MICHIGAN ROSS // COLLEGE OF ENGINEERING

TAUBER INSTITUTE
FOR GLOBAL OPERATIONS
UNIVERSITY OF MICHIGAN

2017 SPOTLIGHT!

UNIVERSITY OF MICHIGAN
BICENTENNIAL

In 1817, the "University of Michigania" was founded in Detroit. In the 200 years since, the University of Michigan has become a research powerhouse, a center of innovation and entrepreneurship, and one of the top universities in the world. We celebrate our bicentennial and look forward to a third century of learning, teaching, and discovery.

Front cover photo
Interior staircase of the Bob and Betty Beyster Building. The staircase spans four levels. The building comprises 60,000 square feet of offices, research labs, instructional space, and common areas.

The Beyster Building houses the College of Engineering's Computer Science and Engineering faculty supporting computer science and information technology, and its open spaces provide wonderful opportunities for interaction between and among faculty and students.

Photographer: Philip Dattilo

WELCOME

Damian Beil

Larry Seiford

Ray Muscat

Dear Honored Guest, September 15, 2017

Welcome!

We are pleased you are joining us at *Spotlight!* 2017. This is the Tauber Institute's 24th *Spotlight!* event and it promises to be our best. Thirty-one team projects, featuring 21 sponsoring companies from a wide range of sectors including manufacturing and supply chain, healthcare, energy, technology, logistics, and more. You will experience the stimulating results of their 3½-month summer efforts.

Your day will begin with opening remarks from Mary-Ann Mycek, Associate Dean for Graduate Education at the College of Engineering, followed by acknowledgment of our longtime sponsors. The opening ceremony will be followed by seven sessions, and you'll be able to choose from several project presentations. Later in the afternoon, our closing ceremony will include remarks from Joel D. Tauber and Dean Scott DeRue of the Ross School of Business and the presentation of alumni scholarship awards. The ceremony will conclude by announcing the judges' choices for top teams and making scholarship check presentations.

Thank you for joining us on this extraordinary day. We sincerely hope you enjoy your *Spotlight!* experience.

Best Regards,

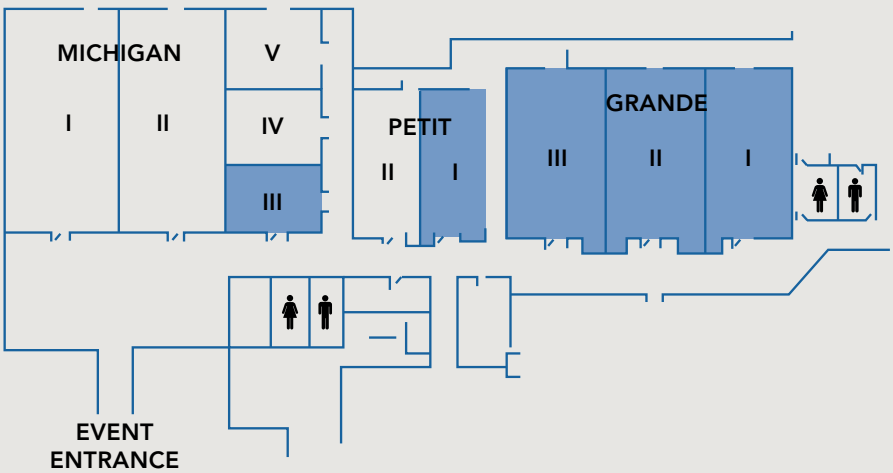
Damian Beil
Ford Motor Company
Co-Director and Professor
of Technology and Operations
Ross School of Business

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

Ray Muscat
Industry Director
Tauber Institute for
Global Operations

SCHEDULE & EVENT MAP

7:15-8:00	Continental Breakfast – Sheraton				
8:00-8:20	Opening Ceremony – Sheraton Michigan Rooms I and II				
8:20-8:35	Transition Period				
	MICHIGAN III	PETIT I	GRANDE III	GRANDE II	GRANDE I
8:35-9:05	Amazon Problem Solve	3M	Boeing 777X		Cardinal Health
9:15-9:45	Dell	Amazon FBA Transportation	PG&E		AIP
9:55-10:25	PepsiCo	Amazon Truck Utilization	Microsoft Licensing		Target
10:25-10:45	Break				
10:45-11:15	Dow	Whirlpool	Amazon Cross Dock	Amazon Gamification	Microsoft Procurement
11:25-11:55	Fresenius Value Stream	Stanley Black & Decker	Amazon Tracking Technology	GM Engine Quality	Pfizer
11:55-12:05	Transition Period				
12:05-1:00	Lunch – Sheraton Michigan Rooms I and II				
1:00-1:10	Transition Period				
1:10-1:40	BorgWarner	AM General	Boeing BDS	GM Supply Chain	Amazon ICQA Elimination
1:50-2:20	Ford	General Mills	Cummins	Amazon FBA MWS	Boeing Supplier
2:20-2:40	Afternoon Break – Sheraton				
2:40-3:45	Closing Ceremony – Sheraton Michigan Rooms I and II				



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ABOUT TAUBER

INDUSTRY IDENTIFIED A NEED. THE UNIVERSITY OF MICHIGAN RESPONDED.

It all began in 1991, when a gathering of business leaders identified a key category of employees missing from their organizations: trained professionals who understood 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 D. 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 from INFORMS. But a truer measure of Tauber's success is that 99 percent of graduates quickly find 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, vying 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 **$460 million in savings** for project sponsors, an average of $14.4 million per project over three years.

"When someone from Tauber comes to us, we really consider them experts in the field and they have the confidence to tell us what needs to change, why it needs to change, and how we can actually implement that change. It's something that I tell people: you're going to get more than you expect."

—Scott Gallett, VP, Marketing & Public Relations, BorgWarner

AWARD-WINNING INSTITUTE

The Tauber Institute is the proud inaugural winner of the UPS George D. Smith Prize for effective and innovative preparation of students to be good practitioners of operations research, management science, or analytics.

MICHIGAN ROSS

MICHIGAN ENGINEERING
UNIVERSITY OF MICHIGAN

PHILANTHROPY

TAUBER'S "FIRST STUDENT"

GIVES BACK

TO NEXT GENERATION OF LEADERS AND BEST

Andrew Masterman (MBA '93, MSE Industrial Engineering/MA Japanese '93), recently donated $150,000 to the Tauber Institute for Global Operations to provide a scholarship for an aspiring Tauber student, bringing his experience full circle from 1993.

It was in that year that Masterman was in on the ground floor of what was to become the Tauber Manufacturing Institute (later the Tauber Institute for Global Operations). His input as a student advisor to the newly created Michigan Joint Manufacturing Initiative (MJMI, an interdisciplinary program administered by the College of Engineering and the Ross School of Business) was crucial then, and his input now as a scholarship donor remains integral to the future of the program.

Back then, Masterman was studying three very diverse disciplines: engineering, business, and international language. He didn't know it at the time, but he was blazing a trail for thousands of business and engineering students at the University of Michigan and beyond.

"It was an exciting time," Masterman recalls. "When the concept of an interdisciplinary program came up—because I was doing both degrees, plus a Japanese degree and MBA—they tapped me to be on an advisory board with the deans. I was providing the student voice on what the institute should be. It was really an amazing experience, being able to brainstorm on what the future of the institute should look like, what type of students we could attract, and what the goals and direction should be."

Because he had already been in the work force, Masterman could clearly see the benefit of an interdisciplinary program that combined hands-on manufacturing operations with business strategy. "It made complete sense to me. In essence, it was what I was trying to do on my own," he says. "There were other institutions out there focusing on international issues, and business and manufacturing, but none that combined it all together. Made a world of sense to me."

CONTINUING A TRADITION OF GIVING

Andrew Masterman served on the University of Michigan Ross School of Business Board of Governors for six years, and has been engaged with the Ross Business School for more than 20 years. He credits Professor Linda Lim with playing a huge role in creating a network of U-M alumni around the world. And he praises former Ross School of Business Dean Robert Dolan for making an impact on his desire to give back by creating an environment in which people wanted to contribute their time, talents, and financial support.

"I had been successful and felt it was right to give back. It made sense, and I felt the scholarship could have a significant impact with students," he says. "Dean Dolan's example made me want to continue the history of giving and hopefully stimulate involvement in the future."

> "It was really an amazing experience, being able to brainstorm on what the future of the institute should look like, what type of students we could attract, and what the goals and direction should be."

Masterman's career features work with a wide variety of international industrial businesses and significant experience managing large organizations. He recently became CEO of BrightView Landscaping Services, the nation's leading landscaping and snow removal company. Previously, he was Executive Vice President at Precision Castparts, a company that specializes in manufacturing structural investment castings, forged components, and airfoil castings for aircraft engines and industrial gas turbines. Prior to Precision Castparts, he served as President and Chief Executive Officer of North America for ESAB Group, Inc., a leader in welding and cutting equipment and consumables.

"At the end of the day, when you manage large businesses, you gain a skill base that lets you objectively look at it as an entire enterprise. I do believe being involved in the manufacturing world provides a great foundation for understanding the ways businesses work," Masterman says. "It is a testament to the educational base at Michigan — the fact I've earned business, engineering, and liberal arts degrees. That foundation creates flexibility of thought and a level of adaptability that's so necessary. Education needs to go that way — truly take advantage of that cross-functional education. Hopefully through this scholarship, we can identify students with passion for cross-functional disciplines."

What advice does he have for the 2017 Tauber students? "I would tell students that gaining a diversity of experience is critical. Don't limit yourself to a single industry; rather find situations where you can gain from multiple experiences. A diversity of experiences and rich flexibility is important for your ability to lead."

Andrew Masterman currently lives in Pennsylvania with his wife Cheryl and his three sons. The family loves to spend time outdoors, enjoying trips to the San Juan Islands of the Pacific Northwest each summer. Back home in the Philadephia area, Masterman and his wife are avid sports enthusiasts, and keep busy following their boys' activities.

But Masterman says he doesn't have to look very far to find University of Michigan alumni — no matter where he is. "The reality is that Michigan is an international school, and everywhere I've lived I have run into professionals who are U-M grads. We all share that Michigan perspective."

BE A VICTOR

FOR TAUBER STUDENTS

"As Tauber alumni, we believe we have a responsibility to give back to the Tauber Institute for Global Operations, which has helped so many of us to be successful in our careers. In an effort to substantiate this belief, we have set up a Tauber Alumni Scholarship Fund for second-year students. In the same spirit, we believe students have a responsibility to give back to the Tauber Institute while active in the program."

