

2018

SPOTLIGHT!



**TAUBER INSTITUTE
FOR GLOBAL OPERATIONS**
UNIVERSITY OF MICHIGAN



25 YEARS

In 1993, the Michigan Joint Manufacturing Initiative (now the Tauber Institute for Global Operations) was launched. In the 25 years since, the Tauber Institute has become a leader in operations excellence, continuing to combine business and engineering with leadership training, action-based learning, and industry partnerships. We celebrate our anniversary and look forward to many more years of theory, practice, and impact.

Front cover photo

On the covers: Architectural details of the Stephen M. Ross School of Business and the Robert H. Lurie Engineering Center. Located on U-M's Central Campus, the Ross School of Business facilities feature integrated technology, collaborative spaces, and environmentally conscious features. The Lurie Engineering Center is home to the College's administrative offices. The sleek, contemporary building serves as an anchor for state-of-the-art North Campus Engineering facilities that include a 3D lab, clean rooms, and the autonomous-vehicle Mcity test facility.

Photos: Michigan Photography

This marks the 25th anniversary of the Tauber Institute for Global Operations. We are pleased to share with you In academic year 2017-2018, 72 students participated in 30 team projects, featuring 20 sponsoring companies from a wide range of industries, including aerospace, Internet commerce, high tech, healthcare, automotive, energy and retail. Tauber was pleased to strengthen relationships with 15 continuing sponsors – Amazon, Boeing, BorgWarner, Cummins Inc., Dow, Ford Motor Company, Fresenius, General Mills, General Motors, Microsoft, PepsiCo, Pacific Gas & Electric, Stanley Black & Decker, Target, and Whirlpool – and excited to form partnerships this year with 5 new sponsors: IDEX, Mayo Clinic, Principal Financial, Spacelabs, and Stoneridge. Students also participated in facility tours as part of their comprehensive LeadershipAdvantageSM program. The results include 98% student placement overall, and 48 % of students placing in a Team Project sponsor and/or corporate sponsor company.

This book documents student teams' regional and global impact with executive summaries describing the challenge, method, and results from each sponsored project. The depth and breadth of our students' projects reflect the demands faced by operations in an ever-changing world. We hope these executive summaries will provide insight into the University of Michigan's strong global reputation and partnerships with leading companies, who know that our students can be called upon to solve some of their most challenging problems.

Damian Beil

Damian Beil
Ford Motor Company
Co-Director and Professor
of Technology and Operations
Ross School of Business

Larry Seiford

Larry Seiford
Goff Smith Co-Director
and Professor of Industrial
& Operations Engineering
College of Engineering

Ray Muscat

Ray Muscat
Industry Director
Tauber Institute for
Global Operations





September 14, 2018



Welcome to the University of Michigan for the 25th anniversary of the Tauber Institute for Global Operations.

The Tauber Institute is a spectacular example of why our university is a world leader in innovation and impact. Thanks to the generosity and vision of our friend and dedicated alumnus Joel D. Tauber, the Institute brings together our College of Engineering and Ross School of Business students in a partnership that is making an incredible difference in our world.

As a public university, we are proud to devote our strengths in research and education in service of society. By bringing together our talented students from different disciplines, the Tauber Institute unleashes their ingenuity and intellectual power to tackle large-scale operational challenges, further demonstrating that the best solutions to big problems are never produced in isolation.

The results are astounding. In the last year alone, Tauber Team Projects identified more than half a billion dollars in potential savings, according to sponsoring company calculations. I commend our partners’ willingness to engage in important collaborations that make lives better, including improving disaster response, creating more fulfilling workplaces, and reducing greenhouse gas emissions.

Thanks to the Tauber Institute’s outstanding work over the last quarter century, University of Michigan students are better prepared for dynamic and unpredictable dilemmas on a global stage. I am honored to offer my congratulations to the Institute’s alumni, students, faculty, staff and sponsors on your legacy of accomplishment. To Joel Tauber, our friends, industry partners and supporters, I offer my deepest appreciation, and I am looking forward to your successes in the years to come.

Sincerely,

Mark S. Schlissel
University of Michigan
President



STATE OF MICHIGAN
EXECUTIVE OFFICE
LANSING

RICK SNYDER
GOVERNOR

BRIAN CALLEY
LT. GOVERNOR

August 17, 2018

Dear Friends:


Welcome to Michigan! I am pleased to extend my congratulations to the Tauber Institute for Global Operations at the University of Michigan as it celebrates a landmark 25th anniversary this year.

For more than two decades, benefactor Joel D. Tauber has maintained an unwavering commitment to the advancement of cross-disciplinary education in global operations management. Through his sustained and thoughtful support, he has guided the Institute, a unique joint venture between the U-M School of Engineering and the Ross School of Business, to the position of a global leader in operations.

We are especially proud to welcome leadership from 30 of the Institute’s industry partners to the annual Spotlight! Team Project Showcase and Scholarship Competition, held in Ann Arbor, Michigan. This two-day event is an extraordinary opportunity for Tauber scholars to showcase their achievements during team internships in the U.S. and across the world as they compete for academic scholarships.

As you gather for this celebration, please accept my best wishes for an enjoyable event and continued success in the future.

Sincerely,


Rick Snyder
Governor

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Office of Mayor
Christopher M. Taylor

August 29, 2018

Dear Guests,

Welcome to Ann Arbor!

It is my honor to congratulate the Tauber Institute for Global Operations at the University of Michigan on its 25th anniversary.

For a quarter of a century, Joel D. Tauber, U-M alumnus and the Institute's benefactor, has demonstrated steadfast devotion to building and shaping this effort, a joint venture between the U-M College of Engineering and the Ross School of Business. Mr. Tauber's contributions are truly extraordinary.

Today, through its business and engineering collaborations, global industry partnerships, faculty research, and action-based education, the Institute is a leader in operations management worldwide.

Many thanks to the Institute for the remarkable contributions it has made to the greater Ann Arbor area, especially through its Community Service Day, now in its seventh year. Through this event, the Institute continues to share its invaluable expertise with our community partners and organizations.

Congratulations also to the Institute's faculty, staff, sponsors, and alumni on its continued pledge to developing the next generation of leaders in operations management.

Sincerely,

Christopher Taylor
Mayor, City of Ann Arbor

MICHIGAN ECONOMIC
DEVELOPMENT CORPORATION

August 29, 2018

Tauber Institute for Global Operations
University of Michigan
700 East University
Ann Arbor, MI 48109

Dear Guests:

I am pleased to extend warm greetings to all those industry partners participating in the 25th anniversary of the Spotlight! Team Project Showcase and Scholarship Competition through the Tauber Institute for Global Operations.

Joel D. Tauber, the Institute's benefactor, has made enormous contributions to the advancement of cross-disciplinary education in global operations. His vision and his commitment to innovation have helped the Institute – a joint venture between the Stephen M. Ross School of Business and the College of Engineering – become a world leader in operations management.

On behalf of the state of Michigan, congratulations to the Tauber Institute on this tremendous milestone. Please accept my best wishes for a memorable time of celebration and fellowship as well as continued growth and achievement for the Institute.

Sincerely,

Jeff Mason
Chief Executive Officer

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ABOUT TAUBER INSTITUTE

INDUSTRY IDENTIFIED A NEED. THE UNIVERSITY OF MICHIGAN RESPONDED.

It all began when a gathering of business advisors identified a key category of employees missing from their organizations: trained professionals who understand both the business and engineering aspects of manufacturing.

As a result of that discussion, the University of Michigan's Ross School of Business and College of Engineering formed a new cross-unit collaboration. Named for benefactor and U-M alumnus Joel Tauber, the Tauber Institute was born — and immediately began to innovate.

Faculty in the two schools created new courses to deliver an integrated education addressing the challenges of modern manufacturing, with an emphasis on leadership skills.

The Tauber Institute sought every opportunity to immerse students in real-world experiences — leading to the development of Tauber team projects and the annual *Spotlight!* event, where students compete for academic scholarships through their presentations about work at top companies across the U.S. and around the world.

The Tauber Institute has enjoyed many accolades — most recently receiving the UPS George D. Smith Prize for effective education in the fields of operations research, management science, and analytics. But a truer measure of Tauber's success is that 98 percent of graduates quickly secure employment, making an immediate impact in their respective companies, and rising to positions of authority.

TAUBER TEAM PROJECTS: ON DISPLAY AT *SPOTLIGHT!*

Over the summer, teams of Tauber Institute students tackle a wide range of operations challenges faced by our industry partners. At the annual September *Spotlight!* event, student teams present their solutions in a competitive setting to win academic scholarships.

Spotlight! is an ideal opportunity for corporate representatives to meet Tauber students, develop relationships, and explore how a future Tauber team project could improve operations at their organization. According to sponsoring company calculations, last year's Tauber team projects resulted in \$18.5 million/per project savings over 3 years, per company calculations. **The total savings projected was \$575 million.**

PLACEMENT RATE FOR GRADUATES IS **over 98%** ANNUALLY.

TWENTY-FIVE YEARS OF TAKING RISKS AND EXPLORING THE OUTER EDGES



U-M TAUBER INSTITUTE FOR GLOBAL OPERATIONS' 25TH ANNIVERSARY IS MARKED BY \$1.75M GIFT FROM PHILANTHROPIST AND BENEFACTOR JOEL TAUBER IN SUPPORT OF THE INSTITUTE'S SCHOLARSHIP PROGRAM

In 1959, Detroit native and U-M alumnus Joel D. Tauber (BA '56, MBA '62, JD '59), was fresh out of law school and just months into his first job at the law firm of Honigman Miller Schwartz and Cohn, in Detroit, when a considerable opportunity presented itself. "My father-in-law, Barney Keywell, had invited me to run his newly acquired manufacturing business, Towne Robinson Fastener, in Dearborn," said Tauber. "He had an eighth-grade education and had been in the scrap business, and he thought, with all my degrees, I really knew something. So he asked me if I wanted to run the business. And, of course, I said 'yes.'"

At the time, Tauber was the fifth lawyer at the newly established Honigman firm. "I lasted there just about three months," he explained. "And that's how I began my career in manufacturing. But I quickly learned that I knew very little about the manufacturing business, and that my education had not helped me to understand

the whole of an organization. So, I developed my own training program, working in every department in the manufacturing business — from shipping to midnights to production control — to try to learn the business." At the time, Tauber had no inkling that he would one day become the benefactor of the Tauber Institute for Global Operations at the University of Michigan, impacting manufacturing operations worldwide. Tauber went on to serve as president and chief executive officer of Towne Robinson Fastener, which later merged with other family businesses to form Key International, Inc., where he was employed for more than 40 years.

THIS GIFT REFLECTS BOTH MY HIGH REGARD FOR THE U-M, AND THE GREAT SUCCESS OF THE PROGRAM.

In the late 1980s, Tauber became a member of the Visiting Committee for the University of Michigan Business School (now Michigan Ross), under then-dean B. Joseph White. "In one of my first meetings, the dean was talking about trying to elevate the business school from 15th in the country to a position in the top five," said Tauber. "He felt that he could do that by concentrating on

a particular skill of the University of Michigan. Harvard had its own expertise. Wharton had its own expertise. At the time, everything was done in silos, and there wasn't any cross-fertilization between the various departments of the university. Each had its own program. So, the question became, what can we do at Michigan?"

Poised to answer this query, Tauber raised his hand and offered what would prove to be invaluable advice for the dean and the committee members. "First, if you really want to make a difference, make it in the area of manufacturing. We are in the heart of manufacturing [in the Midwest]. And there is no other business school that specializes in that," Tauber explained. "Second, you have to change your methodology of education. At the

time, every major corporation in the United States had a 3-month or 6-month program to train people graduating from business schools on how to enter their industry. That didn't make any sense to me."



THE INITIATIVE FOCUSED ON THE LACK OF SOLIDLY TRAINED PROFESSIONALS WITH EXPERTISE IN BOTH THE ENGINEERING AND BUSINESS COMPONENTS OF MANUFACTURING.

THE MICHIGAN JOINT MANUFACTURING INITIATIVE

In the years that followed, and unbeknownst to Tauber, Michigan Ross had begun thinking about his suggestions, and had started moving forward in a small way, with the 1993 creation of the Michigan Joint Manufacturing Initiative (MJMI), an interdisciplinary program administered by U-M's College of Engineering and Michigan Ross. "The initiative focused on the lack of solidly trained professionals with expertise in both the engineering and business components of

manufacturing," he said. "It was action-based learning, where the MJMI went out to companies and listened to their needs. After a couple of years there was some success, but it was only a trial program."

That same year, Dean White requested a meeting with Tauber, first reporting that the MJMI was doing very well, and second, asking if he was willing to finance the initiative, since it had been Tauber's brainchild. "I asked how much money they needed, but learned that the dollar amount was clearly beyond anything that I could afford," explained Tauber. "So I declined. The MJMI continued on, with various elements that were very attractive."

