along with minimized deadhead miles associated with each facility location's snow routes.

Overweight Divisible Loads: Permit Administration and Impact on Indiana's Road Infrastructure & Safety

The project involved analyzing the state's current permit system for overweight freight and its impact on Indiana's road infrastructure and safety. The goal of the project is to understand the current permit fee



DCMME Projects

structure that the state has in place and to review necessary changes to it by providing incentives for the major truck hauling companies. The project occurred in collaboration with the Civil Engineering department over the period of twenty-four months. The team worked to understand Indiana's current permit fee structure that is implemented by INDOT. The team analyzed the historical data for 2017-2019 that consisted of the company details, routes taken by the trucks, permit fee paid, axles on the truck, etc. The team also reviewed the current literature and research conducted before that helped the team understand the factors that impact the weight distribution of goods on a truck and how the truck can impact the road infrastructure. The team used AWS-housed MySQL and Python to clean the data and perform preliminary analysis. The team then performed detailed analysis that helped develop a permit fee calculator dashboard based on Power BI.

Economic Effect of Active Transportation Features and Association of Healthcare Industry & Transportation

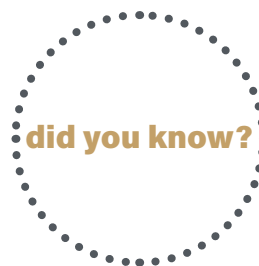
The project involved analyzing the economic effect of active transportation on industries across the state and the impact of transportation on the healthcare industry. The project entailed analyzing the relationship between access to active transportation (walking, bicycling, hiking, etc.) and the region's economic viability in addition to how the overall transportation features impact the healthcare industry. The goal of the project is understanding what initiatives, with respect to active transportation, can INDOT take to make Indiana attractive to advanced industries as well as observing how

the overall transportation impacts the healthcare industry. The project is in collaboration with the Civil Engineering department over the period of twenty-four months.

The team worked on reviewing the literature related to the goals of the projects. The team also performed a benchmarking study to review the actions taken by other state DOTs and agencies in relation to active transportation initiatives and healthcare industry's relation to overall transportation. The team worked

to identify the active transportation related factors that impact the state's attractiveness to industries. This data will be used to prepare a model that helps changing the active transportation related factors to attract more industries to Indiana. The team also identified the current healthcare practices in Indiana and how the industry would change in the future. Using these trends the team will prepare an analysis of transportation factors impacting the healthcare industry.

DCMME assists companies in developing best practices for their businesses. If you are interested in partnering with us on a project, email dcmme@purdue.edu



Connexus

This project aimed to study the impact of the MRG program on the manufacturing ecosystem in Indiana and to uncover relevant trends among the hundreds of applications. The research was intended to identify digital transformation trends, company demographics, investment and use case trends, and other program data that may become apparent during analysis to assess the state-wide dynamics of transformation and program impact.

The deliverables culminated in an analysis on the Manufacturing Readiness Grants program across Indiana, as well as an ‘analysis tool’ and strategies and/or recommendations that can enhance the program as it relates to Indiana’s manufacturing ecosystem. The team worked to analyze and improve the quality of the data from approximately 150 applications that answered more than 30 questions. The team used the data to prepare insightful analysis in the form of visualizations using Power BI dashboards. The visualizations provide key metrics about funding, employment, growth, investment, etc. and categorizations about industry

sectors, technology, and workforce regions. The dashboard provides key takeaways about the applications submitted by companies interested in deploying Smart Manufacturing technology and technology enabled equipment.

Additive Manufacturing and Digital Engineering Strategy Development

The project in collaboration with the Department of Defense (DOD), is divided into several tasks, where Purdue University is responsible for Task 4. The goals of this task are to develop an additive manufacturing (AM) supply chain and sustainment strategy as well as a digital engineering strategy. The Krannert team is tasked with developing a simulation model to investigate the benefits of AM and how it can be best used by DOD. *(Continued on pg. 10).*



WHIN Education

WHIN Education is a long-term (5 years) project under the WHIN grant funded by the Lilly Endowment. The center in association with WHIN has worked to create an education portal with the aim of elevating the productivity of the regional workforce by helping employees learn about the innovative techniques and development in the manufacturing related fields. The team has worked to add individual courses offered by various partners and web sources and workshops to the education portal. The data on the tool is connected to a MySQL database that is hosted on an AWS server.