—Tauber Alumnus Geoffrey Phillips (MBA '98)

››› Make a gift online at:
tauber.umich.edu/giving

TAUBER YEAR IN REVIEW

2016 *SPOTLIGHT!* TEAM PROJECT SHOWCASE AND SCHOLARSHIP COMPETITION

In 2016, 32 teams composed of 82 students—and supported by 54 faculty advisors at 23 sponsoring global companies—worked in sectors including manufacturing and supply chain, healthcare, energy, retail, technology, and logistics to uncover solutions to operations-related challenges. The average savings was $14.4 million per project savings over three years. The total savings projected was $460 million.

In first place was the Boeing Company team of Alberto Arguello (MBA), Susan Biggart (EGL, BSE/MSE Industrial and Operations Engineering), and Travis Parsons (MSE in Electrical and Computer Engineering).

Tied for second place was the BorgWarner Transmission Systems' team of Kyle Gilbert (EGL, BSE Electrical Engineering/MSE Industrial Operations Engineering) and Ryan Kennedy (EGL, BSE/MSE Industrial and Operations Engineering).

Also tied for second place was the Fresenius Medical Care team of Katie Redman (MBA) and Matt Riley (EGL, BSE Chemical Engineering/MSE Industrial and Operations Engineering).

Receiving $2,500 Alumni Scholarship awards for service to the Tauber Institute: Misaki Nozawa (MSE-ME) and Nantha Rajendran (MBA).

The Boeing Company received awards in appreciation and recognition for 20 Years of Team Project Sponsorship. General Mills and the Dow Chemical Company were presented with an award in appreciation and recognition for five Years of Team Project Sponsorship.

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.

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 2017, we made a positive impact on the Ann Arbor community by donating expert operations advice to Community Action Network, Food Gatherers, Growing Hope, and the Humane Society of Huron Valley.

2017 INTEGRATED PRODUCT DEVELOPMENT TRADE SHOW

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

The culmination of this year's course was the 2017 IPD Trade Show, which took place in April and featured an exhibition of products from six teams of U-M students from the Stamps School of Art & Design, College of Engineering, School of Information, and Ross School of Business.

Each team was required to have at least one member from the four schools in order to work through a variety of important elements of product development—including the process of market research, concept generation and selection, technical development, production process design, pricing, inventory stocking, and advertising.

The 2017 new product challenge: Wearable Technologies.

This innovative 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.*

TAUBER YEAR IN REVIEW

GLOBAL OPERATIONS CONFERENCE

Tauber's 10th Annual Global Operations Conference brought together industry and academia to discuss "New Frontiers in Operations." Experts from a wide range of industries shared how rapidly expanding Operations concepts are redefining the competitive landscape. Featured speakers included Somesh Nigam, IBM VP of Information & Data Governance and Health Informatics in the Global Chief Data Office; Stitch Fix VP of Operations Jonathan Czaja; and Dow Chemical Company Global Supply Chain Visibility Leader Jeff Tazelaar. Faculty moderated robust panel discussions on Globalization through Operations, the Evolution of Operations in Healthcare, and Big Data and Predictive Analysis, featuring leaders on the front lines of Operations at Amazon, PwC, Cardinal Health, Henry Ford Health, the Mayo Clinic, Boeing, General Mills, Whirlpool, and Verizon Wireless.

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, and the tangible steps students can take to achieve excellence in their own career paths. The 2016–17 speaker series featured Peter Denk, president of Electrical Drives NA at Robert Bosch LLC, who led a discussion on building a high-performance team; George F. Halow, technology strategy and planning manager at Ford Motor Company, who addressed issues of ethics and integrity in business; and Peter Frank, advisory principal at PwC, who discussed opportunities and risks presented by current megatrends.

"Interdisciplinary study is crucial today. No single discipline operates on its own in a vacuum apart from other disciplines. The Tauber Institute for Global Operations enables engineering and business students to interact with each other and learn interdisciplinary skills. The Tauber Institute allows students to work in a truly interdisciplinary environment."

—Mark Daskin, Clyde W. Johnson Collegiate Professor of Industrial and Operations Engineering, Chair and Professor of Industrial and Operations Engineering, and Professor of Operations and Management Science

RATE LEAN: FAST

Rate Lean: Fast helps give 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.

During his 45+-year career, Tauber Executive-in-Residence R. Eugene Goodson has evaluated plants all over the world. Lean manufacturing, visual management, and the importance of an empowered workforce are major tenets of his management philosophy.

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.

"Students are hungry for real stuff. So touring plants and assessing them is something they really embrace. It is real, not theory. Having an experience where they can go out into the industrial world and be capable of assessing it is something they value. I hear from students who took the RPA course at Michigan saying they use it all the time. I have been around long enough that I have seen the pendulum go back and forth. The educational process tends to go naturally to theory but students move to: how does this really work?"

—R. Eugene Goodson, Tauber Executive-in-Residence

"Looking back, being a Tauber student was one of the best experiences of my life. I was skeptical that I could even do it, but the support system is so great, I did very well. I'll always continue to support U-M and Tauber alumni, and encourage others to be involved."

—Tauber Alumnus Chandrashekar Shastry (MSCM '13), Manager - Healthcare Operations at OptiFreight Logistics at Cardinal Health

TIME DEALER OF THE YEAR

A panel of Tauber Institute business and engineering faculty selected the 48th annual TIME Dealer of the Year Award finalists from each of the four National Automobile Dealers Association (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.

Carl Swope, president of Swope Toyota in Elizabethtown, Kentucky is the 2017 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.

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 the Tauber Institute 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 General Manager Automotive and Aftermarkets Division

A.T. Kearney Inc., Paul Carrannanto, Partner

Amazon, Sanjay Shah, Vice President, NAFC Operations/IAB President

American Industrial Partners, Danny Davis, Partner

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, Stefan Grunwald, Senior VP Global Sourcing

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

Dell Inc, Piyush Bhargav, Executive Director, Executive Director, Global Materials & Packaging

The Dow Chemical Company, Tom Ammerman, Supply Chain Director

DTE Energy Company, Sharon Pfeuffer, 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, Vice President and Head Manufacturing, Americas and Europe

Mayo Clinic, Russell Rein, Administrator, Enterprise Department of Cardiology

McKinsey & Company, Russell Hensley, Director

Microsoft, Rick Lawlor, Senior Finance Director, Corporate Accounting

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

Pfizer Inc., Paul Stuart, Vice President, Drug Product Supply

Pacific Gas & Electric, Mallik Angalakudati, Vice President, Corporate Strategy

Precision Castparts, Jay Khetani, Vice President, Strategic Business Development

Steelcase, Tom Dawson, Chief of Staff for Global Operations

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

Chagrin Consulting Associates, Roger Kallock, Chairman & CEO

Tauber Enterprises, Joel D. Tauber, President


Sanjay Shah
President


Scott Gallett
Vice President


Mae Zyjewski
Vice President


Laurie Altman


Paul Carrannanto


Danny Davis


Randall Scheps


Ed Petkus


Stefan Grunwald


Craig Weiss


Piyush Bhargav


Tom Ammerman


Sharon Pfeuffer


James
VanSlambrouck


Daniel Grieshaber


Kevin Harrington


Nitesh Bansal


Russell Rein


Russell Hensley


Rick Lawlor


Rick Jarman


Paul Stuart


Mallik
Angalakudati


Jay Khetani


Tom Dawson


Roger Kallock


Joel D. Tauber

EDUCATION IN ACTION

Over the summer, 72 students participated in 31 team projects sponsored by 21 global firms. Team projects are highly visible operations-related challenges with both engineering and business components. Tauber's 2017 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 19 continuing sponsors—3M, AIP, Amazon, Boeing, BorgWarner, Cardinal Health, Cummins, Dell, Dow, Ford, Fresenius, General Mills, GM, Microsoft, Pepsi, Pfizer, PG&E, Stanley Black & Decker, and Whirlpool—and to begin new partnerships this year with AM General and Target.

Tauber students addressed substantive issues such as lean process design and implementation, business unit manufacturing plans, manufacturing site strategic assessment, supply chain implementation plan, strategic capacity analysis, material handling redesign, new product/process development strategy, product complexity analysis, managing transitions between products, plant floor layout, and manufacturing process design.

A successful project results in a significant return on a sponsoring company's investment. In 2016, the student teams worked on 32 projects from 23 companies, and averaged $14.4 million/per project savings over three years. The total savings projected was $460 million.

Team Ford at Flat Rock Assembly Plant


Team Boeing in flight simulator


Teams Amazon ICQA, Gamification, and Problem Solve working together.


Team Dell at Chennai, India

Team Fresenius in Concord, CA plant.


Team Pfizer at the Groton, CT plant.

THE CHANGING FACE OF OPERATIONS

Today, we are celebrating yet another successful summer at Tauber. The depth and breadth of our students' projects say a lot about the demands faced by operations in an ever-changing world. Tauber's strong global reputation means that we're able to partner with leading global companies, who know that our students can be called upon to solve some of their most challenging problems.

Today's projects reflect the changing face of operations. Whereas in the past, the majority of projects focused on issues dealing with supply chain and lean manufacturing—still important challenges in today's operations—companies have now added elements of modeling and strategic planning to their project requirements. While skills such as value stream mapping and lean/six sigma are still vital to operations work, our project sponsors are also demanding skills in machine learning, big data, and analytics. As the amount of data available has grown exponentially, companies continue to look at how to harness this information to improve performance. Additionally, sustainability and the international nature of operations continue to be a common thread in many of our Tauber projects, all of which are team projects—another feature that distinguishes Tauber from similar programs at other universities.

Industry composition has also changed over time. While traditional manufacturing industries such as automotive, aerospace, and diversified manufacturing continue to be highly valued and strongly represented, technology/telecommunications companies have grown to become a bigger piece of the pie. Operations, in its broadest possible definition, is now recognized as a vital competitive element regardless of business sector. Across all industries, supply chain and logistics play an increasingly important role in helping to serve customers in unique and differentiated ways, with speed now a common element.

These factors have combined to create an incredibly diverse portfolio of Tauber student team projects. Whether it's managing worldwide environmental challenges, developing faster and more efficient product commercialization, or designing world-class manufacturing systems, Tauber students welcome the challenges to improve operations as part of their training to become the next generation of leaders. It will be exciting to see what lies ahead for our Tauber students of the future.