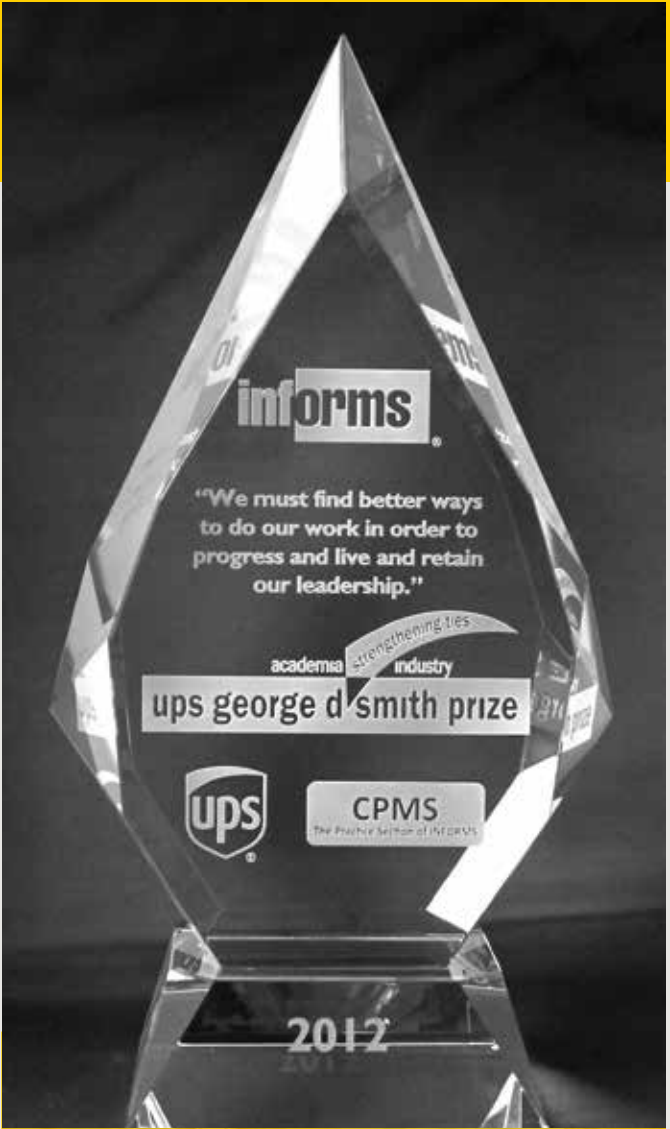
THE JOEL D. TAUBER MANUFACTURING INSTITUTE

In 1995, building on his strong belief in the MJMI model, Tauber made a \$5 million pledge to endow the program, and to ensure that the efforts of the MJMI were sustainable. "I had some good fortune in business and I was ready," said Tauber. With that gift, Michigan Ross and the College

of Engineering formed a new cross-unit collaboration called the Joel D. Tauber Manufacturing Institute (TMI), named for its benefactor. Faculty in the two schools created a new curriculum to deliver a cross-disciplinary education that focused on the challenges of global operations management, with an emphasis on leadership skills.

THE TAUBER INSTITUTE FOR GLOBAL OPERATIONS

In 2006, Tauber decided it was time to transition the TMI to a more global profile. One year later, the TMI was renamed the Tauber Institute for Global Operations at the University of Michigan. "Our mission is to lead the field of operations through our business and engineering collaboration, global industry partnerships,



AWARDS AND ACCOLADES

The recipient of numerous accolades, the Tauber Institute for Global Operations was awarded the first UPS George D. Smith Prize, in 2012, for effective and innovative preparation of students to be good practitioners of operations research, management science, or analytics.

faculty research, and pioneering action-based education to create the next generation of operations leaders," he explained. "I must tell you that, in my earlier vision when the Tauber Manufacturing Institute was formed in 1993, I was not thinking about a global institute. It was just, well, let's do a better job of manufacturing."

In support of its commitment to placing students in real-world positions, the Institute created the signature Tauber Team Project, which provides students with a highly visible, operations-related, paid internship to apply their skills. "We pair exceptional students with top companies in aerospace, internet commerce, high-tech, health care, automotive, energy, and retail, for a 14-week multidisciplinary, collaborative project," Tauber said. Each two- or three- person team of graduate students (business and engineering) work together to find solutions for substantive issues in lean process design and implementation, business unit manufacturing plans, manufacturing site strategic assessment, and supply chain implementation plan, among others. Moreover, the team provides a significant return on the sponsor's investment—typically resulting in millions of dollars in savings for companies.



Added to the Team Project is the LeadershipAdvantageSM Program, which brings a selected tailored and comprehensive set of modules and workshops to the classroom. Students learn to apply their skills to the team project, and later, to their career. "Our leadership training program has been very effective," he explained.

“What I’m getting at here is that we are working to develop the whole person, not just an engineer or a business professional.”

THE ANNUAL SEPTEMBER SPOTLIGHT! EVENT

The cornerstone of the Institute’s programming is the annual September Spotlight! Team Project Showcase and Scholarship Competition, where students compete for academic scholarships through presentations showcasing the results of their work during team internships at top companies across the U.S. and around the world. “What’s really fascinating about this year is that Amazon has given us seven projects. One of the top companies in the world, we are happy that they see such an advantage in using our teams,” said Tauber. “Spotlight! is a fantastic event, and it is a great thrill to see what these young people are able to do.”

THE TAUBER INSTITUTE FOR GLOBAL OPERATIONS CELEBRATES 25TH ANNIVERSARY

This year, celebrating its 25th anniversary, the Institute welcomes more than 30 industry partners in a wide range of industries. It’s advisory board, with principals from Amazon, The Boeing Company, Mayo Clinic, BorgWarner, Cardinal Health, Whirlpool, Microsoft, Ford Motor Company, General Motors, and Dell, assist the program in achieving its academic and research goals. “The advisory board is critical to the success of the program because it’s the group that keeps us at the forefront of what’s needed,” Tauber explained. “It’s just been a wonderful group to work with.”

JOEL D. TAUBER PRESENTS \$1.75M GIFT TO EXPAND INSTITUTE’S SCHOLARSHIP PROGRAM

Earlier this year, Tauber presented the Institute with a generous gift in the amount of \$1.75 million. “It came time for me to make another commitment. The one thing lacking in our program is scholarships. I wanted to build up our scholarships so that anyone needing money would have the opportunity to join the program,” he said. “This gift reflects both my high regard for

COST-SAVINGS FOR CORPORATE SPONSORS
AVERAGE **\$10-15M**
PER TEAM PROJECT.

the University of Michigan, and the great success of the program. Philanthropic giving is important on many levels. First, the dollars are extremely important. The state keeps giving less, and the cost of programs keeps going up. Second, without philanthropy, I don’t think we’d be among the top public universities in the nation.”

LOOKING FORWARD– THE TAUBER LEGACY

These days, Tauber often pauses to ask himself whether the Institute, and its mission, will be relevant in five to 10 years. His answer is a resounding ‘yes.’ “This particular kind of training is unique,” said Tauber. “Fifty years from now, we’re not going to recognize what is happening in terms of digital technology, robotics, data analytics, and even innovations such as the autonomous vehicle. People who can think through how that is being done, in advance, will be the winners. Our scholars are extremely well prepared to face the issues of today. But more importantly, we encourage them to think about the issues of tomorrow. And that may involve some disruptive thinking and disruptive approaches, because if you’re going to change what you’re doing, you have to take risks and go to the outer edges of what’s happening to explore and advance.”

As Tauber reflects on his remarkable and longstanding career, he also looks to the legacy he hopes to leave behind. “My son-in-law, who runs a very large equity firm in New York, will soon be joining the board. Also, I’m hoping, beyond this, that my son, who is in manufacturing, will join us as well. That’s kind of my insurance policy,” Tauber added.

Today, Joel Tauber serves as chairman of the board of Carolina Precision Plastics, LLC, and C-Enterprises. He resides in West Bloomfield, Michigan, with his wife, Shelley.



25 YEARS
OF
OPERATIONS
EXCELLENCE



INTERNATIONAL TAUBER TREK

Tauber students spent their spring break examining operations in Germany on the inaugural International Tauber Trek. Their trip included facility tours of Amazon, BMW, Coca-Cola, DeutscheBahn, Fresenius, Lemke Brewery, Viessmann, and Volkswagen – as well as opportunities to learn about German history and experience German cuisine and culture.

COMMUNITY SERVICE DAY

The Tauber Institute’s annual Community Service Day is a celebration of our longstanding commitment to organizations in the state of Michigan. Tauber Industry Advisory Board members, alumni, students, faculty, and staff make Michigan nonprofits and community-oriented companies top clients for the day by contributing their time and talent to help solve operations challenges.

In 2018, we made a positive impact on the Ann Arbor community by donating expert operations advice to Community Action Network, Food Gatherers, Ronald McDonald House Charities, and The Salvation Army Family Store.



TAUBER LEADERSHIP SPEAKER SERIES

The Tauber Leadership Speaker Series is a student-organized initiative. The series invites high-level executives to share insights with students about their careers, the qualities leaders need in today’s global economy for strong leadership, and the tangible steps students can take to achieve excellence in their own career paths.

The 2017–18 speaker series featured MG Industries CFO Mike Masha on “CFO to Entrepreneur...Lessons Learned,” GE Healthcare Services VP & GM Rob Reilly on “Inspiring Employees in Uncertain Times,” King Consulting President James B. King on “Managing Operational Excellence,” and Dawn Foods CEO Serhat Unsal on “Adapting Leadership Styles to Reflect Technological Advancements.”

2018 INTEGRATED PRODUCT DEVELOPMENT TRADE SHOW

For more than 20 years, the Integrated Product Development course at U-M has brought together students and faculty members from different disciplines to participate in an innovative product design competition.



This academic year, U-M offered the course in both the Fall and Winter semesters, allowing 15 teams of students from the Stamps School of Art & Design, College of Engineering, School of Information, and Ross School of Business to create brand-new products. Each team was required to have at least one member from each of the four schools in order to work through a variety of important elements of product development — including market research, concept generation and selection, technical development, production process design, pricing, inventory stocking, and advertising.

FOR MORE THAN **22** YEARS STUDENTS HAVE
COMPETED IN A COMPETITIVE PRODUCT DEVELOPMENT
ENVIRONMENT AND ECONOMIC COMPETITION

The 2017–18 new product challenges—“Efficient & Satisfying Use of Small Living Spaces” and “Technology to Maintain Senior Health”—each culminated in a trade show where student teams demonstrated their products to potential consumers in a competitive marketplace.

This multidisciplinary course is managed by the Tauber Institute for Global Operations, and is taught jointly by faculty members Eric Svaan of the Ross School of Business and Stephanie Tharp of the Stamps School of Art & Design. It has been featured on CNN and written up in the *New York Times*, *Wall Street Journal*, and *Businessweek*.

OVER **1,400**
TAUBER ALUMNI GLOBALLY

GLOBAL OPERATIONS CONFERENCE

The Tauber Institute’s 11th Annual Global Operations Conference brought together industry and academia to discuss “Operations in a Dynamic World.” Experts from leading industries shared insights on the topics of Sustainability, Forecasting, Industry 4.0, and Globalization. Featured speakers included Amazon Director of Operations Samuel K. Eldersveld, Dolly COO and Tauber Institute alumna Kristin Toth Smith, and Procter & Gamble Global Business Services Director of Business Intelligence & Analytics Services David Dittmann.

Faculty moderated robust panel discussions on Leveraging Forecasting for Improved Operations, Sustainability through Innovative Operations, True Globalization through Operations, and Incorporating Industry 4.0 into Operations, featuring leaders from AlixPartners, Amazon, Bain & Company, Bloom Energy, Boeing, Bosch USA, Dell, Dominos, Dow, Ford Motor Company, General Motors, Llamasoft, Microsoft, Nike, Polaris, Steelcase, and Whirlpool.



STUDENTS INITIATED THE
ANNUAL “GLOBAL OPERATIONS
CONFERENCE” IN **2007**



FACILITY TOURS

Facility tours expose students to operations and manufacturing processes practiced by organizations ranging from the Ann Arbor-based Zingerman’s Community of Businesses to Amazon, UPS, and Delta Airlines. Students complete a Rapid Plant Assessment which provides companies with same-day feedback on how even the best-run plant could improve.

2017-18: Arbor Brewing Company, Stryker Medical Equipment, Hermann Miller, Zingerman’s Mail Order, Germain Audi/VW/ Porsche, Meijer Distribution



TIME DEALER OF THE YEAR

A panel of Tauber Institute business and engineering faculty selected the 49th annual TIME Dealer of the Year Award finalists from each of the four NADA regions, as well as the national award winner. In appreciation of this service, TIME and Ally have established an annual scholarship at the Tauber Institute in the name of TIME, Ally, NADA, and the Dealer of the Year nominees.

Jack Salzman, owner of Lake Norman Chrysler-Dodge-Jeep_RAM in Cornelius, North Carolina is the 2018 TIME Dealer of the Year. The Tauber Institute faculty panel evaluated competitors on both the business practices in their dealerships and their contributions to the community. The award is considered the most prestigious honor a new car dealer can receive.



RATE LEAN: FAST

Rate Lean: Fast gives busy professionals the skills needed to accurately evaluate operations efficiency from observations made during a brief plant tour. It describes in detail how to plan a tour, rate an operation, and envision an ideal lean plant based on the concepts of the Toyota Production System.

Tauber Executive-in-Residence Emeritus R. Eugene Goodson first described his Rapid Plant Assessment process in 2002 for the Harvard Business Review. More than 1,000 plant tours and assessments later, Goodson applied the accumulated data to create Rate Lean: Fast, published by the Tauber Institute. The workbook combines clear, direct instruction with numerous photographs, illustrations, and examples drawn from Goodson’s extensive experience in industry, government, and academia.