This was the last year of the grant; the grant concludes in Sept 2022. The education website has been revamped to make it more appealing and make it more user-friendly. The team has continued to add new courses to the portal in collaboration with other partners. The team has added new events that were conducted throughout the year including conferences, workshops, user group meetings. A new section dedicated to Power BI resources was added as the tool has seen increased popularity with partner companies. A series of courses was added as a program that provide detailed information about the topic for the users to enroll in. The center will continue to maintain and support the education website beyond the end of the grant.

Bridging Industry, Students, & Faculty

DCMME Projects



Continued (p. 7)

The team used JaamSim to develop a simulation model which exhibits the working of tasks. The objective of the simulation was to identify when the parts of an aircraft/machine need to be repaired or sent for maintenance and whether additive manufacturing or traditional manufacturing (TM) should be used. The simulation helps obtain results that can be displayed on a dashboard. The dashboard allows the user to keep track of costs associated with the decisions made by the inputs in the simulation model

MANUFACTURING OPPORTUNITIES WITH THE GLOBAL ELECTRIC VEHICLE TRANSFORMATION

DCMME Conference Highlights Impact of Electric Vehicles on Manufacturing

General Motors announced plans recently to introduce a \$30,000 electric SUV, part of its bid to overtake Tesla as the leading manufacturer of electric vehicles in the United States. Ford Motor Company, meanwhile, announced that it is partnering with a South Korean supplier to build three battery factories and an electric truck plant in the U.S. at a cost of \$11.4 billion. While electric vehicles account for more than 25 percent of auto sales in several European countries, they've captured only a sliver of the U.S. market so far. But the shift from internal combustion (IC) engine vehicles to EVs seems inevitable, partly because of government regulations to reduce greenhouse gas emissions.

"We are in a transition to electrical vehicles. It's real and it's coming faster than most Americans know," said Rick Dauch, president and CEO of Workhorse Group, a Cincinnati-based company focused on manufacturing drone-integrated electric vehicles for the last-mile delivery sector.

Dauch was speaking at the fall conference of Purdue University's Dauch Center for the Management of Manufacturing Enterprises (DCMME), held on Oct. 8 in the South Ballroom of Purdue Memorial Union. About 150 people, including students, faculty, staff and industry representatives, attended the conference both in-person and virtually.

Dauch and other speakers made presentations on the theme of "Manufacturing Opportunities with the Global Electric Vehicle Transformation," sharing not just the benefits that electric vehicles might bring, but also the potential challenges and downsides.

Dauch provided an overview of the electric vehicle's impact on the auto industry and shared his experience driving a Tesla, noting that EVs—with no exhaust systems, fuel systems, and transmissions—need far fewer components than IC vehicles. That poses a challenge to the automobile industry's Tier 1 and Tier 2 suppliers, many located in the Midwest and focused on IC parts.

"It is both a risk and an opportunity," Dauch said. "If a supplier is asleep at the wheel

speakers

Robert Bierwagen
VP of Digital Strategies
MPI Corporation

Vani Dantam
Chief Project Consultant
Lucas TVS Industries

Richard F. (Rick) Dauch
President & CEO of Workhorse

Danny J Ernstes
CAP Coordinator Indiana
Retiree Representative Indiana
UAW Region 2B

Robin Fleming
Co-Founder & Chief Executive Officer
Anvl

Sydney Hollingshead, Ph.D.
Development Engineer
Cook Biotech, Inc.

Dr. Ananth Iyer
Director, DCMME & GSCMI | Susan
Bulkeley Butler Chair in Operations
Management

Jeremy Konkle
Chief Operating Officer
Tipmont REMC

Amanda Raver
Powertrain manufacturing engineer
Subaru of Indiana

Jonathan Schalliol
Director
Heritage Group Ventures

today, they may be out of business in five years, because half their business is going to disappear.”

Part of the challenge for manufacturers is figuring out when to make the shift, said Robert Bierwagen, vice president of digital strategies at MPI Corporation, whose holdings include a supplier of transmission parts.