Ray Muscat
Industry Director
Tauber Institute for Global Operations

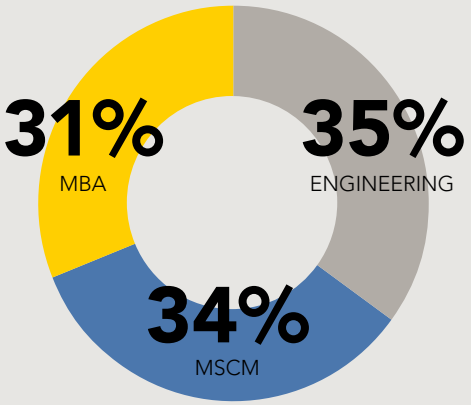
TAUBER INSTITUTE CLASS PROFILE 2016

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.

98%
STUDENT PLACEMENT

52%
ACCEPTED POSITIONS WORKING FOR TEAM PROJECT SPONSORS AND/OR TAUBER CORPORATE SPONSORS

86
STUDENTS GRADUATED BETWEEN AUGUST 2015 AND APRIL 2016



CULTIVATING THOUGHT LEADERSHIP

DEGREE PROGRAMS ASSOCIATED WITH TAUBER

Tauber students can be admitted through either the College of Engineering or the Stephen M. Ross School of Business. The majority bring with them significant experience in fields such as product engineering, manufacturing, and consulting. Most Tauber students also have undergraduate training in engineering and 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 enroll 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.

Master of Supply Chain Management (MSCM)
This one-year program includes every aspect of global commerce: marketing, sourcing, manufacturing, logistics, inventory management, information technology, and customer relations.

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. 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
A graduate-level engineering degree program that, coupled with Tauber requirements, provides intensive coursework 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 1,300-+ 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 TAUBER ADVANTAGE

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

- The **LeadershipAdvantage℠ program** comprised 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 of students 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, and prioritize the targets of opportunity for 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 directly from current leaders in operations from top global firms. The 2017 Leadership Forum offered students insider views of aerospace, energy, technology, and big-box retail management.
- 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 think and act locally as well. 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.

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3M COMPANY

Streamlining Demand Planning

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3M is a global manufacturer of products across multiple industries, grouped into five business groups: Industrial, Healthcare, Electronics and Energy, Consumer, and Safety and Graphics. The company generates over $30 billion in revenue due to fundamental strengths in technology, innovation, manufacturing, global reach, and brand. The Automotive Aftermarket Division (AAD) manufactures products for each stage of the automotive repair and refinishing process.

The abrasives product portfolio supply chain, the focus of the team's analysis, was often placed under enormous pressure due to episodic demand spikes. The supply chain was not well planned for this erratic demand, leading to increased backorders, production overtime, and superfluous expediting costs. The team was tasked with identifying the SKUs that drove this sales variability. These findings were to be used to help AAD improve their current demand planning process to decrease backorders, overtime, and expediting costs.

The Tauber team performed an analysis of historical sales for 3000 abrasive SKUs between January 2015 and February 2017, identifying multiple SKUs that consistently drove demand spikes. The team also developed a capacity planning tool and associated training documentation that, along with the key SKUs, were communicated to the production facilities to enable them to level load the facilities in preparation for demand spikes. The Team designed a new business process to better align sales, marketing, demand planning, and operations to establish proper metrics and information sharing across all functions. This process ensures coordinated procurement, production, and logistics operations to support sales efforts.

Utilization of the team's findings and implementation of the new business process will drastically increase supply chain responsiveness and is expected to lead to an estimated one-time cash savings of $2M–$6M in safety stock reduction for the abrasives portfolio and annual cost savings of $1M–$4M in overtime and expediting fees.

AMERICAN INDUSTRIAL PARTNERS – ACPI
NEW PRODUCT AND FACILITY LAUNCH

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Matt Gibson – College of Engineering

ACPI is a United States-based manufacturer and distributor of kitchen and bath cabinets, with annual revenues around $300M. The company was acquired in 2012 by American Industrial Partners, an operationally oriented middle market private equity firm. As a result, ACPI grew rapidly, focusing on expanding both its market share and manufacturing footprint.

In April 2016, acpi purchased a new manufacturing facility in Mount Union, PA, in order to serve as the home of a new frameless brand of cabinetry called Serenade Cabinetry and to assist production of existing brands in a nearby facility in Thompsontown, PA. This purchase was integral to capturing a new higher-end segment of the cabinet market and in creating capacity to support demand growth of existing brands. As a result of this purchase the Tauber team was challenged to develop a robust launch strategy for the Serenade Cabinetry brand and to launch key manufacturing lines at Mount Union to support the Thompsontown plant.

For the Serenade Cabinetry product launch strategy, the team developed a detailed competitive analysis with future product recommendations, a value-based pricing model, and a prioritized list of target customer dealers. To support manufacturing, the team transferred a slab door manufacturing process from Thompsontown to Mount Union, including process improvement measures. Finally, the team created a raw goods inventory replenishment model to assist with existing production and to support the manufacturing of Serenade Cabinetry.

Based on the territory and dealer analysis conducted by the team, the expected annual revenue of the product is estimated to be at $7M in 2018 with 240 dealers on board. The launch of the slab door process resulted in an additional $4M in annual revenue from freed capacity at the Thompsontown plant, coupled with a 58% reduction in lead time. Finally, the replenishment model set the stage to manage plant inventory worth $1M and rapidly growing.

AM GENERAL
EVALUATING COST FROM PROTOTYPE TO PRODUCTION

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AM General is a major player in the specialized vehicle industry, for both the military and commercial sectors. While the company is best known for the HMMWV "Humvee" used by military allies around the world, AM General serves as both an original equipment manufacturer (OEM) and a contract manufacturer for companies such as General Motors and Mercedes-Benz. The company's Engineering and Product Development Center in Livonia, MI is partnered to build and deliver a new prototype vehicle and is in the process of developing a bid for full-scale vehicle production. The primary concern is identifying and estimating all cost contributors for the production vehicle to determine a price to the customer.

To address this, the Tauber team coordinated with an AM General integrated product team (IPT) to identify the costs associated with moving from prototype to production. First, the team estimated the material cost of the current prototype design scaled to full production. As part of this effort, the team created a consolidated database of suppliers across AM General's military and commercial supply base to streamline purchasing and maximize economies of scale. Next, the team calculated the vehicle's total cost of ownership, mostly focusing on fuel expenditures, over the full lifetime of the vehicle to evaluate AM General's competitive standing beyond vehicle price. The team also assisted the IPT with determining required engineering investment—in dollars and time—to calculate a final vehicle price. The manufacturing costs and the capital investment required to set up a facility to run full scale production was also included in the final vehicle production price. Finally, the Tauber team coordinated with the IPT to develop multiple program timelines reflecting varying levels of investment risk and identifying the effects of each scenario on the overall program.

The primary challenge in calculating the program cost was the lack of complete and up-to-date information, as the vehicle was still in the development stage. The team identified appropriate sources of information, documented and justified assumptions, and explored options to populate missing data with a degree of confidence and precision. While the final cost remains confidential, the Tauber team provided major inputs to advise the IPT's ultimate recommendation to AM General and the company ownership regarding the status of the bid and the appropriate way forward.

AMAZON – CROSSDOCK

CROSSDOCK INBOUND VISIBILITY AND LABOR OPTIMIZATION

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As a world leader in retail, Amazon strives to be Earth's most customer-centric company. In an attempt to achieve this vision, the business continuously works to improve on a vast network to improve customer experience each year. To drive innovation within the supply chain, Amazon's Fulfillment Execution and Data Science (FEDS) team leverages technology and operations to develop and deploy data rooted solutions for the fulfilment network. Specifically, the Inbound Research Science team supports operations at crossdock warehouses. The purpose of a crossdock is to reduce costs by consolidating freight and optimally distributing units at fulfillment centers across the country.

As the first point of contact for many incoming units, crossdock play a vital role in the supply chain, and any variations or delays at crossdock can significantly impact downstream activities. For this reason, optimized labor allocation and hiring decisions are essential to ensuring Amazon meets customer promise. The FEDS Crossdock Tauber team was challenged with providing better visibility of incoming volume, flow, and backlog for upcoming weeks. With enhanced inbound accuracy, managers can better plan and hire labor to meet the required work demand. Better planning and hiring results in improvements in associate productivity and reductions in unhealthy labor and backlog buffers.

The Tauber team initially focused on doing a current state assessment of the labor planning process. Next, the team explored potential data sources and analyzed different prediction techniques. Using a statistically driven approach, the Tauber team developed a forecasting method for a pilot location. Working with crossdock leadership, the team initiated a controlled launch and performed validation and testing on the preliminary forecast model. After several iterations of fine-tuning the model and incorporating senior management feedback, the model was expanded and optimized for Amazon's entire crossdock network. A deliverable for the project that the team developed and published was a dynamic dashboard to both visualize and automate the forecasting tool. The server-based dashboard graphically presents actuals and predictions for volume, flow, and backlog over time and provides historical prediction accuracy. The tool was presented to all crossdock leadership and received positive responses. In addition to making improvements in prediction accuracy, the Tauber team's forecasts increase granularity with daily predictions. The project demonstrated potential savings in both labor hours and costs, ultimately improving operations of the crossdock network.

AMAZON – FULFILLMENT BY AMAZON MWS

LET APIs AUTOMATE YOUR WORLD!

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Amazon is a $130B company and strives to be Earth's most customer-centric organization, where people can find anything they want and buy it online. Fulfillment by Amazon (FBA) is a service for third-party Sellers on Amazon. FBA Sellers inbound shipments to Amazon warehouses, and Amazon stores, picks, packs, fulfills a customer order, provides customer support, and handles reverse logistics. FBA helps Sellers access Prime customers while improving product selection on Amazon.com. Amazon provides an integrated web service API (Application Programming Interface) that allows Sellers to programmatically exchange data with Amazon on listings, orders, shipments, payments, reports, etc., without having to go to the Seller Central Web application. In the long run, this scale of data integration ensures lower costs to customers by reducing the overall cost of the supply chain and increasing automation for Sellers and Amazon through adoption of MWS FBA Inbound APIs.

But over the years, APIs used by Sellers to inbound products have not been adopted extensively. The FBA Inbound Supply Chain team tasked the Tauber intern team to find out why.