Rate Lean: Fast is available for purchase through Amazon.com.

INDUSTRY ADVISORY BOARD

The Industry Advisory Board (IAB) ensures that the Tauber Institute stays at the forefront of multidisciplinary operations and responds quickly to industry needs. Offering guidance and support consistent with the program's mission and objectives, the IAB actively assists Tauber in achieving its academic and research goals through industry leadership, cooperation, feedback, and acquisition of financial support. The following industry leaders serve on the IAB:

3M Company, Laurie Altman, Vice President and Sales Operations

A.T. Kearney Inc., Doug Mehl, Partner

Amazon.com, Inc., open

American Industrial Partners, Danny Davis, Partner

American Securities, David Horing, Managing Director

Arconic, Randall Scheps, Vice President, General Manager, Wheel Products

The Boeing Company, Ed Petkus, VP - Engineering for Airplane Development

BorgWarner Inc., Scott Gallett, Vice President Marketing, Public Relations, Government Affairs, Internal Communications/IAB Vice President

Cardinal Health, Meredith Rarey, Vice President, Global Strategic Sourcing

Chagrin Consulting Associates, Roger Kallock, Chairman & CEO

Cisco Systems, Inc., open

ConAgra Foods, Craig Weiss, VP Supply Chain Planning, Programs & Logistics

Dell Technologies, Piyush Bhargav, Vice President, Global Operations

DTE Energy Company, Sharon Pfeuffer, Director of Electric Strategies and Development

The Dow Chemical Company, Jeff Tazelaar, Digital Fulfilment Center Director

Ford Motor Company, Jim VanSlambrouck, Director - Americas Quality

General Motors Company, Daniel Grieshaber, Director, Global Manufacturing Engineering Integration

HERE Technologies, Kevin Harrington, Vice President, Global Customer Operations

Infosys Limited, Nitesh Bansal, Senior Vice President, Industry Head Manufacturing

Mayo Clinic, Joseph Dudas, Vice Chair, Supply Chain Management

McKinsey & Company, Russell Hensley, Director

Microsoft, Andy Miller, Finance Director

National Center for Manufacturing Sciences, Rick Jarman, President & CEO

Pacific Gas & Electric, open

Pfizer Inc., Paul Stuart, Vice President, Clinical Supply Chain

Precision Castparts, Jay Khetani, Vice President Commercial and Strategic Development

Steelcase, Tom Dawson, Chief of Staff for Global Operations

Tauber Enterprises, Joel Tauber, President




Tesla, Inc., Sanjay Shah, Senior Vice President of Energy Operations

Whirlpool Corporation, Mae Zyjewski, Sr. Director, Global Advanced Manufacturing, GPO/IAB Vice President

THE

IAB

ACTIVELY ASSISTS TAUBER IN
ACHIEVING ITS ACADEMIC AND RESEARCH GOALS.

					
President OPEN	Scott Gallett Vice President [BorgWarner Inc.]	Mae Zyjewski Vice President [Whirlpool Corp]		Laurie Altman [3M Co.]	Doug Mehl [A.T. Kearney Inc.]
					
Danny Davis [American Industrial Partners]	David Horing [American Securities]	Randall Scheps [Arconic]	Ed Petkus [The Boeing Co.]	Meredith Rarey [Cardinal Health]	Roger Kallock [Chagrin Consulting Associates]
					
Craig Weiss [ConAgra Foods]	Piyush Bhargav [Dell Inc.]	Jeff Tazelaar [Dow Chemical Co.]	Sharon Pfeuffer [DTE Energy Co.]	James VanSlambrouck [Ford Motor Co.]	Daniel Grieshaber [General Motors Co.]
					
Kevin Harrington [HERE Technologies]	Nitesh Bansal [Infosys Limited]	Joseph Dudas [Mayo Clinic]	Russell Hensley [McKinsey & Co.]	Andy Miller [Microsoft]	Rick Jarman [National Center for Manufacturing Sciences]
					
Paul Stuart [Pfizer Inc.]	Jay Khetani [Precision Castparts]	Tom Dawson [Steelcase]	Joel D. Tauber [Tauber Enterprises]	Sanjay Shah [Tesla, Inc.]	

EDUCATION IN ACTION

Over the summer, 72 students participated in 30 team projects sponsored by 20 global firms. Team projects are highly visible operations-related challenges with both engineering and business components. Tauber's 2018 team project sponsors are leaders in a wide range of industries, including aerospace, internet commerce, high tech, healthcare, automotive, energy, and retail. Tauber is pleased to strengthen relationships with 15 continuing sponsors—Amazon, Boeing, BorgWarner, Cummins, Dow, Ford, Fresenius, General Mills, GM, Microsoft, Pepsico, Pacific Gas & Electric Company, Stanley Black & Decker, Target, and Whirlpool—and excited to form partnerships this year with five new sponsors: IDEX, Mayo Clinic, Principal Financial, Spacelabs, and Stoneridge.

Tauber students addressed substantive issues such as lean process design and implementation, business unit manufacturing plan, manufacturing site strategic assessment, supply chain implementation plan, strategic capacity analysis, material handing redesign, new product/process development strategy, product complexity analysis, managing transitions between products, manufacturing process design, and machine learning and advanced analytics.

A successful project results in a significant return on a sponsoring company's investment. In 2018, the student teams worked on 30 projects, from 20 companies. The per project saving and revenue generation was more than \$28 million/per project over three years. The total 3-year cost savings and additional revenue projected was \$564 million.

**Only 19 projects out of 30 are present in the reported values*



Team Amazon.com, Inc. (Performance Measurement)



Team General Mills, Inc.



Team Boeing Company (787)



Team Microsoft Corporation (Partner)



Team Fresenius Medical Care



Team Target Corporation

CELEBRATING 25 YEARS OF OPERATIONS INNOVATION!

This year we celebrate the 25th anniversary of the Tauber Institute, originally known as the Michigan Joint Manufacturing Initiative. It all began with 13 students and six projects primarily focused on the business and engineering aspects of manufacturing. For our 2018 class of students, we can proudly say that we have 30 projects completed by 72 graduate students from the Ross School of Business and the College of Engineering, working together to solve complex operational challenges using the latest in engineering and business learning.



We are fortunate to have some of the world's most respected companies as project sponsors, spanning industries as diverse as financial services and retail sales, from consumer products to medical devices and from the automotive industry to the aerospace industry. These projects are providing our students with unique operational challenges testing both their technical skills as well as their business acumen.

Today, you will hear Tauber students describe the real-world operational challenges they faced and how they were able to overcome them. Each team will discuss not only their results, but also the journey they took to achieve unique solutions leveraging the support of their sponsors and guided by their advisors and coaches in Ann Arbor. These Tauber projects require the ability to work "hands on" from the shop floor, to operating effectively in highly computational financial environments, leading to an incredible summer of learning and growth at the leading edge of operations.

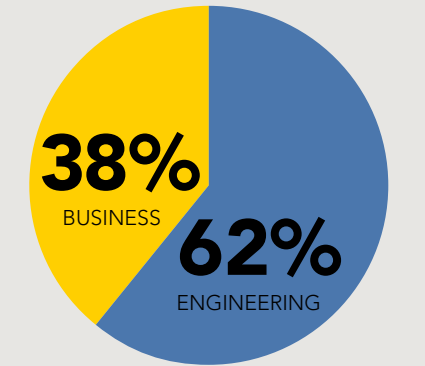
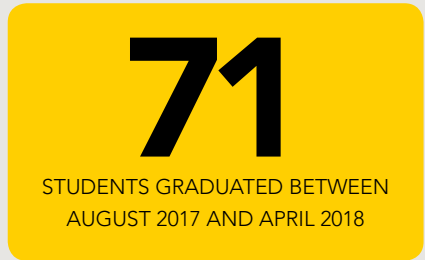
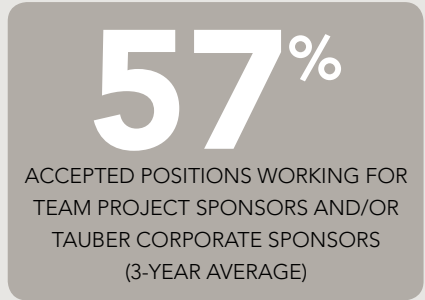
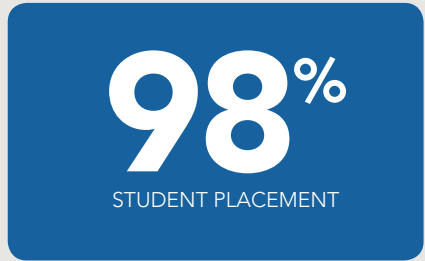
Worldwide, our 2018 projects took our students from Seattle to Milan, Italy, and from Midland, MI to Atlanta, GA. Tauber students have traveled the globe to experience team-based, cross-functional operations projects in real-world, global applications. Industry sponsors have provided strategic challenges that are vital to their long-term success, testing our students and achieving substantive long-term results.

Today we honor Joel Tauber's vision of a comprehensive, interdisciplinary, real-world approach to operations education. Whether it is optimizing an international supply chain, or reducing a company's carbon footprint...creating a lean manufacturing system, or a more effective way to manage financial portfolios...Tauber students are there, taking on the challenge and making a difference. These are our operations leaders of the future. Congratulations to our students, our sponsors, faculty, and staff! We are excited to see what the next 25 years has in store.

Ray Muscat
Industry Director
Tauber Institute for Global Operations

TAUBER INSTITUTE CLASS PROFILE 2018

Students in five different degree programs participate in the Tauber Institute. Through the Tauber Institute, all students complete a rigorous joint business and engineering curriculum and participate in a Tauber Team Project.



CULTIVATING THOUGHT LEADERSHIP

DEGREE PROGRAMS ASSOCIATED WITH TAUBER

Tauber Institute students are admitted through either the College of Engineering or the Stephen M. Ross School of Business. They bring with them significant experience in fields such as product engineering, manufacturing, and consulting. Most Tauber students also have undergraduate training in engineering or other technical fields. They have made a substantial commitment to careers in operations or manufacturing and pursue an education specifically designed to meet the needs of today's firms. All Tauber students are enrolled in one of the following degree programs:

ROSS SCHOOL OF BUSINESS

Master of Business Administration (MBA)

This two-year program prepares students to accept general management leadership positions. The Tauber program includes a sequence of operations management, supply chain, and manufacturing-related engineering courses.

COLLEGE OF ENGINEERING

Engineering Global Leadership Honors (EGL)

This five-year honors program prepares students to enter a variety of firms as engineers, while giving them the necessary management skills to quickly assume business leadership roles quickly. A highly valued element of this program is a cultural concentration in a global region of choice. The EGL program leads to both a BSE and a MSE.

Engineering Graduate Programs (EGP)

A graduate-level engineering degree program that, coupled with the Tauber requirements, provides intensive course work in operations and manufacturing technologies paired with business electives courses. EGP students are pursuing MEng, MSE, PhD, or Doctor of Engineering degrees.

RECRUITING STUDENTS

The *Spotlight!* Competition is one way to introduce yourself and your organization to our group of supremely qualified candidates. Some opportunities are listed below:

- Individual interview with the student(s) of your choice.
- Permission to post job openings on the Institute's website, accessible by current students as well as our growing group of 1,400+ alumni.
- A connection to the career centers at the Business School and College of Engineering and their employment events.
- Access to Tauber's Student Advisory Board, which can assist you in developing networking opportunities such as football tailgates, receptions, and speaking engagements.

THE **EGL** PROGRAM LEADS
TO BOTH A BSE AND A MSE DEGREE



THE TAUBER ADVANTAGE

Team projects are just one way that Tauber students distinguish themselves from other business and engineering graduates. Tauber programs and courses also enhance their employability:

- The **LeadershipAdvantageSM** program of learning modules and workshops emphasizes leading and influencing an organization through collaboration, creativity, communication, and analytics.
- The **Integrated Product Development course** challenges cross-disciplinary teams to jointly develop a new product.
- **Facility tours** deliver insight into operations and lean manufacturing. Students learn to perform a rapid audit of the state of an operation, judge the relative leanness of an operation, prioritize the targets of opportunity for improvements, and develop an action plan to facilitate improvements.
- The **Global Operations Conference** affords students the opportunity to join with leaders in industry and academia in strategizing ways to advance the practice of operations worldwide.

- The **Leadership Forum** allows Tauber students to learn about ethical leadership directly from current leaders in operations from top global firms.
- The **Tauber Leadership Speaker Series** invites high-level executives to share insights with students about their careers, the qualities needed in today's global economy for strong leadership, and tangible steps students can take to achieve excellence in their own career paths.
- Tauber students are encouraged to give back. Each year, on **Community Service Day**, they apply what they've learned to address operations challenges at southeast Michigan nonprofits.

Many Tauber students assume leadership roles in organizing the Global Operations Conference, Leadership Forum, and Tauber Leadership Speaker Series, gaining valuable experience in the complexities of event planning, and developing rapport with the seasoned executives they bring to campus. Student groups plan Tauber's Community Service Day and organize networking events, and Student Advisory Board members work closely with Tauber leadership to strive for continuous improvement in our own operations.