“There’s no question that we’re going to see a transition,” Bierwagen said. “The thing that’s in question is how quickly it’s going to happen. And as a supplier, we have to invest in new tooling, new systems and new processes, and we have to pick the right time to do that.”

Because they use fewer parts, electric vehicles require less labor. That’s a concern for the United Auto Workers union, which released a report in 2019 suggesting that labor hours could drop 30 percent per vehicle.

Danny Ernstes, the Indiana CAP Coordinator for UAW Region 2B, said the UAW wants to ensure that government subsidies and tax breaks for the electric vehicle transition are contingent on high-quality jobs being created for American workers.

“This is a great opportunity to invest in U.S. manufacturing, produce the vehicles of the future and create high-quality jobs,” Ernstes said.

Some manufacturers may transition to supplying parts for EVs, but others may have to look beyond the automotive industry as part of an agile strategy to reduce their risk, said Ananth Iyer, director of DCMME and the Susan Bulkeley Butler Chair in Operations Management at the Krannert School of Management. He presented DCMME research that suggested several risk-reduction strategies for manufacturers.

“A whole bunch of companies might be retraining their people to start being involved in other parts,” Iyer said, “but some might be developing the management capabilities and developing the skillset to be able to consider the requirements of adjacent industries that could use the same part.”

Electric vehicles have fewer parts, but one

of those parts, the battery, is critical to their operation. Not only does an EV need a powerful battery, charging the battery can be burdensome for drivers, as well as a strain on electric supply systems.

Vani Dantam, who has 40 years of experience in the transportation and energy industries, shared his expertise on battery production, detailing the technical requirements of setting up a battery plant. Working for Lucas TVS Industries, he is currently the chief project consultant for a lithium-ion battery plant being built near Chennai, India.

While the EV transformation will create the need for more charging stations, many drivers will seek the convenience of plugging in their cars as soon as they return home from work. This could be taxing for electrical systems, said Jeremy Konkle, chief operating officer of the electric cooperative Tipmont REMC.

But the current infrastructure can serve customers' needs, he said, as long as they are flexible, perhaps by using technology that allows the charging to begin after 10 p.m., during off-peak hours.

"They could use that excess capacity that we have in the electrical system, from already-paid-for infrastructure, and accomplish what they need—a charged car when they go to work in the morning," he said.

Other speakers at the conference included Jonathan Schalliol, director of Heritage Group Ventures; Robin Fleming, CEO of Anvl; Sydney Hollingshead, development engineer for Cook Biotech; and Amanda Raver, powertrain manufacturing engineer at Subaru of Indiana.

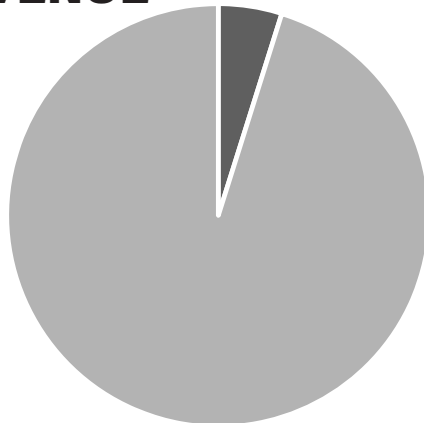


DCMME Year Review

We look forward to
even
further growth in the
year ahead.

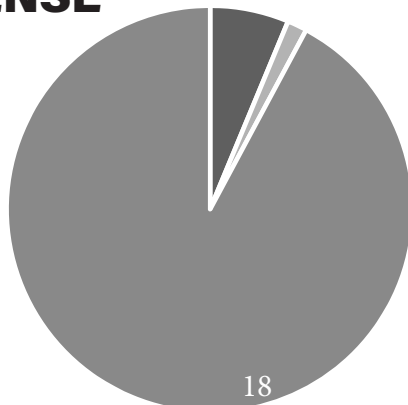


REVENUE



■ Gifts ■ Grants

EXPENSE



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■ Operations ■ Engagement Center ■ Project Work

Our future goal will continue to enhance our global reputation for thought leadership in supply chain. We see a bright future leveraging emerging technology 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.

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