The team identified the segments of Sellers currently using APIs globally based on specific attributes to explain the adoption and then extrapolated these attributes, quantitatively and qualitatively, to predict Seller behavior indicative of adopting Inbound APIs in the future. They then used value stream mapping on inbound processes and brainstormed a future state map. Due to the explosive growth of Amazon, some of the feature sets available via Seller Central were not available via APIs, creating parity gaps between the two services. The team launched new product features to fix the major gaps responsible for a suboptimal Seller experience. They also established a long-term adoption strategy by clearly defining target Sellers and how to communicate their value proposition.

The new feature launch will directly benefit a sizable number of Sellers with significant savings. Additionally, the adoption plan will reach out to large-scale FBA Sellers and is expected to result in substantial savings in overall supply chain costs directly to Sellers and lead to an outstanding Seller experience.

AMAZON – FBA TRANSPORTATION
INCREASING UTILIZATION OF THE PARTNERED CARRIER PROGRAM (PCP)

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Amazon is a $130B company and strives to be Earth's most customer-centric organization where people can find and discover anything they want to buy online. Fulfillment by Amazon (FBA) is a service for third-party Sellers on Amazon. FBA Sellers inbound shipments to Amazon warehouses, and Amazon stores, picks, packs, fulfills a customer order, provides customer support, and handles reverse logistics on behalf of the Seller. FBA helps Sellers access Prime customers while improving product selection on Amazon.com. FBA seeks to provide tools to Sellers to improve the efficiency of selling on Amazon. One of these services is the Partnered Carrier Program (PCP), which provides Sellers shipping inventory to Amazon FCs discounted freight rates. In the U.S., Partnered Carrier offers Sellers both less than truckload/ full truckload (LTL/TL) and small parcel delivery (SPD) options.

The FBA Inbound Transportation team tasked the Tauber team to improve utilization of PCP. The Tauber team focused on understanding the Seller decision-making process and priorities when it came to making transportation choices. This task is difficult due to the diverse business models and supply chains of FBA Sellers. Ensuring that PCP is aligned and provides service to as many Sellers as possible will allow more Sellers to benefit from the discounted rates provided by PCP (average 45%).

The Tauber team's initial focus was on conducting a current state analysis to capture trends in PCP utilization across different market segments. This current state review included data analysis, Seller interviews, Seller visits, and targeted polling. The analysis led the Tauber team to split the project along two paths; LTL/TL and SPD. The decision was based on the unique issues affecting each transportation method and different Seller experience.

Challenged to drive increased utilization of PCP the Tauber team implemented and piloted short-term solutions along with recommending long-term enhancements. The long-term recommendations are geared at not only increasing PCP utilization, but also improving the Seller experience of those Sellers currently using PCP.

AMAZON – GAMIFICATION

AMAZON NORTH AMERICA CUSTOMER FULFILLMENT FC GAMES USE CASE EXPANSION

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Behind Amazon's peerless selection and ever-shortening delivery times are thousands of dedicated fulfillment center (FC) associates performing repetitive, physical tasks every day. They are the engine that drives Amazon's ability to consistently provide excellent customer experiences. The work of an associate can be dull and often requires minimal engagement to perform, leading to attrition and plateaued performance. As Amazon continues to steep its trajectory of year-on-year growth, its fulfillment network also continues to expand at an exponential rate. With such rapid expansion, the cost of controlling attrition and increasing productivity is of the utmost importance. To mitigate rising attrition costs and increase FC productivity, the Tauber team focused on exploring solutions targeted at increasing associate engagement. Increased employee engagement has been shown to increase performance and reduce turnover. Thus, Amazon can increase FC productivity and reduce FC attrition by implementing solutions that positively impact associate engagement.

The Tauber team collaborated with ACES (Amazon Customer Excellence System) Ops Integration, AFT (Amazon Fulfillment Technology), and FC Operations Managers to explore FC Games. FC Games is a user engagement platform that provides video game experiences for associates while they work, driven by FC labor activities. The goal of FC Games is to provide FC associates with an experience that makes work more fun, leading to increased engagement, motivation, and job satisfaction.

Initially, the team sought to understand the state of engagement in the entire fulfillment network. Through deep dive data analysis of FC types and processes, the team was able to discern engagement differences across the fulfillment network. A mathematical model was developed to holistically score processes and FC types on multiple dimensions of engagement. The results of this model indicated that the Stow, Pick, and Pack processes in AR (Amazon Robotics) Sortable FCs suffer the most from low engagement.

The team set out to test gamification of the Stow process to understand the effects gamification has on engagement. On the floor competitions and challenges at BFI4, an AR Sortable FC in Kent, WA, were used to initially test gamification; however, the team quickly realized that while associates found the games fun, their engagement was triggered by seeing their performance improve throughout the day. This prompted the team to change course and test the effects of increased performance awareness on associate productivity and satisfaction. The results from the performance awareness pilot showed a 4.91% increase in Stow productivity. A previous study in the Pick process showed increased performance awareness led to a 3.40% increase in Pick productivity and an 11.35% decrease in injected defects. Together, these studies show that increased performance awareness leads to improved associate performance. If implemented network-wide, potential annualized cost savings from increased productivity are projected at over $50M for the current network, with a three-year 2018–2020 NPV of more than $500M. While the FC Games platform shows promise as a long-term engagement solution and should continue to be built and expanded across the fulfillment network, increased performance awareness can be implemented immediately, allowing Amazon to realize significant labor cost savings.

AMAZON – ICQA ELIMINATION

AMAZON NORTH AMERICA CUSTOMER FULFILLMENT ICQA ELIMINATION

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Amazon, the largest online retailer in the world, operates a vast network of Fulfilment Centers (FC) across North America. Within FC operations, Inventory Control and Quality Assurance (ICQA) teams help in maintaining the inventory accuracy and quality within process paths. The goal of this project is aligned with the long-term vision of eliminating ICQA from FCs in the Amazon Robotics (AR) Sortable network.

The team first created a strategy to integrate ICQA Count activities, amounting to 60% of ICQA labor hours, with existing workflows without compromising quality or other key metrics. After analyzing various process paths, integration with Pick and Stow process paths showed the most promise, as it will lead to maximum utilization of the already used station and tools and minimize deviation from the current processes. The intent of the integration is also to drive quality consciousness within the teams up to the Amazon Associate (AA) level. To see the concept in action and understand its impact on the operations metrics of productivity, operator utilization, and quality errors, the team designed the new integrated work processes and conducted a pilot study on the floor. With pilot iterations across different shifts, teams, and locations, the team saw a statistically significant improvement in operational metrics. Inputs from AAs, Operations experts, and the Robotics team were incorporated to create robust as well as simple new work process.

Next, the team led the cost-benefit analysis of the project and saw efficiency gains on various fronts. First, in absence of a simulation, the team used Little's Law to calculate the change in the number of inventory pods coming to a station in today's work stream vis-à-vis a future integrated work stream. With this, the team determined the reduction in robotic drives usage and identified potential savings of upwards of $170 M over the next three years. Next, the team conducted an in-depth study of the cycle time of the current and proposed work streams through on the floor pilots and historical data, and observed ~4.5% improvement in Operator Utilization (OU). Also, with no stations needed for Count in the future, every site will now have more Stow and Pick stations. With the increase in OU and number of stations, the network's annual capacity will increase by 16%. This increase translates to labor hour savings of $740+ M over the next three years. Post integration, the sites will also see reductions in operational wastefulness. In fact, 14% of the current pod movements can be made redundant, leading to savings of $60+ M over the next three years. Finally, FCs will have the flexibility to better balance labor requirements since sites will no longer have an indirect Count function. This will lead to further savings of close to $10 M over the next three years due to better resource allocation and labor planning. In total, the network benefits over $1 billion over the next three years with this integration.

For successful process change on the floor, key buy-in from associates was required. Thus, associate feedback and openness toward changed workflows was collected and feedback was very positive. The cross-function transfer request data yielded similar insights. The data also projected the strong pull of Stow and Pick associates to incorporate ICQA count functions. Post-pilot feedback has been even more encouraging with pilot associates finding the new integrated job easy to learn and less tiring. The above analysis and NPV upwards of $700 M, calculated over next three years, made an integration use-case more compelling. The team wrapped up by creating a business case for funding the project and creating handover plans for Amazon teams who will be driving the project for North American network-wide implementation in existing and future sites.

AMAZON–PROBLEM SOLVE
OUTBOUND PROBLEM SOLVE ELIMINATION

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David L Kaufman–College of Engineering

Amazon is the largest online-based retailer in the United States. To manage inventory owned by both Amazon and sellers in Fulfillment by Amazon (FBA), the company operates 80+ Fulfillment Centers (FCs) across North America. As Amazon continues its steep trajectory of year-on-year growth, its fulfillment network also continues to expand at an exponential rate. Amazon plans to open over 10 new FCs in the last two quarters of 2017 alone; with such rapid expansion, the need for robust processes against defects in customer order fulfillment has become more important than ever.

Currently, between 1–2% of all outbound shipments experience an issue that requires intervention by problem-solve associates for their successful fulfillment. However, due to the complexity of the problem- solve process, these interventions result in reduced throughput and increased variable cost per unit (VCPU). Therefore, the Tauber team was tasked with improving the current problem-solve process and reducing the number of issues occurring in the outbound process. The use case site was selected to be BFI4, which is an Amazon Robotics (AR) Sortable FC located in Kent, WA with a footprint of 900,000+ square feet and more than 18 million units of inventory.

The team identified the Pack function as the process path where the majority of problem solve labor hours are spent, and missing item shipments as the most prevalent issue in the outbound process, based on Pareto analyses. Diving deeper into the missing item shipments occurring in Pack, the team laid out each resolution path followed under each case by using process maps to decode the complexity of problem solving and identify non-value added activities. Two metrics were developed on which to base process improvements moving forward: number of re-picks for fixing shipments and number of missing item shipments. The team identified the key factors influencing these metrics by running two pilots, and developed a future state based on the insights gained from those pilots.