TAUBER STUDENTS

AMAZON - CONTAINER ROUTING



Mohit
Mengale
MENG-MFG

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Charles
Su
MBA

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AMAZON - PROCESS



Jenna
Locricchio
*EGL (BSE-IOE
& MSE-IOE)*

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Hao
Ran
MBA

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AMAZON - CUSTOMER RETURNS



Abhishek
Gowrishankar
MFG-MENG

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Andrea
Krushefski
MBA

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AMAZON - VNA



Ryan
Kim
MBA

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Kelsey
Wyatt-Mair
*MBA AND
MSE-IOE*

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AMAZON - KICKOUT REDUCTION



Noah
Feingold
*MBA & MS
ENVIRON*

Page 39



Zheng
Zhang
MBA

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AMAZON - YARD MANAGEMENT



Corinne
Beemer
*EGL (BSE-IOE
& MSE-IOE)*

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Muhammad
Umair
*EGL (BSE &
MSE-IOE)*

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AMAZON - PERFORMANCE MEASURE



Wendy
Lei
MBA

Page 42



Nikhil
Pawar
*MSE-IOE &
Graduate Data
Science Certificate*

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BOEING - 777X



Andrew
Davis
MBA

Page 54



Colin
McNally
MBA

Page 55



Cameron
Stitt
*EGL (BSE-CHE &
MSE-CHE)*

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TAUBER STUDENTS

BOEING - 787



Yatri Patel
EGL (BSE-ME & MSE-IOE)

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Kartik Raju
MBA

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CUMMINS, INC



Advait Bhogte
MENG-MFG

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Makura Compton
MBA

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Dieon Roger
MSE-ME & MSE-SED

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BOEING - COMPOSITES



Cornell Daia
MBA

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Greg Halmi
MBA

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Jonathan Zwier
MSE-ME

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DOWDUPONT



Jeff Eyler
MBA

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Jerry Li
MBA

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BORGWARNER MARKET SENSING



Umang Lathia
EGL (BSE-COMP & MSE-COMP)

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Junyi Zhang
MBA

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FORD MOTOR COMPANY



Yanan Gong
PHD-MACRO

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Matt Hildner
PHD-BIO MFG

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Megan Liu
EGL (BSE-MSE & MSE-IOE)

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BORGWARNER MORSE SYSTEMS



Austin Friedant
EGL (BSE-ME & MSE-ME)

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Anab Waris Rathore
MBA

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FRESENIUS MEDICAL CARE



Astha Bhawsinka
MSE-IOE

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Jason Kertayasa
EGL (BSE-ME & MSE-IOE)









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Sijie Ruan
MSE-ME

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TAUBER STUDENTS

GENERAL MILLS			MICROSOFT CORPORATION – COMMERCIAL		
	<div><div>Rodrigo Martinez</div><div>MBA</div></div>	Page 86		<div><div>Michael Barnes</div><div>MBA</div></div>	Page 101
	<div><div>Andy Trahan</div><div>MBA</div></div>	Page 87		<div><div>Rahul Hingorani</div><div>EGL (BSE-EE & MSE-ECS)</div></div>	Page 102
GENERAL MOTORS COMPANY			MICROSOFT CORPORATION – PARTNER		
	<div><div>Gustavo Acosta</div><div>MBA</div></div>	Page 89		<div><div>Sameer Arora</div><div>EGL (BSE-IOE & MSE-IOE)</div></div>	Page 104
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	<div><div>Dalton Geraldo</div><div>EGL (BSE-ME & MSE-IOE)</div></div>	Page 93		<div><div>Norman Farquhar</div><div>MSE-EE</div></div>	Page 108
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	<div><div>Sho Kawabe</div><div>MBA</div></div>	Page 98		<div><div>Tom Walkinshaw</div><div>EGL (BSE-ME & ME-ESE)</div></div>	Page 112
	<div><div>Giuliana Sanchez</div><div>MBA</div></div>	Page 99			

TAUBER STUDENTS

PRINCIPAL FINANCIAL GROUP



Chris Hudson
EGL (BSE-IOE & MSE-IOE)

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Pan Rakpanitmanee
EGL (BSE-ME & MSE-IOE)

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Leila Syal
EGL (BSE-EE & MSE-EE)

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TARGET CORPORATION



Reed Hostrander
EGL (BSE-CHEM & MSE-IOE)

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Erica Kirshensteyn
MBA

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Sabrina Lin
EGL (BSE-IOE & MSE-IOE)

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SPACELABS HEALTHCARE



Richard Doktycz
EGL (BSE-CHEM & MSE-IOE)

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Mark Hardin
MBA

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WHIRLPOOL CORPORATION



Justin Lee
EGL (BSE-ME & MEng SE)

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Michael London
MBA & MS-SEAS

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STANLEY BLACK & DECKER



Moses Pezarkar
MENG-MFG

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Ziyan Xu
MENG-MFG

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STONERIDGE, INC.



Jared Moon
MBA

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Madison Riley IV
MBA

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Anna Schmeissing
EGL (BSE-CE & MSE-CE)

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AMAZON.COM, INC – CONTAINER ROUTING

Inbound Container Routing at Amazon Robotics Sortable Fulfillment Centers

STUDENT TEAM:

Mohit Mengale – Master of Engineering in Manufacturing
Charles Su – MBA & MS Industrial and Operations Engineering

PROJECT SPONSORS:

Ben Mullican – Senior Program Manager, Ops Integration
Saravana Sigamani – Principal Program Manager, Ops Integration
Greg Zielinski – Director, NACF ACES Ops Integration

FACULTY ADVISORS:

Siqian Shen – College of Engineering
Hyun-Soo Ahn – Ross School of Business

Amazon’s mission statement is “to be Earth’s most customer-centric company, where customers can find and discover anything they might want to buy online.” To accomplish this, Amazon operates a large and complex inbound supply chain: its 25 North American Amazon Robotics Sortables (ARS) Fulfillment Centers (FC) process billions of inbound items each year from vendors, Amazon cross docks, and other FCs. Inbound units come in corrugated cases and plastic totes and vary in size, weight, and shape: from books to headphones to packs of diapers. After products are unloaded into the FC, they undergo a variable series of process steps—such as changing containers, electronic logging, palletizing—before they are distributed to one of over 100 stow stations across several floors, where associates stow them into bins.

Today, there is no procedure for deciding where in the destination FC inbound units should be sent or the order in which they should be moved and stowed. This creates variation in the inbound cycle times of units and causes units to be stowed late. While a majority of units are stowed within 10 hours of being received, a meaningful percentage of items currently takes over 20 hours to be stowed. The unreliability of inbound stow times directly impacts Amazon’s customer experience: inbound is estimated to cause upwards of one million customer orders to miss promised delivery. Additionally, Amazon is unable to offer faster shipping times on items that are already inside the FC but not yet in a bin.

Combining learnings from Associate observations and leadership interviews with statistical analyses on inbound cycle times, the team identified the product attributes that cause statistically significant delays in stow time. The team designed an electronically enforced FIFO system that directs inbound associates to the longest-dwelling WIP and prevents the unit neglect that drives high inbound cycle times today. Pilot testing showed a decrease of 95th percentile (TP95) inbound cycle times by over 30% and a decrease in percentage of items stowed in 20+ hours by 5%. By increasing inbound cycle time reliability and creating visibility into inbound product movement, our project will directly contribute to increases in on-time delivery rate and shortened shipping time estimates worth over \$70M. Our project will enable FCs to make a reliable commitment to Amazon’s customers, vendors, and sellers to stow units consistently on time once they enter the building.

AMAZON.COM, INC – CUSTOMER RETURNS

Customer Returns Sortation

STUDENT TEAM:

Abhishek Gowrishankar – Master of Engineering in Manufacturing
Andrea Krushefski – Master of Business Administration

PROJECT SPONSORS:

Ranjan Banerji – Program Manager, NACF ACES Operations Integration
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Greg Zielinski – Director, NACF ACES Operations Integration

FACULTY ADVISORS:

Xiuli Chao – College of Engineering
Mohamed Mostagir – Ross School of Business

Amazon seeks to be Earth’s most customer-centric company for four primary customer sets: consumers, sellers, enterprises, and content creators. Amazon.com offers over 3 billion unique items to its customers. As part of its commitment to customer obsession, Amazon offers convenient customer returns policies.

In 2018, Amazon will receive 187MM customer-returned items. Offering variety and volume to customers requires the Amazon Returns & Recommerce network to have corresponding capabilities to handle this variation efficiently. Returns Centers must be able to receive, process, and finally route these items to a final disposition. The variation in the types of inventory causes task-switching inefficiencies in Associate workflows. Currently, all US returned items are routed to one of six Returns Centers to be evaluated, and then shipped back out to outbound fulfillment centers for sale, held for vendors to claim, or sent for liquidation. The centralized location of returns processing causes inefficient routes for packages from the consumer to the Return Center then back to the Fulfillment Center, incurring transportation costs.

This variation presents an opportunity to decentralize and manage variety in the Customer Returns network, lowering net costs, and increasing process efficiency while maintaining/improving the accuracy of Sellable Yield (percentage of returned items that are resellable). The Tauber team piloted methods for sortation automation, identified opportunities for process decentralization, and developed a transportation model to decrease costs. The team selected 14 Fulfillment Centers in the outbound network to begin processing Customer Returns to minimize transportation spending and increase Sellable Yield for large items. Through increasing returns hubs at Outbound Fulfillment Centers and introducing automated item sortation, the Tauber team was able to identify over \$40M in potential labor, transportation, and COGS savings in the Amazon ReLogistics network.

AMAZON.COM, INC – KICKOUT REDUCTION

AutoSLAM Kickout Reduction

STUDENT TEAM:

Noah Feingold – MBA & Master of Environment and Sustainability
Zheng Zhang – Master of Business Administration

PROJECT SPONSORS:

Kyle Attamante, Principal PM, NACF ACES, Subject Matter Expert, Regional Quality
Ben Mullican, Principal PM, NACF ACES, Ops Integration

FACULTY ADVISORS:

David Chesney, College of Engineering
Ari Shwayder, Ross School of Business

At Amazon Fulfillment Centers (FCs), an “AutoSLAM” machine is used to apply shipping labels to packages as they flow down a conveyor belt. While most packages are successfully labeled, some packages can “kickout” for multiple reasons, resulting in the package needing to be manually processed. The Tauber team investigated the root causes of kickouts and identified five improvements that will eliminate more than 10% of kickouts, saving over \$3M.

First, after running pilot tests at two FCs, the team determined a method using speed differentials on conveyor belts to increase package spacing and eliminate kickouts that are driven by congestion.

Second, because each conveyor line has two “AutoSLAM” printers, the team identified a way to determine if one printer is likely to require maintenance by comparing its performance to the other printer on the same conveyor line. The team worked with software developers to provide this data to sites in real time and has proposed thresholds to send alerts to sites when a printer is likely to require maintenance.

Third, the team found statistically significant differences in the performance of sites depending on their sp00 supplier (a barcode used to track packages and convey customer information to the AutoSLAM machine to print the appropriate shipping label). The team then conducted a test by using sp00s from two suppliers at the same FC and comparing their performance. The test, as well as visual inspection, confirmed the substandard nature of the one supplier. This information was shared with the supplier, who has confirmed a process change with new sp00s that are ready to be tested.

Fourth, the team found that debris that is not properly disposed of by packers often flows through the AutoSLAM machine, and this debris causes several issues that lead to kickouts. On multiple lines the team installed fans to blow away lightweight debris, resulting in reduced kickouts.

Lastly, after conducting a root cause analysis of several kickout types, the team determined which kickouts are most commonly caused by packers. The team conducted a short 2-minute training before a shift, which resulted in much lower kickouts of the types commonly caused by packers. The team has provided a roadmap to use kickout data to automatically generate training for packers.

AMAZON.COM, INC – PERFORMANCE MEASUREMENT

Amazon FC Outbound Performance Measurement

STUDENT TEAM:

Wendy Lei – Master of Business Administration
Nikhil Pawar – Master of Science in Industrial and Operations Engineering

PROJECT SPONSORS:

Sam Eldersveld – Director, Fulfillment Execution Data Science (FEDS)
Maria Lee – Sr. Manager, Transportation Sustainability
Navjot Singh – Sr. Manager, Tech Program Management

FACULTY ADVISORS:

Luis Garcia-Guzman – College of Engineering
Roman Kapuscinski – Ross School of Business

Amazon’s project aims to increase trailer fill, reduce logistics costs, and simultaneously reduce environmental impact through improvement of Fulfillment Center (FC) outbound fluid loading labor management and performance measurement. Optimized labor allocation is the foundation for implementation of fair associate performance measurement processes, which is the long-term objective of this project. Currently, there are no standardized rates nor performance measurement processes to drive fluid loading accountability, unlike in other FC areas where associates are held accountable to standardized rates.

The Tauber team performed a series of labor experiments across four fulfillment centers in addition to data analysis, and stakeholder interviews. Experiment results indicated that there are opportunities to leverage labor allocation and performance measurement on the outbound dock to drive trailer fill improvement. Based on experiment results, the team recommended implementing a series of mechanisms to better prioritize trailer fill initiatives within FCs, optimize labor allocation, and to sustain truck savings. The immediate mechanism to address misaligned incentives is the integration of trailer fill metrics into FC leadership reports, for which the team gained buy-in. Long term, the team recommended deploying a streamlined fluid loading operations dashboard coupled with real-time utilization cameras as a mechanism to generate proactive alerts to dock managers, automating the QA function. To support this, the team delivered a document outlining business requirements for the development and integration of the real time utilization camera system. Short term, the team gained support to roll out trailer fill quality ambassadors (QAs) in key FC locations to drive adherence to standard work until the recommended technology can be deployed.

The immediate recommendation to better optimize labor allocation is to socialize across outbound teams a standardized fluid loading rate that the team calculated using industrial engineering time studies. Long term, the team supported another team’s recommendations to install a centralized labor planning team that controls staffing decisions. The team also identified additional factors that impact labor management such as simultaneous truck departures and package flow rate variability. To address these findings, the team provided guidelines for additional experimentation to measure the impact of fewer simultaneous departures on trailer fill. By executing these recommendations, Amazon will develop the labor allocation processes, dock visibility technology, and aligned FC culture necessary to then implement fair associate performance measurement. These recommendations represent an estimated net savings of more than \$25M in total system costs.

AMAZON.COM, INC – VNA

Very Narrow Aisle Optimization

STUDENT TEAM:

Ryan Kim – Master of Business Administration
Kelsey Wyatt-Mair – MBA & MSE Industrial & Operations Engineering

PROJECT SPONSORS:

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Greg Zielinski – Director, NACF ACES Operations Integration

FACULTY ADVISORS:

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Albert Shih – College of Engineering

Amazon, the e-commerce behemoth that strives to be Earth’s most customer-centric company, uses a variety of storage and retrieval systems to fulfill customer orders. The Traditional Non-Sort Fulfillment Center (TNS FC) network uses both wide and very narrow aisles (VNA) to manually store and retrieve large-type items fulfilled by Amazon. TNS FCs were in search of an optimization solution within VNA that would decrease cycle time, increase throughput, and enhance shareholder value.

Analysis of current state VNA operations showed over 50% of cycle time being attributed to travel waste. From June 2017 to May 2018, over \$100 million was spent on travel waste within the VNA across the North American TNS network. As the TNS network is expected to grow significantly in the coming years, a solution to improve process flow and eliminate undue waste was required.

To address this opportunity, the Tauber team studied and tested combo-tasking (combining multiple VNA functions into one) as a solution. Combo-tasking was assessed via full-scale pilots at multiple TNS FCs. This solution yielded benefit through the elimination of 50% of all changeovers as well as reduction in redundant travel time. The team therefore made the data-driven recommendation to move forward with combo-tasking, and began the phased implementation of this solution. This phased implementation includes a short-term, non-software driven method, a mid-term, software-driven method, as well as a long-term systems redesign.

In the near term, after implementing the non-software-driven method, Amazon’s annual savings are expected to exceed \$30 million. The addition of software solutions nearly doubles these savings. Finally, in the long term, a systems approach to VNA Optimization (via the introduction of retrofitted automation) that eliminates 100% of travel waste will achieve over \$100 million in savings.

AMAZON.COM, INC – YARD MANAGEMENT

Fulfillment Center Truck Yard Capacity Forecasting

STUDENT TEAM:

Corinne Beemer – EGL (BSE & MSE Industrial and Operations Engineering)
Muhammad Umair – EGL (BSE & MSE Industrial and Operations Engineering)

PROJECT SPONSORS:

Sam Eldersveld – Director, Supply Chain Data Science, Transportation Execution
Navjot Singh – Sr. Manager, Technical Program Management, Transportation Execution

FACULTY ADVISORS:

David Kaufman – College of Engineering
Brain Talbot – Ross School of Business

Amazon, a world leader in retail, strives to be the Earth’s most customer-centric company. To achieve this vision, Amazon focuses on continuously improving its vast network of operations to ensure top customer experience in a cost-effective manner. To drive operational excellence within their fulfillment network, Amazon’s Fulfillment Execution Data Science (FEDS) team focuses on leveraging technology and operations to develop data-driven solutions for internal customers across the network. Specifically, the FEDS-Tauber team supported the Transportation Operations Management (TOM) team by developing solutions to manage truck yard capacity.

The TOM team manages day-to-day yard operations and seasonally procures additional yard capacity for Amazon’s peak season. Due to current physical capacity constraints at Fulfillment Centers (FCs), off-site yards are sourced to manage excess trailer buffers and dwelling trailers and result in less efficient management of yard operations. During peak in 2017, tens of FCs exceeded their engineered yard capacity and would have entered a gridlock state if no off-site yards were present. Based on actual usage of the off-site yard, it was estimated that 25% of these FCs could forego an off-site yard with better proactive planning. TOM challenged the Tauber team to develop a robust tool to forecast yard utilization for the peak season and aid in efficiently managing yards to avoid unnecessary off-site yard spend.

The Tauber team initially focused on assessing the current state of the TOM team’s yard capacity planning process to identify areas of opportunity. The team converged on two primary goals to manage yard capacity: the first was developing a long-term model that forecasts FC yard utilization over a 4- to 6-month horizon to make decisions on leasing off-site yards; the second was developing short-term visibility to proactively manage operational decisions. To achieve these goals, the team leveraged Amazon Web Services (AWS) and SQL to evaluate data sources and explored time-series forecasting techniques with RStudio. Using an iterative process with feedback from key stakeholders, the team developed forecasts for long-term yard utilization using historical data and FC volume predictions. Additionally, the team developed 1-, 2-, and 3-day forecasts of yard utilization and created metrics to monitor how long trailers dwell in the yard. This provided central visibility of yard performance and enabled managers to proactively address problems with dwelling trailers consuming yard capacity. The team also developed and launched an interactive dashboard to summarize and visualize forecasts and manage yard capacity and performance. This project generated savings in labor hours and yard spend, ultimately improving offsite yard planning and enabling more efficient truck yard management.

THE BOEING COMPANY – 777X

Optimizing Improvement Efforts by Reducing Variability

STUDENT TEAM:

Andrew Davis – Master of Business Administration
Colin McNally – Master of Business Administration
Cameron Stitt – EGL (BSE & MSE Chemical Engineering)

PROJECT SPONSORS:

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The Boeing Company is the world's leading manufacturer of commercial jetliners. Recently, the company started production of the new 777X, which will be the largest and most fuel-efficient commercial twin-aisle aircraft on the market. The company already has more than 300 orders for this aircraft, which is expected to take its first flight in 2019. The composite wings are assembled in the main factory in Everett, WA on the Horizontal Build Line (HBL) using a combination of skilled manual work and state-of-the-art automation.

Bringing the production of composite wings in-house for the first time, as well as the first build of any product, is challenging. To ensure the program schedule was not impacted, the program launched several hundred separate improvement projects (referred to as “enablers”). If 777X customer airplane deliveries are delayed, standing contractual obligations will impose hefty fines on Boeing, which highlights the importance of successfully executing these enablers.

The Tauber team, identifying the disorganization involved in these enabler efforts, realized an opportunity to improve and standardize the process for HBL and other startup programs within the company. The team began by treating these enabler projects as a product in a factory, creating extensive value stream maps of the process in which typical projects are taken from ideation to implementation. The team supplemented this analysis with benchmarking of processes on other internal aircraft programs as well as project management techniques from outside industries. By synthesizing internal and external best practices, the team developed an ideal future state value stream map of the enabler project process and a playbook of recommendations to achieve this state. The team was able to pilot several key components of this playbook in order to ensure HBL's introduction remained close to the original schedule.

The new process for handling enablers will alleviate project arrival and handoff rate variability, with the potential to reduce time from initiation to completion by nearly 85% based on results seen in controlled, fully dedicated pilot efforts. The Tauber team's more conservative estimate predicts a reduction in 777X enabler project lead time and process time by 59% and 35%, respectively. Furthermore, new airplane programs adopting these efficient processes will substantially reduce costs associated with resource assistance and delivery delays.

THE BOEING COMPANY - 787

Kitting Process Improvement on the 787 Dreamliner Program

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The Boeing Company is the world's largest aerospace company and a leading manufacturer of commercial airplanes and defense, space, and security systems. The 787 Dreamliner, the latest aircraft offering from Boeing Commercial Airplanes (BCA), made its first customer delivery in 2008 and has since delivered to over 70 global customers. With the number of air travel passengers predicted to double by 2036, Boeing is focusing on continuous improvements in manufacturing to meet growing demand.

The 787 program has pioneered several innovative manufacturing processes for the aircraft, which BCA plans to implement on other commercial programs. Chief among these processes is the use of “kit carts” to deliver parts and tools to mechanics. Since “kitting” was implemented nearly three years ago, the 787 Program has experienced challenges delivering kits to the right location, at the right time, and with the right parts. Kitting inaccuracies lead to mechanic downtime, traveled work, and reduced trust in the kitting system. As the 787 program prepares to increase production rate to 14 airplanes per month next year, it is essential that the factory receives accurate kits to minimize delays in final assembly.

To address these inaccuracies, the Tauber team mapped the entire kitting process, identified the parts and tools most frequently involved in kitting issues, and identified root causes and corrective actions for these issues. After interviewing over 150 engineers, managers, supply chain and purchasing analysts, and manufacturing teams, the Tauber team created a comprehensive Value Stream Map documenting the kitting process, from the moment a change is proposed to design engineers to the time when a kit is delivered to the mechanic. Using this map, the Boeing Problem Solving Model, and analysis of historical kitting error reports, the team identified five root causes that contribute to kitting inaccuracies. The team also quantified the scale of each of these root causes and the subsequent financial impact of these issues on the 787 program.

Finally, the Tauber team worked with staff across departments to determine corrective actions and implementation plans for each root cause, including changes in the planning process, software redesign of the Bill of Materials Management tool, and use of RFID to track kit deliveries. The revised planning process and software tool will improve communication between manufacturing engineering and supply chain to ensure that the correct parts are included in mechanic kits. In addition, use of RFID in tracking kits will improve the physical kit delivery on the shop floor and provide metrics to track these improvements. As these recommendations are implemented, the Boeing Company is expected to recognize savings of \$1.8 million per year for the 787 Program and over \$10 million per year across all commercial airplane programs that utilize kitting for final assembly.

THE BOEING COMPANY - COMPOSITES

Establishing a Composite Center of Excellence

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Boeing Defense, Space, and Security (BDS), one of the \$205 billion aerospace company's three major divisions, is faced with fierce competition as measured by the customer on cost, quality, service, and schedule. To compete as a global industrial champion, BDS must excel in four key areas: a common production system, value stream orientation, a collaborative high-performance culture, and common metrics aligned to customer needs. Center of Excellence (CoE) implementation across the organization has resulted in increased collaboration and cost competitiveness, common designs and production systems, improved flow and production efficiency, increased equipment utilization, and reduced material cost and labor demand variability.

Currently, three programs are distributed across two BDS sites. A new, highly complex and technical labor-intensive product is slated to be produced in its current location. Unless significant advances in composite production automation are made, Boeing and its customers will be subjected to the higher labor costs at that site. BDS will also miss a window of opportunity to integrate composite operations and strategically position itself for future demand.

To address these issues, the Tauber team created a business case and implementation plan for a composite CoE that included current and future state value stream maps, CoE facility layouts, equipment and tooling move timelines, capital investment requirements, and knowledge transfer plans. This required the development and assessment of numerous scenarios representing multiple facilities layouts, standardized production processes, accounting systems analysis, efficiency frontiers, and learning curves.

The result of the Tauber team's work led to the development of a comprehensive comparative model, design of a new state-of-the-art facility and manufacturing center, and the strategic outlook for future composite products. From this analysis the team recommended that BDS develop a core competency in composite production by consolidating capital equipment and human capital in a single production facility. If implemented, the CoE designed by the Tauber team would yield a projected savings of over \$30 million and position BDS as a global industry leader in composite design and manufacturing for years to come by increasing cost competitiveness, design to manufacturing, and customer satisfaction.

BORGWARNER - MARKET SENSING

Reducing Cost Gaps and Increasing Competitiveness

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Emissions Systems is a rapidly growing business within BorgWarner, Inc., dedicated to the design and manufacturing of industry-leading air management and emission control systems for global automotive and truck manufacturers. One product within Emission Systems, the Exhaust Gas Recirculation (EGR) cooler, has been dominated for the past decade with 20% market share by BorgWarner. However, during 2017, they missed a potential \$205 million in annual revenue because of lost bids for EGR coolers. Of these lost bids, \$101 million was a direct result of a BorgWarner's quote being underbid by a competitor.

BorgWarner has demonstrated the capability to produce at comparable cost to low-cost competitors. However, due to inaccuracies when producing quotations and BorgWarner's decentralized structure, which limits transferring production improvements between plants, the initial quote typically exceeds the market average by 20%. With expected annual growth of 10% for EGR coolers as emission and efficiency regulations become stricter, BorgWarner wishes to improve each plant's competitiveness to maintain its position as the dominant cooler supplier. During this project, the Tauber team developed two tools—an Excel-based Cost Estimation tool and a web-based Market Sensing tool—to identify improvement opportunities. The tools run in parallel to calculate a competitive price during the cooler quotation process.