The team redesigned the outbound process to be robust to incoming defects by utilizing the usual workflows of direct functions, as well as the current physical layout and conveyor systems of FCs. In this future state, software buildouts will be employed to automate decision making and guide associates accordingly, thereby enabling problem solving to silently occur on the pack wall. As a result, the project will eliminate problem solve as a separate function, and reduce VCPU by 50% and issues arising in Pack by 30%. These benefits were validated by testing the concept in action in a final experiment. Hence, the successful implementation of this project across the North America AR Sortable network is projected to yield savings of over $200M. To secure the future of the project, the team led discussions with Amazon Fulfillment Technologies (AFT) and Subject Matter Expert (SME) teams to obtain funding and hand off the project to Amazon Customer Excellence System (ACES) Ops Integration team.

AMAZON – TRACKING TECHNOLOGY

EVALUATING EXISTING TECHNOLOGY FOR USE IN FULFILLMENT PROCESSES

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Amazon spent more than $11.5 billion on shipping in 2015 alone. Based on the sole scale of shipping expenditure, Amazon would have ranked as the seventh largest third-party logistics (3PL) provider in the world. While spending $11.5B in shipping costs, Amazon made over $6.5B in shipping revenue at the same time, suggesting a huge opportunity for the company. As a result, Amazon has started optimizing its current shipping cost structures, fulfillment processes, and the expansion of its own logistics capability. The Amazon Fulfillment Technology (AFT) platform works to provide technology solutions for the fulfillment networks of Amazon and is responsible for creating and maintaining software infrastructure for software tools used throughout the warehousing and fulfillment process.

The AFT team challenged the Tauber team to target and define potential defect injection points in Amazon's outbound supply chain and then develop and implement an integration of hardware, software, and processes that utilize innovative technology in fulfillment operations to prevent the occurrences of targeted defects in the Fulfillment Center (FC), enabling Amazon's customers to get what they want, when they want it.

The strategic importance of our project was to significantly improve quality and to reduce human touches in the process. Amazon is exploring package tracking technology applications to enable accurate location tracking of each item/package within and across various FC types. In our FCs, middle-mile, and last-mile networks, the team aimed to increase process visibility, inventory accuracy, and process throughput and also reduce defects by providing real-time feedback to associates. For our end customers, our project enabled increased granularity about where and when their packages would arrive, as well as an increased rate of on-time deliveries.

In a test environment for new processes, the team created and tested the implementation of new technologies with the intent of reducing quality defects, increasing productivity, and increasing accuracy. The team implemented three proof-of-concept pilots to develop, test, and deploy equipment and processes. The team developed success criteria and compared performance against a control site. The project team then conducted Fulfillment and Sortation center visits, performed extensive data analysis, recommended technology solutions, and conducted cross-functional workshops to achieve program goals. At the end, the team delivered results for the three phases of our study, and these results enabled the business unit to move to the next phase of development.

AMAZON–TRUCK UTILIZATION

AMAZON SORT CENTER INBOUND (SCIB) TRUCK UTILIZATION PROJECT

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Amazon.com, Inc. is a leading retailer that was established in 1994 and is publicly listed on NASDAQ Global Select Market as "AMZN." The three segments of its business —North America, International and Amazon Web Services — are worth $430 billion. Amazon's mission is "to be Earth's most customer-centric company, where customers can find and discover anything they might want to buy online, and endeavors to offer its customers the lowest possible prices."

For YTD 2017, trailers from Fulfillment Centers (FCs) to Amazon Sort Centers (SCs) are on average 35% below the target fill of total available air space. For this period, a significant share of transportation cost was spent on underutilized trailers. Hence, there is an opportunity to save transportation dollars through better end-to-end systems alignment and more efficient operations. This project aimed to identify upstream systems and downstream FC opportunities to increase Sort Center Inbound (SCIB) trailer utilization by 5% across the network.

The Tauber team recommended the following Phase One actions over the next six months to deliver 2.6% transportation spend savings through 2020: 1) eliminate ad hoc trucks on non-critical departure times; 2) reduce excess capacity on short haul lanes; and 3) introduce and enforce standard work at the outbound docks through process map visuals (PMVs) and remote technological audits. For visibility of utilization metrics across the network, the team recommended using the control Dashboard built by the team. Deliverables and insight from this project will inform a more comprehensive Phase Two rollout by other teams: a systems integration and systematic automation of FC operational processes over the next 12 months.

Research and experimentation on upstream systems and downstream processes confirm that trailer utilization is heavily dependent on the timing of package flow from order picking to reaching dock doors. Despite occasional success, efforts to improve outbound trailer load quality have not been able to reduce the number of trucks required due to constraints in current upstream systems and network design. Current system challenges identified by stakeholders were addressed in a Kaizen Event and Pilot Experiment, ultimately resulting in phased recommendations.

Phase One actions, as the team has investigated and recommended, are designed to drive a culture that emphasizes load quality and trailer utilization. In addition to saving money and reducing emissions, better load quality will reduce product damage, thus leading to a better customer experience. Phase Two requires the integration of upstream systems with operational outbound dock tools, allowing systematic automation of operations to drive a sustainable, network-wide utilization increase within 12 months. An initiative by a team managing upstream order assignments is planned in 2018 to address package flow to better optimize outbound trailer loading. The Tauber team recommends that, while this new team collaborates with FC Operations for a truly integrated system redesign at the end of Phase Two, the Phase One recommendations are initiated to prepare downstream processes for optimal loading of scheduled trucks. With all systems and operational practices aligned, network-wide trailer air fill utilization is projected to increase by 10% on SCIB lanes, representing a potential savings of 12% on network-wide transportation spend through 2020. Of these savings, an entitlement of 22% through 2020 is attributable to this project's specific findings.

THE BOEING COMPANY

Optimizing 777X Wing Recovery Planning for On-Time Delivery

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Boeing is the world's leading manufacturer of commercial airplanes. The 777X, Boeing's newest twin-aisle airplane, is a key part of the company's strategy to maintain market leadership in commercial wide body aircraft manufacturing. Expected to enter service in 2020, the 777X advanced design includes all-new composite wings and engines. As a result of these design changes, the 777X promises to deliver 10% greater fuel efficiency and a 12% reduction in operating costs over the competition, making it the world's largest and most efficient twin engine airplane.

Preparing to manufacture the 777X has presented many new challenges for Boeing. The 777X's wings are larger than any other commercial airplane wing, and they are fabricated using carbon fiber composites – materials that require an entirely new fabrication process. During low rate initial production, schedule disruptions were occurring frequently for a variety of reasons, including machine breakdowns, defects, construction, and labor loss. As Boeing prepared for full rate production, the Composite Wing Center (CWC) needed to strengthen its ability to respond quickly to unexpected delays with a recovery planning process that minimized costs and reduced the risk of missing a delivery.

After observing current state scheduling practices for 777X wings, evaluating practices at five other fabrication and assembly sites, and interviewing more than 30 engineers, operators, managers, and subject matter experts, the Tauber team conducted a thorough root cause analysis to determine why the CWC was not responding more efficiently to schedule disruptions. As a result of this analysis, the Tauber team developed a dynamic recovery planning tool to efficiently assess and display the downstream impact of disruptions and prioritize processes based on the Theory of Constraints.

With the Tauber team's tool, engineers can easily view the current status, resource constraints, and precedence networks of thousands of production processes; monitor shared asset utilization; and quickly generate optimal minute-by-minute recovery plans. To transition the tool to Boeing, the Tauber team trained engineers to develop recovery plans and prioritize shared assets using the tool and modify the tool's underlying logic as production scales up and processes change. After fully implementing the tool, the CWC will produce more optimal recovery plans 43% faster, resulting in less overtime, improved asset utilization, and reduced risk of missed deliveries.

THE BOEING COMPANY–BDS (BOEING DEFENSE, SPACE & SECURITY)

PROCESS IMPROVEMENT FOR ELECTRICAL PANEL MANUFACTURING

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Boeing Defense, Space & Security (BDS), a $50B global company, specializes in manned and unmanned aircraft programs, space and satellite systems, and intelligence and security systems. The BDS location in Mesa, AZ, produces attack aircraft and fabricates wiring harnesses and cockpit electrical panels for both commercial and defense aircrafts. Recently, the Mesa site became the Electrical Center of Excellence (ECOE) for BDS Fabrication. In an effort to move the company toward One Boeing, the ECOE will be increasing production by onboarding more programs. Management believes the current program-based manufacturing layout has resulted in siloed production and duplicated resources and work practices that cannot be sustained with an increase in volume.

BDS partnered with the Tauber team to move away from this siloed production system and toward a process-based manufacturing system within the ECOE. After assessing several production areas, the commercial cockpit electrical panel (LMI) assembly area was chosen as the scope of the 14-week Tauber project. The Tauber team worked closely with all BDS and Boeing Commercial Airplanes (BCA) stakeholders to understand the current state and vision for the future state as well as to identify potential process improvements for the LMI assembly area and ECOE as a whole.

The LMI assembly area was not meeting its customers' budget and delivery dates. The team identified several root causes: unclear assembly instructions, a high fluctuation in demand, delayed responses from production support functions, and high variability of products and build time. Although there is a plant-wide push for process-based manufacturing, the team saw a need to resolve these foundational issues first to be successful in future implementation of process-based manufacturing.

The team conducted interviews, benchmarked other Boeing fabrication sites, and analyzed process data to develop recommendations for process improvements and cost reduction. The team recommended creating graphic assembly instructions to increase build efficiency, implementing visual management to increase sense of urgency, level loading demand to reduce overtime, and grouping similar products to prepare for the implementation of process-based manufacturing.

Combined, these recommendations are projected to save approximately $2.8M over the next five years, which equates to a 22% reduction of the manufacturing labor and support budget. Through a stronger foundation, the team expects a smoother changeover to process-based manufacturing and continued further reductions in cost and defects.

THE BOEING COMPANY–SUPPLIER
RISK WITHIN BOEING'S RAW MATERIAL STRATEGY

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The Boeing Company (Boeing) is the world's largest aerospace company and the leading manufacturer of commercial airplanes and defense, space, and security systems. The company supports airlines and government customers in 150 countries.

Our project was focused on Boeing Commercial Airplanes (BCA), which designs and manufactures both single-aisle and twin-aisle commercial airplanes and cargo freighters. There are more than 10,000 Boeing-built commercial jetliners in service worldwide, which is almost half of the world's fleet. With growing demand for air travel, Boeing is increasing production rates to unprecedented levels. To support these increased rates, Boeing relies on suppliers to deliver millions of parts on time and at an acceptable quality in order to assemble its airplanes for on-time delivery. If one structural part is missing the plane cannot be delivered to the final customer and placed into service. This makes assessing risk within the supply chain a critical part of Boeing's strategy.

Aluminum and titanium, in particular, are two critical materials in airplane manufacturing for two reasons: (1) parts made from aluminum and titanium make up significant portions of an airplane and (2) raw material production is a single point of failure in the supply chain. If there is a shortage of aluminum or titanium, Boeing and its suppliers cannot get the material they need to produce their parts, which means Boeing cannot build its airplanes. This could in turn affect airlines' ability to transport people and businesses around the globe.

To address these concerns, the Tauber Team performed a risk analysis of the aluminum and titanium mills in order to re-architect the risk assessment process. After discovering that there is a low likelihood of a mill disruption, the team reduced the number of areas of analysis in the risk assessment by 72% and modified the question to better align with mill risks. Since it was determined there was minimal risk with mill production, the team decided to broaden the scope of the project to identify other opportunities for improvement in the rest of the raw material strategy. The student team identified areas that contained costly risks to Boeing, including forecasting errors and distributor capacity constraints. In addition, the team discovered an area of opportunity for increased savings with titanium scrap recycling. By improving these select areas, Boeing can expect cost savings of millions of dollars per year.

BORGWARNER MORSE SYSTEMS
CAPITAL EFFICIENCY AND HEAT-TREATMENT BENCHMARKING PROJECT

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BorgWarner Inc., a $9B company, is a global leader in clean and efficient technology solutions for combustion, hybrid and electric vehicles. Morse Systems, a business unit within BorgWarner, delivers expertise in customized solutions for variable cam timing, engine timing systems and drivetrain chains. Within chain manufacturing, Morse Systems was eager to benchmark and standardize heat-treatment furnace performance measures and was looking for recommendations on how to most efficiently utilize capital at Morse Systems Korea (MSK).

Heat-treatment is a critical value-add process during the manufacturing of chains that requires capital intensive furnaces that work 24/7. These furnaces, which operate at high temperatures, are difficult to shut down and demand extensive maintenance to operate at ideal conditions. Therefore, it is imperative that MSK is able to determine optimal capacity, utilization, and production schedules to ensure maximum capital efficiency. In addition, it is important that plants are able to internally benchmark furnace performance to identify key areas for improvement. To successfully benchmark performance, plants must use a common set of metrics that rely on identical assumptions, which is currently not the case.

The Tauber team, based at Morse Systems Korea (MSK), was assigned two main tasks: 1) Study the heat-treatment process in MSK to determine optimal utilization and improve capital efficiency and 2) visit Morse "sister" plants in Japan, China, and Italy to understand local performance measurement and bring back best practices to implement in MSK. Additionally, after identifying key differences in the calculation of Overall Equipment Effectiveness (OEE) among plants, design a standardized OEE metric that can be implemented across plants to enable a commensurable comparison of heat-treatment performance.

The team, using linear programming, the Bill of Materials system, capacity analyses, and cost analyses, presented an optimal production schedule and ascertained required production capacity at MSK. By doing so, the team reduced up to 2,600 overtime labor hours per year in addition to recommending a 25% reduction in the number of furnaces while still meeting demand. Together, the recommendations resulted in potential savings of up to $1.37 million over the next five years. Overall, this represents a yearly reduction of up to 9.1% in direct costs related to heat-treatment furnaces at MSK.

After visiting MSK's sister plants, the team conducted a detailed analysis of OEE calculations while noting fundamental differences. Taking into consideration the theoretical approach and current business need, the team standardized the OEE calculation to rely on identical assumptions. This new metric can be easily implemented to uniformly compare furnace performance. The team also recommended a Global Improvement Resource Center—a common platform for plants to share continuous improvement ideas with each other. Finally, as a long-term goal, the team recommended standardization of machinery and product mix across plants, making it easier to manage global inventory and enabling easy sharing of best practices.

CARDINAL HEALTH
REGIONAL PARCEL CARRIER STRATEGIC ASSESSMENT

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Cardinal Health, a $130B company with more than 40,000 employees, is a global, integrated healthcare services and products company, providing customized solutions for healthcare businesses worldwide. The company provides clinically proven medical products and pharmaceuticals and cost-effective solutions that enhance supply chain efficiency from hospital to home. Cardinal Health connects patients, providers, payers, pharmacists and manufacturers for integrated care coordination and better patient management.

Cardinal Health's non-asset based freight management business unit, OptiFreight Logistics, provides logistics solutions to hospitals, pharmacies, ambulatory surgery centers, and clinical laboratories to control and reduce their freight costs. Today, the business leverages a single national carrier to manage customers' small parcel shipments. With increased cost pressures in the healthcare space, OptiFreight is exploring new logistics solutions to increase customer and business value by identifying further savings without compromising customer service levels.

To help OptiFreight become a comprehensive logistics solutions provider, the Tauber team carried out a strategic assessment of regional parcel carriers as potential partners to supplement OptiFreight's current service offering. The team conducted market research, explored operational change requirements, and led business discussions with major regional carriers. Extensive pattern analysis, service mapping, and financial modeling of historical shipment data was performed to fully evaluate the market opportunity and identify healthcare customer targets. Customized pricing tools and scenario analyses were built to determine optimal customer savings while realizing higher net margins. Ultimately, the team recommended a market rollout and organizational transformation plan to launch and expand the regional carrier offering. Further, pricing and risk mitigation strategies were developed to ensure success of the regional carrier strategy.

By implementing the new regional carrier strategy, OptiFreight Logistics could realize an additional $35.2M in annual gross profit with 50.7% volume growth over five years. Moreover, customers can achieve, on average, a 25.8% reduction in transit time on ground shipments. Overall, the regional carrier offering enables OptiFreight to become a comprehensive logistics solutions provider and strengthens their position as the leading freight management provider in healthcare.

CUMMINS INC.

OPTIMIZATION OF REMANUFACTURING OPERATIONS THROUGH MECHANIZATION AND TECHNOLOGY

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Cummins Inc., a $17.5B company, designs, manufactures, distributes, and services diesel engines and related components. The Cummins New & Recon Parts (NRP) division specializes in remanufacturing; a complex enterprise of restoring used parts back to new part specifications. Remanufacturing is a critical part of Cummins' sustainable business strategy. Remanufacturing is environmentally friendly, but must also be economically viable and socially responsible. The NRP division wanted to improve the economic viability of their operations by: 1) identifying opportunities for automation at two plants in the U.S. and Mexico and then scaling globally to apply to all eight division plants, and 2) sorting the incoming parts to avoid non-value-added labor and inventory costs.

The Tauber team conducted its research for the automation project by interacting with manufacturing engineering, supply chain, finance, and operations teams at plants in Memphis, TN and San Luis Potosi, Mexico. In addition to identifying a method of automation prioritization, the Tauber team worked closely with the Cummins Reverse Logistics Center in Memphis, TN to help quantify the benefits that selectively sorting incoming parts at the Memphis remanufacturing plant will have for efficiently utilizing plant capacity.

The Tauber team created an automation framework by using a comprehensive set of questions that, when answered, are capable of generating a complete cost-benefit analysis. Using this framework, the Tauber team recommended three turnkey solutions that will result in $1.8M NPV after a $540K investment. The team also provided Cummins with a five-year roadmap of 13 automation solutions specific to its U.S. and Mexico remanufacturing plants which included timelines, cost estimates, benefits, and priorities for each of the recommendations. The NRP Central Manufacturing & Strategy Team accepted the Tauber-developed framework and will be implementing it across the other plants globally. Secondly, the Tauber team's suggestions in the sorting project led to $500K in annual recurring savings. While the Tauber team's automation recommendations will lead to potential labor reductions, the sorting project will allow Cummins to retain operators, consistent with the company's commitment to employee welfare.

Apart from the above economic impact, the globally applicable standard approach developed by the student team will also help in reducing lead time for evaluating automation proposals. This new method also reinforces a consensus-based approach within Cummins to take any project to completion.

DELL TECHNOLOGIES

DEVELOPMENT OF AN ASIA-BASED OCEAN PLASTICS SUPPLY CHAIN FOR PRODUCT PACKAGING

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Dell Technologies is a large, privately held company that provides consumers, industry, and government customers a range of technology products and service solutions. Based in Austin, TX, Dell has a rich history of supply chain and packaging innovation. As part of their commitment to ocean health outlined at the 2017 United Nations Oceans Conference, Dell pledged to source and incorporate 10 times their current ocean plastic usage into their packaging (up to 160K pounds cumulatively) by 2025.

Over 8M tons of plastic enters the ocean each year—a growth such that by 2050, there will be more plastic in the ocean than fish. Dell's strategy to tackle this looming environmental crisis is to create a supply chain that intercepts land-based mismanaged waste within 50 km of the shore, thereby targeting plastic at its highest economic value and addressing the root cause of ocean plastic early in its lifecycle. In 2016, Dell conducted a pilot in Haiti to source and incorporate 16K pounds of ocean plastic into a packaging tray for Dell's XPS-13" notebook; this Tauber project adapted the Haiti pilot to South Asia to capitalize on regional economic advantages and target the world's leading source of ocean plastic.

The Tauber team first defined a cost-effective supply chain for ocean plastic that could be scaled to meet growing demand. Building on previous internal and external research, the team defined viable sourcing locations of ocean plastic based on a variety of factors, including the availability of mismanaged waste, processing infrastructure, and logistical simplicity. Onsite visits in South Asia validated ocean plastic availability and confirmed the capability of local suppliers to source, clean, and process the material. Pricing, capacity, and quality certifications were modeled with logistics, manufacturing costs, taxes, and risk factors to define optimal supply chain scenarios for delivering ocean plastic resin to current Dell manufacturing sites in China as well as scenarios that co-located manufacturing in regions with suppliers.

The team then identified and recommended that Dell certify three Indonesian and Indian partners as viable sources of ocean plastic and co-locate packaging manufacturing in these countries. The proposed supply chain delivers scalability with the production capacity to source nearly 500 times Dell's commitment for ocean plastic usage, or the equivalent of 1.8 billion plastic bottles annually; it also reduced the total landed cost of ocean plastic by 73% over the current state, and by 31% and 16% against prevailing recycled and virgin plastic prices, respectively. Co-locating manufacturing of the current XPS-13" packaging tray with sourcing also reduced manufacturing costs by 54%, saving Dell more than $350K. At the conclusion of the project, the Tauber team successfully delivered an innovative supply chain capable of delivering scalability and cost-effectiveness to both Dell and other like-minded companies.