The Cost Estimation tool assesses the cost of production at a given plant through estimations of material, labor, machine and tooling depreciation, variable and fixed overheads, and other components using sales and design information. The tool then computes the sell price based on desired profit level, intended annual discounts, and business incentives. The tool will be used by BorgWarner's Global Strength team to verify quotes, analyze competitive gaps between plants, and streamline the quotation process.

The Market Sensing tool predicts a cooler's market value and identifies similar coolers for corroboration. Machine learning and similarity algorithms estimate the potential winning bid irrespective of BorgWarner's competitive ability. The tool will also return the most similar historical coolers. BorgWarner's Quote Review Board will use these insights to review a quote's competitiveness, pinpoint overestimated coolers to recalculate the quote, and determine the necessary profit reduction for "must-win" strategic programs.

Visits to Auburn Hills, US; Vigo, Spain; Viana, Portugal; and Ningbo, China helped the Tauber team to develop these tools that will enhance BorgWarner's competitiveness in the fast-growing EGR cooler market. The tools will enable an estimated annual revenue increase of \$20 million through increased program wins. These tools can also be adapted to other products, increasing their potential future impact.

BORGWARNER MORSE SYSTEMS

Developing Strategy for Automated Chain Inspection

CUMMINS, INC.

3D Printing Integration for Aftermarket No-Source Part Order Fulfillment Process

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BorgWarner is a leading global automotive supplier with \$9.8B in revenue in 2017. BorgWarner’s Morse Systems division provides components for automatic transmission and engine timing applications, with this project focusing on chains used in engine timing applications. In Morse Systems Arcore (MSA-Italy), a large component of the cost of chain production is visual inspection to ensure product quality, a non-value-adding but necessary activity. This project sought to develop a strategy for the elimination of this step to improve customer quality, decrease inspection costs, and reduce ergonomic risk. Potential for this project includes expansion to seven additional global facilities.

The Tauber team conducted a technological assessment of proposed solutions that could detect all defects currently found in visual inspection. Defect types were categorized based on the technologies capable of their detection, and pilot studies of these technologies were completed. This included validation of eddy current sensing for the detection of missing components and a feasibility study for artificial intelligence in chain inspection. Alongside technical development, an attribute study was conducted to establish the current state effectiveness of visual inspection. These studies informed a recommendation around the system design of a future state, fully automated chain inspection system.

A comprehensive cost benefit analysis was conducted for a pilot assembly line, providing a robust decision-making tool for the expansion of automated inspection to other chain assembly lines. The cost analysis tool built in the possibility for an imperfect technical system to demonstrate the financial impact under different scenarios. In addition to financial considerations, a strategic approach was taken toward managing key stakeholders in the project. Outputs included a stakeholder map and risk assessment capturing the concerns of key stakeholders. From this analysis, an engagement strategy was developed to manage high-priority risks.

Upon conclusion of the project, the team developed a roadmap for continued technical development in pursuit of fully automated inspection. In the immediate term, recommendations provided by the team can decrease inspection times by 33%, improve customer quality, and reduce ergonomic risk for visual inspectors. Furthermore, a strategy of process control recommended by the team can limit defective production and reduce scrap costs. Moving from the single pilot line, the team provided recommendations around the expansion of automated inspection within MSA and to other global Morse Systems facilities.

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Cummins Inc., a \$20.4B Fortune 500 company that designs, manufactures, distributes, and services diesel and alternative fuel engines and related components, recently adding electrified power systems to its product lineup. The Cummins New & ReCon Parts (NRP) division supports the aftermarket supply chain for over 200,000 current and legacy parts. The company is committed to supplying aftermarket parts for upwards of 30-40 years for many types of equipment. As new engine models are introduced, demand for legacy parts decreases. This decrease in demand leaves Cummins with greater supplier risk in the form of suppliers discontinuing production for parts that clients still need. Once a legacy part no longer has a supplier, it becomes “no-source.” Fulfilling no-source parts orders can be a time-consuming and complex process that inhibits Cummins’ ability to provide customers with world-class service.

3D printing or additive manufacturing is an emerging way of producing parts that does not require complex tooling. 3D printing is suitable for low-volume production and presents interesting possibilities for resolving no-source cases. The Tauber team was tasked with integrating additive manufacturing into the cross-functional no-source order fulfillment process. They began by analyzing the current process flow and performance through multiple rounds of stakeholder interviews. Based on information gathered from the interviews, value stream maps were constructed to uncover process optimization opportunities. The team also built a cost model that quantified approximately \$1M in annual indirect costs incurred in resolving no-source cases with conventional suppliers.

The next phase of the project involved building the necessary operations to support 3D printing no-source parts. A new sequence of decision-making and internal infrastructure was designed by the Tauber team and will be used to pilot rapid 3D printed end-use parts delivery within the aftermarket. This process will enable engineering, purchasing, and marketing resources to “fast track” no-source order resolution for qualified parts, thereby improving lead time and customer satisfaction. The new process will also reduce labor hours, the number of required information systems, and the number of decision points and cross-functional handoffs embedded in the process. Because of the team’s work, NRP’s business case for additively manufactured parts was revised to include reduced indirect costs to offset potentially higher per unit direct costs in additive manufacturing.

DOWDUPONT, INC.
Improving The Customer Experience Through
A Digital Supply Chain

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Dow is a Fortune 50 multinational corporation that manufactures plastics, chemicals, and agricultural products. Dow is undergoing a fundamental shift in how it operates as a company by investing in digital transformation across the supply chain, commercial, and manufacturing disciplines with the intent of improving the customer experience. To address this operating shift, the Tauber team set out to design a digitally enabled customer experience for the order-to-fulfillment process within Dow’s Polyurethanes business, a multibillion-dollar product line.

The team conducted a Voice of the Customer analysis, evaluated customer complaint data, interviewed internal stakeholders, and analyzed customer experience survey data to identify the major pain points felt across the customer journey. The Tauber team then conducted an extensive competitive benchmarking study to identify customer experience best practices from across the chemical industry as well as B2B and B2C best-in-class players.

The team identified six digital supply chain solutions that will improve the customer experience: sensor-driven replenishment, demand-sensing algorithms, multimodal ecosystem communication, automated customer notifications, online customer portal, and dynamic routing. The team then developed an immersive video to educate employees on what the customer experience of today and tomorrow looks like, and an augmented reality demonstration of how sensor-driven replenishment works to drive organizational awareness and change management.

- As a result of the Tauber team’s efforts, the team identified three pillars of impact:
- Strategic – Advances Dow’s vision to become the most innovative, customer-centric Materials Science Company in the world.
 - Organizational – Instills a customer-centric mindset into employees by providing a new way to learn about the customer experience and digital supply chain solutions, with 5,000+ employees estimated to view the Tauber team’s products per year.
 - Financial – Improving the customer experience leads to an estimated \$156M in incremental revenue per year for Dow’s Polyurethanes business.

FORD MOTOR COMPANY
Opportunities for Additive Manufacturing
in Tooling and Production

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Ford Motor Company, with \$156 billion in annual revenue, is the second largest automaker in the US and an Additive Manufacturing (AM) leader in the automotive industry. To explore the applications of AM, Ford has created the Additive Manufacturing team to promote AM as a manufacturing tool within the company. The Tauber team has partnered with the Additive Manufacturing team to assess AM for use in tooling and production.

While AM usage in rapid prototyping contexts is developed and mature, AM adoption in tooling and production contexts is still under development. With new advances in AM technology, however, AM is now starting to be considered as a viable option for larger-scale manufacturing environments. The Tauber team conducted a tool redesign and created a comprehensive cost model to identify the potential of AM in tooling and production applications, respectively.

In tooling, Ford can immediately avoid \$2.25 million in assembly line extension and shutdown costs through the implementation of an innovative tool redesign powered by AM. The team demonstrated proof-of-concept on the existing generation of tooling by performing finite element analysis and printing a full-scale model of the resulting tool to test fit compatibility. The learnings and experience from this project will be expanded to similar design for AM (DFAM) applications with the potential to save an additional \$18.5 million in the next five years.

To assess the feasibility of AM in production, a decision matrix was created by incorporating current printing limitations, geometric considerations, and printing quantities. Results showed that AM can currently be considered for select parts with quantities of up to 50,000 units/year with higher economic efficiency than traditional manufacturing processes. In the future, analysis on how improvements in AM printing speed and resolution will boost AM applications in production concluded that quantities of 100,000 units/year will be attainable within five years.

FRESENIUS MEDICAL CARE NORTH AMERICA

Peritoneal Dialysis Device Refurbishment

Lean Transformation

GENERAL MILLS, INC.

Enabling Growth Through In-Store Display

Volume Forecasting

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Fresenius Medical Care North America (FMCNA), which generated \$21.97 billion dollars in 2017, provides healthcare services for chronically ill patients across North America with more than 2,200 dialysis facilities. In addition, FMCNA offers pharmacy and laboratory services, and manufactures a comprehensive line of dialysis equipment and renal pharmaceuticals. The Concord, CA, facility manufactures new dialysis devices and equipment including Peritoneal Dialysis (PD) Devices, Hemodialysis (HD) Devices, Dry Concentrate Mixing Systems, and CLiC crit-line monitors. It is also responsible for refurbishing used PD Devices.

Refurbishment occurs when a customer returns a cyclor for a variety of reasons and Fresenius refurbishes the device to make it fit for customer use again. The increase in demand for the Liberty Cyclor PD Machine has led to opportunities to make the refurbishment process more efficient and reduce cost. The goal of this project was to improve the quality of refurbished cyclors while maintaining compliance, with emphasis on long-term cost savings and continuous process improvement.

The team began this project by creating a value stream map of the current refurbishment process and using data from enterprise software to determine the average cost of refurbishing a cyclor. Based on the value stream map, and a kaizen event held with operators from the production floor and Manufacturing and Quality Engineers, the team identified projects that would have a direct impact on quality, compliance, and cost. The team then created implementation plans for these projects and began pilot programs to test the effectiveness of the proposed projects.

The implementation of piloted projects and recommendations will increase first-pass yield and reduce the number of times a cyclor is touched during refurbishment, increasing quality and maintaining compliance. The projects also helped to increase communication between departments and promote a culture of continuous improvement. The total cost savings realized by the full implementation of the pilot projects and the recommendations are estimated to be a 6% reduction in refurbishment cost, amounting to \$2.4M annually and a one-time cost savings of \$425,000.

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General Mills, a \$15.6B company, is the sixth largest food manufacturer in the United States and markets over 100 different consumer food brands ranging from ice cream to pet food. Special Pack (SPPK), also known as palletized display, is the second largest manufacturing platform within the company and supports 8% of overall US sales, totaling approximately \$960M. With over 1,300 new configurations created every year, SPPK is highly customizable and presents significant obstacles when trying to forecast demand beyond the immediate future.

Last year, General Mills experienced a 70% growth in SPPK demand, which disrupted the supply chain and resulted in an increase of stock-outs, wasted labor, and finished inventory deconstruction. In order to cut costs and reduce the probability of over/under producing inventory, General Mills needed to develop better process visibility and enhanced forecasting methods. These changes would smooth out SPPK production and produce significant opportunities for savings.

To take advantage of these opportunities, the Tauber team focused their efforts into three phases. First, the Tauber team mapped out the entire process from customer order to delivery. A gap analysis of the process revealed several opportunities for improvement, most notably the standardization of communication. Second, the team focused on designing a new forecast methodology to anticipate changes in demand 60 days out to smooth out inventory and capacity at the manufacturing facilities. Lastly, the team modified the existing reporting procedures to reveal more realistic expectations of customer behavior and adjust manufacturing accordingly.

Upon completion, all deliverables were transferred to designated employees within General Mills who will continue the work and oversee its implementation. With an estimated savings of \$425K to \$1M in the first year of implementation, the Tauber team is confident that the recommendations will provide immediate and continued value to the company and support its growth in the near term and future.

GENERAL MOTORS

Manufacturing System Data Integration Strategy

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General Motors (GM) is an American multinational automotive company that manufactures cars and trucks in 35 countries. Every day, GM faces the challenges of managing over \$50 billion in assets and ensuring a steady flow of data to and from plant workers maintaining those assets on production lines.

The Tauber team’s objective was to develop a mobile solution that provided maintenance workers with structured process and information access by equipping them with tablets. The primary project goals were to help workers reduce machine repair time while also providing GM with data to make better decisions on investing over \$5 billion on assets annually. Currently, GM has limited ability to provide workers with fast access to information they need to correct machine errors, while complicated reporting procedures have hindered GM’s ability to make data-driven decisions on asset investments.

In order to develop recommendations, the team analyzed extensive historical data on maintenance faults, examined processes at GM’s Lansing Delta Township (LDT) plant, and prototyped different software features. The team configured a tablet with all their recommended functionality and provided a technical document guiding setup and operation.

To analyze the maintenance process, the team collaborated with maintenance workers to map out standard steps and ran simulations, which produced thorough data on time spent on each activity. It was calculated that leveraging tablets would improve over 20 activities, reduce maintenance time in the LDT Body Shop by an estimated 16.7%, and lower the mean time to repair by 3%. Scaled to all GMNA operations, over \$90 million could be saved annually. Faster access to GM’s enterprise asset management software provided by tablets would also overcome many time constraints that have hindered reporting of maintenance tasks. This will, in turn, provide key data metrics to GM’s financial planners, creating additional benefits for improved asset management.