DOW CHEMICAL COMPANY

VALUE CASE FOR REAL TIME SUPPLY CHAIN EVENT MANAGEMENT (SCEM)

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The Dow Chemical Co, a ~$50B company, has an integrated, market-driven, industry-leading portfolio of specialty chemicals, advanced materials, agro sciences, and plastics businesses, that delivers a broad range of technology-based products and solutions to customers in approximately 180 countries. For a company with such a far-reaching supply chain, continuous supply chain disruptions such as port strikes, natural disasters, and system outages are costly and cause a great deal of impact. These types of disruptions have been difficult to predict, leaving supply chains in a reactive operating mode with high latencies in response time. Dow wants to leverage real time monitoring, big-data analytics, and machine learning technology to increase the predictive and communicative power of their existing supply chain, and they see this platform as a competitive advantage to gain additional market share in a competitive and volatile environment.

The Tauber team's goal was to devise a digital transformation strategy for bringing together the right technology, automated work processes, and organizational structure to build the value proposition for employing a real time event management service. The team recommended the implementation of a supply chain control tower, a centralized, cross-modal platform, enabled with visibility and analytic capabilities to detect and manage events in real time. As per industry research, a control tower solution is expected to reduce the overall response time by 40%, thus enabling Dow to avoid the surge in freight cost associated with delayed and suboptimal shipments.

For the value case analysis, the Tauber team conducted several stakeholder interviews and learned that high-impact events such as the "Polar Vortex," which struck the U.S. in 2015, were among the most time-consuming and expensive to manage. However, a lack of visibility surrounding the costs incurred during historic supply chain disruptions made it challenging to baseline the value case. The team estimated manpower costs by gathering data on stakeholders' time involvement through a workforce survey. They then analyzed shipment data during the Polar Vortex impact window to calculate freight cost surges. The Tauber team identified an overall theoretical value of $6M in labor productivity improvement and freight cost avoidance over a period of three years with the implementation of a control tower and associated business/organization changes.

To build implementation momentum, the Tauber team developed a roadmap for launching a control tower pilot which identified the minimum investment requirement. The roadmap included a resourcing plan, potential technology platforms for collaboration, and the control tower engagement model.

FORD MOTOR COMPANY

IMPLEMENTING DESIGN-FOR-ASSEMBLY FOR THE NEXT GENERATION MUSTANG

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Ford Motor Company is a global automotive company founded by Henry Ford in 1903. Famous for introducing the assembly line to the automotive industry, Ford "put America on wheels" by reducing the assembly costs of the Model T and making cars affordable for middle-class Americans. Today, Ford produces more than 6.6 million vehicles annually across 62 plants worldwide under the Ford and Lincoln brands.

Since 2011, the average assembly cost of a Ford vehicle has increased by 33%. While this trend can be largely attributed to advanced features being added to vehicles to meet consumer demands, the increase in labor costs has cut into Ford's profit margins and become an area of concern. To combat this trend, Ford initiated a project focused on Design for Assembly (DFA)—designing products to reduce assembly times—without sacrificing aesthetics, functionality, or quality. The Tauber team analyzed the current Mustang so that their findings could be implemented in time for the initiation of the next generation Mustang's development program. Additionally, the Tauber team was tasked to develop a DFA process to lower assembly costs across Ford's family of vehicles.

Working as liaisons between Ford's Vehicle Operations and Product Development organizations, the Tauber team identified DFA improvement opportunities on the door and Instrument Panel (IP) for the next generation Mustang. Over the course of the project, the Tauber team also interviewed assembly line workers, consulted product design teams, and benchmarked the current model Mustang's interior with competitor vehicles to identify design improvements.

Business cases encompassing assembly line time studies, savings in part purchasing, and reductions in required tools were calculated to justify implementing the design recommendations. The Tauber team's proposals reduced the required labor on the next generation Mustang door and IP assembly line by 20%. Ford is expected to reduce its annual costs by $5.5M and fixed costs by $500K by reducing required labor, management, tooling, screw, and part costs on the door and IP assembly lines.

FRESENIUS MEDICAL CARE NORTH AMERICA
PRODUCTION DOWNTIME REDUCTION THROUGH IMPROVED INVENTORY ACCURACY

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Fresenius Medical Care North America (FMCNA) is a vertically integrated renal care company, with its North American Durable Goods Division supplying more than 90% of the dialysis machines in the U.S. market. As one of the three active medical device sites within the Fresenius network, the Concord, CA site primarily manufactures hemodialysis (HD) machines, peritoneal dialysis (PD) cyclers, crit-line monitors, and dry concentrate mixing systems.

The Concord site experienced a significant increase in production line downtime in 2017, averaging 439 hours monthly for all assembly lines. The Tauber team partnered with FMCNA to determine root causes and reduce this costly downtime. The team used 5-Why analysis and determined that 84% of downtime was caused by component shortages. Of these shortages, 57% were due to inventory discrepancies between the physical stock and ERP inventory. The remaining 43% were due to ineffective communication with buyers, insufficient ERP safety stock, and supplier issues.

To identify areas contributing to inventory discrepancy, the Tauber team mapped raw material movement and information flow within the Concord site. Inconsistencies in the complex and heavily manual transactions across numerous stages of material movement and consumption were the main cause of inventory discrepancies. The team worked cross-functionally to redesign the material consumption and purchasing processes to enable more accurate inventory. The new process simplified material transactions, reducing opportunities for human error, and ensured that only needed materials were moved from the warehouse to the assembly line.

The team conducted a production pilot with proposed physical bin management changes in preparation for the new consumption process. The team also evaluated the capabilities of in-use software, and tailored the existing manufacturing execution system (MES) to a simpler material consumption interface. Additional causes of line downtime were addressed by restructuring communication within departments and implementing changes in the ERP system.

The Tauber team's recommendations to improve inventory accuracy will result in over 70% downtime reduction, yielding annual savings of $2.3M from reduced overtime, production labor, and expedited shipments. Additionally, $4.6M of inventory investment can be eliminated, and 9% of warehouse space can be reallocated. An average of one hour per day of management time can be shifted from downtime resolution to continuous improvement.

GENERAL MILLS
EVALUATING AND IMPROVING SUPPLY CHAIN ROBUSTNESS

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General Mills is a manufacturer of consumer packaged goods, including cereals, snacks, yogurt, and other food products. General Mills supplies major retailers and provides services to its core customers for improving display configurations and stocking solutions. General Mills prides itself on best-in-class customer service and continually seeks to improve its service performance.

In the past three years, variability has increasingly impacted customer service performance and cost, but the cumulative nature of these impacts is only partially understood by supply chain stakeholders. In order to better serve its customers, General Mills seeks to understand where its supply chain lacks resiliency against variability, and how supply chain robustness can be quantified, monitored, and improved in order to support General Mills' shift toward agility.

The Tauber team began the process of investigating variability in General Mills' supply chain with a series of 30 stakeholder interviews and developed an end-to-end value chain map of the snacks supply chain. The team also created a variability network illustrating cause and effect relationships in the supply chain, and identified key variability sources that impact customer service performance.

Based on data analysis and interview responses, the Tauber team identified four primary sources of variability: demand forecasting, unplanned merchandising events, manufacturing variability, and supplier performance. The team also quantified the current impacts of these sources on the supply chain, identified key variability tolerances across supply chain functions, and recommended a decision-making methodology to improve customer service and reduce costs.

After adoption of the new decision-making methodology by the General Mills snacks team, we anticipate potential savings between $20–25M per fiscal year related to reduced inventory and more accurate forecasting. As the methodology is adopted across different divisions at General Mills, business-wide potential savings may exceed $210M. In addition, the Supply Chain Analytics team at General Mills will use the Tauber team's deliverables in determining actionable areas of supply chain strengthening over the next two to three years.

GENERAL MOTORS COMPANY – ENGINE QUALITY

ENGINE QUALITY IMPROVEMENT THROUGH HEIGHTENED VISIBILITY

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Headquartered in Detroit, Michigan, General Motors (GM) has been a world leader in automotive sales and a pioneer in innovative technologies for over 100 years. One such innovative technology that promises to revolutionize the automotive industry is the electrification of vehicles.

To prepare for the increased complexities of electric propulsion systems, GM set an aggressive quality certification for its eight North American gas engine plants to achieve by the end of 2017. One component of this certification is an ambitious reduction (75% lower than the North American average) in the percentage of engines shipped that experience problems when subsequently built into vehicles at GM's North American vehicle assembly plants.

To achieve this quality certification goal, GM partnered with the Tauber Institute in a 14-week project to analyze defect information in all eight North American engine plants for commonalities and contrasts, and to then leverage the subsequent findings to identify opportunities for quality improvement. The project team interviewed the GM parties responsible for defect identification, investigation, and correction to understand the respective business processes. The Tauber team then standardized historic defect information to analyze for cross-plant trends, and correlated defect information gaps with weaknesses in the underlying business process. Ultimately, the Tauber team discovered an absence of plant-to-plant visibility in the defect resolution process and determined that current information-sharing practices and infrastructure were incapable of facilitating such cross-plant analysis.

To address plant-to-plant defect visibility, the Tauber team developed a centralized tracking system that consolidates engine defect information from the eight North American engine plants and includes problem identification, root causes, and corrective actions. The tracking system operates both as a database of historic information and as a platform to streamline the engine defect business process.

The Tauber team successfully piloted the tracking system at three of GM's manufacturing facilities. Although the system was initially developed only for engine plants, its success led to an expansion to both transmission and battery production. The tracking system empowers GM to utilize the organization's collective learnings to significantly improve engine quality, thereby helping propulsion plants achieve the mandated quality certification and shifting GM to a more collaborative culture.

GENERAL MOTORS COMPANY–SUPPLY CHAIN
COST ANALYSIS OF STEEL LOGISTIC NETWORK

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General Motors (GM) is a global automotive company, delivering 10 million vehicles in 2016 alone! With such a large vehicle output, GM was eager to investigate the steel raw material supply chain and analyze the costs involved in steel logistics. Through extensive analysis, the Tauber team was able to determine that current steel logistic initiatives at GM result in a cost avoidance of $1.9 million annually; if these initiatives were expanded, additional annual savings of over $7.6 million could be expected.