The Tauber team’s recommendations specified how tablets can be optimally integrated into maintenance processes and provided a structured framework for how this can be applied at any GM plant. The team’s proposed mobile solution would create a flow of data previously unseen in GM’s manufacturing operations, achieving immediate and long-term benefits for an array of stakeholders throughout the organization. If implemented throughout all manufacturing in GM North America (GMNA), the team estimated the company would save over \$90 million annually in increased labor and production efficiencies.

IDEX CORPORATION

Complexity Reduction Through Strategic Supplier Consolidation

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IDEX Corporation is a \$2.4 billion applied solutions corporation with 65 subsidiaries in highly specialized engineered applications within niche markets. Liquid Controls (LC) is a business unit within IDEX’s Energy segment that manufactures precision flow meters for high-value liquids such as refined fuels, Liquid Petroleum Gas (LPG), and other industrial metering across aviation, mobile truck delivery, bulk processing plants, food services, and more. LC would like to align their supply base with lean transformation and complexity reduction initiatives taking place across the corporation.

Over the last decade, LC has experienced proliferation in the number of suppliers within the supply chain primarily due to irregularities in purchasing patterns within the organization and the acquisition of two new brands, Avery-Hardoll and Sponsler. The demands of maintaining the larger supply base and a lack of dedicated resources have led to an inability to execute on value-added strategic sourcing projects. This lack of capacity resulted in significant decreases in material productivity over the last three years.

To drive an increase in material productivity, the Tauber team conducted a strategic consolidation of the supply chains for the Liquid Controls, Avery-Hardoll, and Sponsler brands. Initially, the team analyzed the existing supply base to identify opportunities for consolidation into more strategic suppliers based on performance, volume, and spend. Next, the team recommended transitions and presented them to representatives from every relevant department in the organization to gain cross-functional approval. Once approved, the team began implementing the recommendations by quoting parts to new suppliers, working with the Purchasing team at LC to allow for a seamless transfer of the business. Lastly, the Tauber team produced a revamped supplier scorecard and supplier consolidation framework to drive improvement in the performance of the supply base and to ensure the repeatability of the complexity reduction process in the future across IDEX Corporation.

The strategic supplier consolidation effort is expected to generate \$1.3 million in direct material inflation offset at the Liquid Controls business unit over the next three years. During the same time, assuming IDEX implementation rates, of three, four, and six business units per year, the project is estimated to result in an offset of \$10.8 million for the corporation. Additionally, the supplier scorecard will be adopted at the corporate level to drive supplier performance across the organization.

THE MAYO CLINIC

Supply Standardization in Procedure Rooms

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Mayo Clinic is a physician-led nonprofit health care system in the United States and is currently ranked as the best hospital in the nation. Due to rising demand from population growth, external pressure from government and insurance companies, and the rising cost of healthcare from new technology, Mayo Clinic is constantly seeking new ways to reduce cost in order to meet the needs of its patients. A lack of standardization for certain supplies within the Cardiac Catheterization Laboratory (Cath Lab) and Heart Rhythm Services (HRS) divisions resulted in high supply cost variation among physicians. Consequently, additional variability and complexity for supply-related activities such as procedure preparation and inventory management led to increased costs. The University of Michigan’s Tauber project team was charged with identifying opportunities to standardize the supplies used for procedures in Cath Lab and HRS to minimize variability while maintaining quality and physician satisfaction.

Using data analysis of the cases performed in 2017, the team identified key items for each procedure according to their frequency of use and average usage. Along with assistance from Mayo Clinic staff members, the team generated 30 standardized picklists that can be used to cover 91% of the cases performed by Mayo Clinic annually. The picklists contain all items that have a near 100% probability of being used for each procedure and will be used as a guide for preparation regardless of the physician.

The picklists will reduce variability within supply usage, decrease procedure preparation and training times, and increase physician awareness of supply costs. Additionally, the project sets the foundations for an optimized model of inventory management and knowledge transfer among locations. Also, the team conducted a detailed analysis on high-expense items to equip Mayo Clinic with the knowledge for further standardization and cost reduction. Lastly, the team created tools and documentation that will allow Mayo Clinic to maximize these benefits by further expanding supply standardization to other locations and departments.

Due to the importance of patient safety, each picklist requires a consensus from all physicians prior to implementation. The team sparked numerous dialogues among physicians on standardization, and physicians are in the midst of discussions to eliminate variability on select items. Additionally, the team provided Mayo Clinic with a robust communication and training strategy. This, along with the analysis, tools. and documentation the team created, will allow for a smooth and sustainable transition after the team leaves, which will result in a successful and seamless enterprise-wide implementation.

MICROSOFT COMMERCIALIZATION

Strategic Improvements to Microsoft Azure Promotions

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Microsoft’s cloud-first, mobile-first initiative has increased the productivity of people and organizations across the globe. Microsoft Azure, their expanding set of cloud services, enables organizations to build, manage, and deploy applications across a global network. With the increasing prevalence of cloud services in the Global IT market, Microsoft has had to modernize its commercial platform to simplify the commerce experience and better serve its customers.

As part of this modern commerce initiative, Microsoft must evolve its Azure promotions’ strategy. The current Azure promotions strategy is limited by operational constraints that exist in Microsoft’s legacy platforms. Due to these constraints and the lack of a cohesive strategy, Azure business planners have not been able to realize the full potential of promotions.

The Tauber team developed a strategy outlining how business planners should approach future Azure promotions. After first defining a promotion, a timebound price incentive on a service or set of services that seeks to drive certain customer behaviors, the team researched and analyzed the potential costs and benefits of launching promotions. The team then interviewed several business planners to map out the current state of Azure promotions and identify the main intentions and pain points of past promotions. Through these conversations, the team developed a set of strategic scenarios in which promotions could benefit Azure’s long-term growth. Lastly, the team collaborated with business planners to develop a framework with the key steps and decisions that business planners need to consider when planning future promotions. The foundation of the framework came from a set of testable hypotheses the team developed using marketing literature on the outcomes of different promotions’ strategies. The framework describes in detail the ways that business planners can select the promotion’s type, price and terms, and duration. It also provides insights on how business planners can measure the effectiveness of promotions to learn and improve future promotions.

The promotions framework the team developed provides structure around a previously ad hoc process. Business planners can now analyze tradeoffs during the promotional planning stage and make more informed decisions. The framework, paired with the teams’ recommendations, enables Microsoft to build the necessary tools to strategically plan and launch wide-scale promotions that can drive Azure usage.

MICROSOFT CORPORATION – PARTNER INVESTMENTS

Streamlining Partner Investment Operations Through Intuitive Tooling

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Microsoft is a technology company whose mission is “to empower every person and every organization on the planet to achieve more.” For commercial customers, Microsoft furthers this mission and impact by selling through partners—companies who drive adoption of Microsoft technologies like Azure Cloud computing. Partner activity is significant: last year, 95% of Microsoft’s commercial revenue was earned through partners. In 2017, Microsoft established the One Commercial Partner (OCP) division to centralize teams that recruit, grow, and interface with Microsoft Partners.

Currently, OCP manages a large portion of the partner investment pipeline through “OCP Investments,” an internal web-based tool that permits partner-facing roles to request investments on behalf of partners. While OCP Investments was originally designed for a single investment type, it has expanded to accommodate other funding sources and is anticipated to scale further. During the project’s scoping phase, the Tauber team identified OCP Investments as a strategically important aspect in the overall investment process with impact on the request development pipeline, investment timing, and data management policies both corporately and globally.

The team established a baseline of the user experience and backend operations through a series of 23 interviews, survey of partner-facing stakeholders, and engagement with the operations division to define pain points, elevate best practices, and quantify the process timeline. Concurrently, the team analyzed performance data from requests submitted through OCP Investments. The team proposed and piloted three areas for improvement to solve users’ largest issues of getting to and through the investment process. These include 1) developing a central landing page to direct requesters to the correct funding tool or function, 2) designing an improved process flow within OCP Investments to intuitively guide users through the application process and mitigate opportunities for user error, and 3) integrating a monitoring system within OCP Investments to provide performance feedback to managers, operations, and users.

The project expects to shorten the average investment development and approval timeline by 31 days with a total increase in revenue at fiscal year close of over \$30M. Improvements to the request development process would result in projected annual labor savings of \$260,000. These recommendations underpin visibility on the new process globally, which will help to increase the pipeline of potential investments, and a single-entry point to allow for better evaluation of investments and more informed strategic decisions made by OCP leadership.

THE PACIFIC GAS & ELECTRIC COMPANY

Streamlining Gas Leak Detection and Repair

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Pacific Gas & Electric Company (PG&E) serves approximately 4.3 million (MM) natural gas customer accounts in northern and ventral California, the second-largest customer base in the country. The Gas Operations department oversees the daily transport of 2.6 billion cubic feet of natural gas per day over 42,000 miles of distribution pipelines and 6,700 miles of transmission pipelines. Pressurized gas is a highly flammable commodity, with the potential for serious safety risks if system integrity is not managed appropriately. PG&E sought to streamline its gas leak survey and repair processes to maintain a high safety standard and reduce complexity, which would reduce costs, improve visibility, and reduce rework.

Gas leaks can develop on many different types of infrastructure in a wide variety of ambient conditions, all of which influence repair procedures and the resulting planning, scheduling, and documentation of the repair. The process of finding and fixing leaks grew to meet the individual requirements of each unique situation, which created redundant steps and complexities. Reducing these inefficiencies represented a major opportunity for the Gas Operations department to begin its “lean” journey.

The Tauber team conducted nearly 100 interviews and 30 site visits, and facilitated a kaizen event, to define the current process, identify areas for improvement, and brainstorm solutions. The team classified issues according to the eight wastes of lean, categorized solutions according to feasibility and impact, and selected eight solutions with the highest potential for process improvement. These solutions targeted scheduling and coordinating repair work, reviewing survey and repair paperwork, and matching resource capacities throughout the process to improve flow. In conjunction with developments from PG&E’s internal mobile application department, Digital Catalyst, the team expects these solutions to simplify the process from 52 to 31 high-level steps.

The team completed one solution and began pilots for two others, which are expected to generate cost savings of around \$90,000 in 2018. By following implementation plans for other solutions and continuing to develop technology that streamlines documentation, PG&E could save an additional \$1.4 million per year. Further, the team projects that the company can reduce total processing and waiting time by 38% per leak, which will increase the proportion of value-added to non-value-added time. Finally, while this project focused on gas leaks occurring on smaller, “local” infrastructure, there may be significant opportunities to expand the solutions to other groups within the Gas Operations department.

PEPSICO, INC.
Filler Recirculation to Reduce Carbon Emissions
and Water Losses

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PepsiCo is a global powerhouse in the food and beverage business, reaching more than 200 countries with 22 billion-dollar brands including Pepsi, Gatorade, and Quaker Oats. With such far-reaching impact, PepsiCo strives to lead responsibly. To meet that goal, the company has developed efforts directed at creating a healthier relationship between people and food. This includes goals to limit their environmental impact. The organization has publicly committed to reduce absolute greenhouse gas (GHG) emissions across its value chain by 20% by 2030 and water consumption intensities in their operations by 25% by 2025.

The Tauber team focused on a resource conservation project that will reduce energy and water use during the production of Gatorade. During pasteurization, Gatorade is heated and then cooled, which requires fuel, water, and electricity. Due to the current system design, 10-15% of Gatorade production is not bottled during filling and as a result, it is re-pasteurized, resulting in increased GHG emissions and water losses. The team's objective, therefore, was to design and standardize process modifications that would result in substantial environmental and financial savings, and to gain alignment for the process change from leaders across PepsiCo.

The team's first step was to analyze historical filler data to quantify both the financial and environmental savings, and impacts on key thermal process parameters. Next, the team considered factors relating to food safety, food quality, ROI, technical feasibility, machine variation, robustness, and operational simplicity to develop a system design to maximize savings by ensuring full recovery of product that is re-pasteurized. At the same time, the team led a cross-functional group of executives from PepsiCo's Quality Control, Quality Assurance, Food Safety, R&D, and Engineering teams gaining their approval for a process change that would positively impact Gatorade production nationally. Finally, the team began early-stage implementation of the system modifications in multiple Gatorade plants, and developed a guidebook and roadmap for the PepsiCo Engineering and Sustainability team to systematically implement the process changes across the entire Gatorade network.

Successful implementation of the system modifications is projected to result in annual cost savings of \$660K. More importantly, it will result in a 4.6% reduction in absolute GHG emissions and a 0.8% reduction in water usage intensity. These represent 23% and 3.2% of PepsiCo's GHG and water reduction targets for the Gatorade business, respectively. Furthermore, if implementation across the Gatorade business proves successful, PepsiCo may investigate extending the project outcomes to other business units, which would multiply the benefit.

THE PRINCIPAL FINANCIAL GROUP
Developing a Portfolio Management Platform

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Principal Financial Group (Principal) is a \$668.6 billion global financial investment and insurance company. Principal Portfolio Strategies (PPS), an asset allocation boutique within Principal Global Investors, manages over \$120 billion in assets for its clients. PPS was eager to create a single platform to streamline its processes and data sources with the goal of increasing the customizability and scalability of its portfolio offerings.

PPS managed its portfolios in multiple systems across different locations. Due to the recent merging of the three strategies within PPS, there were many non-uniform and non-repeatable processes. The Portfolio Managers did not have a systematic way to find the necessary data in one system, which impacted the CIO's visibility into the portfolios of PPS. This lack of visibility inhibited the scalability and customization of client portfolios. The CIO wanted to increase PPS' competitiveness and generate a significant cost and time saving by improving its operations with a single unified portfolio management platform. To address this opportunity, the Tauber team first validated the need for this portfolio management platform by conducting a current state analysis using value stream maps. Next, the team worked to design a prototype. The team then gathered data and utilized Microsoft Power BI as the tool to build an initial prototype of the platform. Additionally, the team built a database to support implementation. Finally, the Tauber team documented their progress by creating a short-term and long-term workplan to ensure a smooth continuation of the platform development for PPS.

Based on the prototype, the team successfully demonstrated the potential impact of the platform. A fully functional version of this prototype will enable PPS to address problems pertaining to information clarity, efficiency, human errors, costs, quality of analysis, and scalability. As a result, PPS will be able to grow, create more custom portfolios, and scale its operations. The team's prototype is affecting the movement of over \$120 billion in assets under management. More importantly, other areas of Principal are now asking for a platform with similar functionalities to the team's prototype. In the long term, an opportunity exists to shape the entire \$668.6 billion company using the team's prototype design.

SPACELABS HEALTHCARE

Flex Line Implementation and Inventory Optimization

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Spacelabs Healthcare is a subsidiary of OSIE that manufactures and distributes patient monitoring, anesthesia delivery, and diagnostic cardiology medical equipment. Spacelabs has earned a reputation for medical monitoring innovation, servicing patients in over 120 countries. As part of their commitment to outstanding care for their patients, Spacelabs is also committed to the development of a lean culture.

Patients at Spacelabs’ hospital partners expect prompt and reliable care. Consistent, innovative, and well-manufactured instruments and supplies, delivered with perfect quality and on time, are critical to the ongoing treatment of hospital patients. Spacelabs’ lean journey starts at their Snoqualmie, WA facility where 100% of their distribution and manufacturing activities take place. The Tauber team contributed to Spacelabs’ lean journey in three ways, leveraging the DMAIC format.

Flex Line. The team designed and implemented a flexible manufacturing line, allowing assembly of six products previously manufactured in separate, dedicated lines. The team gathered the Voice of the Customer from manufacturing associates and supervisors, created value stream maps, and performed statistical analysis on customer demand trends to implement the line. The line exhibited lean principles, handling quick changeovers of 250 parts, utilizing Kanban visual cues, and enhancing employee comfort through improved ergonomics. The new line reduced occupied floor space by 72% and reduced wasted movement by over 10%.

Inventory Planning & Order Fulfillment. The team recommended an inventory stocking plan to improve order fulfillment for supplies and accessories SKUs responsible for 20% of total revenue. The team developed statistical models to understand order patterns and created a simulation tool to check the stocking model, which yielded a service level over 97%. The team also used spaghetti diagrams and time studies to analyze the inventory locations, and developed a python program to identify high-impact items to be relocated to a central location. The initial phase of relocation was implemented, which reduced picker movement by 8%.

Lean Assessment Tool. The team developed a lean assessment tool that Spacelabs will use to define its current practice and measure future progress toward its world-class, lean operations goals. The assessment is based on key indicators of both general and company-specific lean principles. Operations management performed a self-assessment and specific projects focusing on visual management and communication were influenced by the outcome of the assessment and written into the management team’s goals and objectives.

The implementations and recommendations completed by the Tauber team will provide Spacelabs with significant cost savings and generate momentum for the future as Spacelabs continues its lean journey.

STANLEY BLACK & DECKER

Improving Labor Productivity in the Chesterfield Plastics Plant Assembly Department

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Ziyan Xu - Master of Engineering in Manufacturing

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Stanley Engineered Fastening (SEF), a division of Stanley Black and Decker, manufactures and supplies fasteners for the North American automotive industry out of its Chesterfield, MI plant. The assembly department in Chesterfield has grown by 100% in terms of capacity over the last 2 years. Considering the fact that more than 80% of the activities are manual, SEF management tasked the Tauber team with increasing labor productivity by 20-30% (approximately \$400K savings per year) through a combination of immediate improvement projects, smart factory systems, and strategic long-term projects.

After value stream mapping the assembly department and interviewing various stakeholders, the team identified several projects which included both immediate and long-term improvement opportunities. First, to reduce non-value-added activities, the team implemented a bell notification system. Second, to alleviate ergonomic issues and eliminate scrap for a part family, the team redesigned and implemented an assembly press. Third, to replenish material efficiently, the team suggested implementing Kanban system by utilizing a water spider.

Fourth, to improve labor productivity, the team recommended several Smart Factory systems. These systems consisted of suggesting three automation projects to liberate labor for additional jobs, an automatic box filling system to make the material flow more efficient, and a vertical carousel storage system to reduce inventory locations. Fifth, to accommodate the Smart Factory systems, the team modified the existing assembly department layout. Sixth, to support more customer orders and increase available space for potential automation projects, the team created a future department layout in a new location. Finally, to increase in-house production capacity of strategic parts, the team developed an outsourcing strategy by subcontracting trivial parts.

The recommendations suggested are estimated to save the Chesterfield plant \$781K in actual savings per year. If potential savings from space gained are considered, the estimated total savings will be \$1.56 million per year, almost four times the target. In addition to labor savings and increased efficiency, these projects will promote the Chesterfield facility as one of Stanley’s “lighthouse plants”—a model location for pilot concepts that may be rolled out company-wide..

STONERIDGE INC.

Optimizing Logistics for Total Cost Reduction

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Stoneridge Inc. (SRI) is a global auto parts manufacturer that produces control devices and electronic components for commercial, passenger, and agricultural vehicles. Projected to reach nearly \$900 million in revenue for 2018, SRI’s rapid growth has led to convoluted supply chains. Recognizing the potential for waste within their logistics structure, SRI sought to optimize three problem areas within the firm by involving the Tauber Institute in its continuous improvement effort.

First, SRI sought to optimize its India-to-Lexington, OH supply chain segment, which was projected to have ballooning freight costs from expedited air shipments. The Tauber team leveraged learned academic models to redesign this route and developed an implementation plan to move freight from air to sea. The team’s improvements are estimated to drive \$400K in annual savings.

Second, the team analyzed warehousing operations at the Lexington facility. Above capacity, the Lexington warehouse struggled with movement waste and safety concerns. Negotiating with outside suppliers, the team modeled the cost benefits of relocating warehouse operations and opportunity for safety improvements. Understanding the potential impacts on employee livelihoods, the team determined that labor reallocation would have a more positive impact on the bottom line than labor reduction. Excluding the potential additional revenue from newly free space—estimated at up to \$5 million—the team’s model identified \$300K in annual savings.

Third, the Tauber team travelled throughout Europe, Asia, and the United States seeking consolidation opportunities for SRI’s global freight. The team determined the greatest opportunity for savings is along Asia-U.S. routes. Analyzing these routes, the team negotiated consolidation services with third-party freight forwarders and identified a consolidation model for shipments from Taiwan to the U.S. Implementation should drive roughly \$100K in annual savings.

SRI’s CEO pushed the team to both drive implementation of the \$2.4 million, 3-year savings and identify cultural improvements to better SRI. The team obtained financial approvals, established implementation frameworks, and outlined project team structures to begin implementation and facilitate a smooth handover to permanent employees. Drawing from roadblocks in their project, the team developed a series of out-of-scope recommendations to improve work agility, collaboration, and internal entrepreneurship, fostering positive, non-monetary change.

TARGET CORPORATION

Reducing Distribution Center Cycle Time in Freight Processing

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Target Corporation is an upscale, discount retailer that provides high-quality, on-trend merchandise at attractive prices, generating \$72B in annual revenue. Target has 25 Regional Distribution Centers (RDCs) that support 1,800+ retail stores in the United States. It is pursuing strategic initiatives to improve the guest experience, which includes increasing the number of fulfillment options by leveraging its vast store network and opening small-format stores in urban markets with localized products. As in-store fulfillment options and product offerings increase and space for inventory decreases, Target needs a fast and flexible supply chain to replenish stores from its RDC network.

Receive-to-Put is an Inbound RDC process that spans carton receipt on the inbound docks to putaway in reserve storage locations. The Tauber team was tasked with reducing the Receive-to-Put carton cycle time because it is too long and variable to support Target’s strategic initiatives.

The Tauber team employed an 8-Step Problem Solving Framework to structure the 14-week internship. Analyzing historical carton-level data revealed that cartons received on the Manual Dock (as opposed to automated technology docks) contributed 42% of all cartons that did not meet current cycle time goals, representing the largest opportunity for improvement. The team manually collected data to investigate where cartons wait and the root causes why. This revealed that cartons wait on the dock 2x longer than in the aisle. The Tauber team redesigned the Manual Dock staging and pickup process to prioritize older cartons to be picked up and visually manage on-dock carton buildup, reducing the length and variability of wait time on the dock. The team piloted the process in an RDC, then built a simulation to theoretically predict the long-term impact of the revised process.

The pilot test and complementary simulation suggests a 15% reduction in average cycle time and a 13% reduction in the time it takes to process 90% of all cartons (the 90th percentile) for the total Receive-to-Put process. Following the success of an extended pilot test, Target’s goal is to implement this new process throughout its RDC network. Stabilizing and reducing the on-dock cycle time paves the way for future improvements in the Receive-to-Put process.

THE WHIRLPOOL CORPORATION

Additive Manufacturing for Production Tooling

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Whirlpool Corporation is the world’s leading major home appliance company, with approximately \$21 billion in annual sales, 92,000 employees, and 70 manufacturing and technology research centers. The Global Advanced Manufacturing Engineering (GAME) Department works at the forefront of Whirlpool’s innovation initiatives identifying and integrating state-of-the-art process technologies in manufacturing operations. As part of their Industry 4.0 efforts, the GAME Department recognized additive manufacturing as a potential means to increase manufacturing productivity and reduce operating costs associated with production tooling.

Whirlpool’s current process for production tooling applications, including robot end-effectors, fixtures, jigs, and hand tools, required multiple setups and substantial labor with conventional manufacturing methods. Furthermore, manufacturing engineers routed complex and unique production tooling designs to their plant’s tool and maintenance shops, adding to the workload of machinists primarily focused on maintaining production operations. The GAME Department forecasted these production tooling applications to grow with the expansion of automation projects and the rollout of Whirlpool’s World Class Manufacturing program across the globe.

To support Whirlpool’s automation and process improvement initiatives, Whirlpool requested that the Tauber team develop a strategy to achieve cost savings over conventional manufacturing by using additive manufacturing for production tooling. The team first researched additive manufacturing technologies, materials, vendors, and potential use cases. Next, the team collected computer-aided design files for production tooling across several plants, and analyzed the performance of conventional and additive manufacturing methods for these designs. The team then built a decision support tool to help engineers identify designs that could leverage the strengths and savings of additive manufacturing. The Tauber team tested and refined this decision support tool across four pilot experiments with different collaborative robot end-effectors at three plants. Further, the team conducted extensive interviews with technicians, engineers, tool shop managers, and engineering managers to gauge the applicability of additive manufacturing to future projects. Finally, the Tauber team generated a roadmap for implementation and delivered a technical bulletin to share additive manufacturing knowledge across Whirlpool’s engineering network.

The team’s analysis showed a potential reduction in the cost of robot end-effectors and manufacturing aids by 56-92% and lead time by 60-76% with additive manufacturing. Moreover, the team predicts that over 500 production tooling projects per year could utilize additive manufacturing with increasing quantities as the World Class Manufacturing program spreads across the enterprise. With adoption of the Tauber team’s recommendations for additive manufacturing, the team estimated that Whirlpool will save over \$3M across the next three years as a result of production cost savings, lead time savings, and other savings related to production tooling projects.

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From
Richard Chin, Kiwon Clark,
Alex Herz, Andy Miller,
Camron Smith, and Erez Wohl
at Microsoft

Congratulations
on a successful
& productive
internship

Thank you

We would like to convey our heartfelt congratulations for collaborating across organizations to deliver impactful projects to move the business forward.

Mary Grace Pellegrini

I've loved the exposure to hear from senior leaders at the company as well as external thought leaders like Phil Knight and Melinda Gates. Working at Microsoft has been a rewarding chance to dabble in a full spectrum of passions.



Sameer Arora

I have enjoyed the culture here at Microsoft. Everyone has been extremely helpful and open with me to help me succeed. I have also loved the Seattle area, especially the food and the access to the outdoors!



Michael Barnes

I really enjoyed the effort spent by Microsoft in making sure the interns had a great time during their internship. From the various MBA Executive Speaker Series to the Microsoft Signature Event, Microsoft did an amazing job showcasing the company to interns.

Lucas Brittain Wilcox

Before I came to Microsoft I didn't realize how much of an impact partners had on Microsoft. It has been extremely rewarding to work on a project that will help drive future growth of that impact as well as improve the relationship with partners.



Rahul Hingorani

Microsoft far exceeds any company I've worked for in the past on providing access to higher level executives. Over the summer I have had the ability to hear from Chris Capossela, Amy Hood, and even our CEO Satya Nadella.





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