GM partners with eight major steel mills for steel coils and three main processors for steel blanks. The steel material is freighted between the mills, processors, and ultimately 15 GM stamping plants with locations in the U.S., Canada, and Mexico. This freight is controlled by the suppliers and indirectly paid for by GM as a rate per metric ton of steel. Recognizing potential cost savings, GM took control of 80% of the inbound freight coil volumes, directing them to one processor. GM then partnered with the Tauber team to verify that this transition of control resulted in significant cost savings and to analyze the cost saving potential from the remaining supplier-controlled freight. The main goal of this 14-week project was to provide a steel logistics cost analysis model to examine freight rates for negotiating future supplier freight rates.

The Tauber team performed a cost analysis on current GM-controlled business and then leveraged that information to expand the analysis to the remaining supplier-controlled freight. The team characterized the logistics structure of the steel network and then replicated costs for freight, warehousing, material handling, and management to develop a comprehensive cost model to compare to the supplier freight rates. These model costs were compiled for annual steel volumes and compared with annual logistics charges from the suppliers.

Analysis of current GM-controlled freight revealed that GM achieves a cost avoidance of $1.9 million annually by contracting with freight companies directly. Potential for an additional annual $7.6 million in savings exists, cutting expenses in direct steel logistics by 15%. As rates obtained for the model were based on initial responses from outside companies, final annual savings will be even higher than projected, as model rates can be negotiated lower. The model simulates the logistics setup of the supplier and provides a rate per metric ton to compare to the supplier's rate per metric ton. The team also delivered a user interface of the model for future use to update data and view the new saving analysis. The model can also be replicated to analyze the steel logistics costs for material through Mexico, material through GM's resale division (which is responsible for 30% of the steel volumes GM purchases), as well as for aluminum raw material.

MICROSOFT CORPORATION – LICENSING
MODERNIZING CUSTOMER SEGMENTATION STRATEGY

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Microsoft's mobile-first, cloud-first strategy provides users with a rich digital experience enabled by Microsoft's Azure cloud platform. As the Global IT market is transformed by the increasing prevalence of cloud services and the emergence of born-in-cloud vendors, Microsoft has evolved its core go-to-market strategy and customer segmentation approach to be cloud-centric.

The current customer segmentation approach for Azure is heavily influenced by Microsoft's legacy approach that governs the selling and licensing of on-premises products. This approach lacks the ability to provide modern business intelligence and adequately equip Azure to compete in the rapidly evolving cloud services market. Continued application of this legacy segmentation to Azure will cause overgeneralization of customer characteristics, restricted customer access to incentives and offers, inaccurate reflection of true customer value, and missed customer growth opportunities.

To modernize Azure's segmentation, the Tauber team developed a data-driven framework that segments Azure customers based on metrics including customer life time value (CLV), growth potential, and loyalty. The team first performed a current state analysis of the Azure segmentation methodology, identified gaps and capabilities to be addressed by the modernized segmentation framework, and defined the future state. The team then collaborated with marketing and engineering stakeholders to gather and analyze customer consumption data and developed a segmentation framework by leveraging data science machine learning models to calculate the identified segmentation metrics. The team then performed a k-means clustering analysis using R to identify distinct Azure customer segments.

The segmentation framework provides a more holistic understanding of customers' characteristics and needs, enabling better targeting and positioning of Azure services. It will allow Microsoft to align go-to-market strategies and sales motions with specific customer segments to drive up profitability, nurture customer growth, and enrich the overall transaction experience. In addition, the segmentation insights are extensible and scalable to new Azure customers, enabling Microsoft to predict a priori segments for any new Azure customer by matching its customer profile to existing segment profiles.

MICROSOFT CORPORATION – PROCUREMENT
OPTIMIZING THE SOURCING AND DEVICES FULFILLMENT PROCESS

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Indirect procurement within Microsoft touches close to $21B/yr spend and is responsible for ensuring that internal customers get high-quality service to meet their sourcing requirements. Microsoft employees all over the world turn to Procurement to purchase goods and services. The Tauber team was given the opportunity to work on two different process improvement projects within Procurement.

The first project required the team to propose a new, and more efficient sourcing service model. Currently, on complex purchase requests, those with budgets over $25K or that require quotations, Procurement guides the buyers as project managers. Moreover, the project manager can be either a Microsoft Sourcing Manager or an outsourced partner (BPO). The decision to use a BPO is based on the location and projected spend. To address the task assigned, the team performed a value stream mapping of the existing processes and analyzed differences between BPO-led and Microsoft-led projects. The team found that a project led by a Microsoft employee has higher cost but generates 4.5% higher savings. Additionally, the team found an opportunity to simplify the sourcing process for low spend projects and reduce the project cost. Based on this work, the team proposed a new model with clear guidelines on when and what to outsource. Also, the team recommended process improvement opportunities to make the existing processes more efficient and customer friendly. The new service model constitutes a $5M (annualized) opportunity to reduce costs and generate additional savings. Furthermore, the identified process improvement opportunities could generate up to $2M (annualized) savings.

The second project consisted of optimizing the internal laptop distribution process in the US and Asia. First, the team focused on solving the problem of internal laptop distribution in the US. Analyzing the current state, the team found that the process was managed by multiple admins, who had to rely on outdated tools and had no control over device delivery. To solve the issue, the team designed a centralized and standardized process both for employees requiring device refresh, and for new hires. Through the implementation, the team forecasted annual savings of $8M for Microsoft, along with an improved employee experience. Next, the team analyzed the current Microsoft Surface's fulfillment model in Asia, where 75% of the escalations were regarding Surface requests. Through the existing model the Surface laptop goes directly from the Microsoft factory to the employee. The process is simple from a transportation perspective, but the administrative process is lengthy and complex. The team performed a value stream map of the existing process and proposed a new service model where a third-party distributor is used in each country. The new distribution model reduces the time required to process a Surface request by 90% and generates $91 savings per device while decreasing the lead time by over 50%.

Overall, through all the projects, the team forecasted total annual savings of $15M. Along with that, the new sourcing model and the streamlined hardware distribution processes will lead to better user experiences.

PEPSICO

REFINING SUPPLY CHAIN NETWORK STRATEGY FOR AQUAFINA

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PepsiCo is a consumer food and beverages company which generated approximately $63 billion in net revenue in 2016, driven by a portfolio that includes Frito-Lay, Gatorade, Pepsi-Cola, Quaker, and Tropicana. Its North American Beverages (NAB) division, based in New York, handles production, storage, and distribution of its wide and complex portfolio of beverages ranging from carbonated drinks to bottled water. Within NAB, the Supply Chain Network Strategy team plays the crucial first role in shaping production, warehousing, and sourcing strategies, using a network optimization tool that pulls in input from most stakeholders in the supply chain.

PepsiCo's flagship bottled water brand, Aquafina, constitutes nearly 10% of total PepsiCo demand and drives a large portion of the company's supply chain complexity and cost. It is a highly seasonal product that, coupled with demand shocks like hurricane warnings or price markdowns, creates immense strain on the company's existing warehousing and production networks. Aquafina inventory strategy was founded on static, long-held assumptions such as flat rates for critical costs; the company therefore recognized the need for refinement of its strategy and more specifically, its network modeling tool, to facilitate better decision-making. The Tauber team was tasked with analyzing this complex tool to identify and prioritize areas of opportunity along with formulating recommendations to capitalize on these opportunities.

The team first used data from the Transport, Warehousing, and Finance teams to build a sophisticated cost model which included accurate warehousing costs for storing and handling Aquafina. The team then updated the network modeling tool with these refined costs before developing and testing alternate inventory management strategies. Finally, a detailed storage capacity gap analysis was conducted to identify a more cost-effective warehousing strategy for Aquafina.

Based on this work, the team recommended revised costing inputs, alternate safety stock policies, and changes to PepsiCo's Aquafina warehousing strategy. These changes would not only unlock a savings potential of up to $600k for 2018, but also significantly improve PepsiCo's future decision-making ability.

PFIZER

OPERATIONAL EXCELLENCE IN CONTINUOUS, PHARMACEUTICAL MANUFACTURING

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In 2014, Pfizer began developing Portable Continuous Miniature Modular (PCMM) technology with the goal of accelerating its pharmaceutical portfolio through continuous manufacturing. Historically, pharmaceutical drug product is manufactured through a batch process, which consists of several unit operations akin to an assembly line. In contrast, PCMM technology allows for continuous manufacturing which transforms raw material into tablets using a single equipment train. Continuous manufacturing has advantages over batch processing, such as improved quality, reduced costs, and a faster R&D timeline.

As the PCMM progresses towards becoming the industry's standard manufacturing platform, Pfizer recognizes the need to establish operational excellence within the PCMM. The ultimate goal is to enable Pfizer's portfolio by increasing PCMM availability via operational excellence.

To achieve this goal, the Tauber team created an operational excellence framework and identified applicable metrics with which to analyze and measure the PCMM's operational performance. By analyzing the current state and identifying operational gaps, the team implemented a series of solutions and made long term recommendations to bridge operational gaps and increase operational excellence. The solutions implemented by the team included a visual communication tool, a schedule adherence tracker, a Kaizen sprint project focused on the organization of the PCMM's workspace, and an in-depth analysis of task dependency of PCMM operations. These implementations decreased single-lot production cycle by 30%, increased OEE by 8%, and increased manufacturing availability by 50%. Long term recommendations include establishing a value stream manager, continuing workspace improvement efforts, and exploring clean-in-place technology.

Due to the work done by the Tauber team to improve communication, scheduling logic, and operational efficiency, Pfizer will save an estimated $5.85 million/year, and the PCMM will better enable Pfizer's portfolio by supporting the development of two additional compounds per year.

PACIFIC GAS AND ELECTRIC COMPANY

CLEAN TRANSPORTATION: FUEL SWITCHING-ADVISORY SERVICES

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Pacific Gas & Electric (PG&E) is a California-based utilities company headquartered in San Francisco. The company provides natural gas and electric services to approximately 16 million people throughout a 70,000-square-mile service area in northern and central California. The state of California has been working with key stakeholders, including PG&E, to achieve goals of reducing greenhouse gas (GHG) emissions in all sectors. Policies put forth to achieve these goals include the Clean Energy and Pollution Reduction Act of 2015, which requires the state to reduce GHG emissions to below 40% of 1990 levels by 2030. Therefore, PG&E is actively considering new growth opportunities that can complement the state's objective of reducing GHG emissions.

In order to identify an appropriate growth avenue, the Tauber team project scope included two phases. The first was to perform a market refresh on a former analysis completed by the PG&E Corporate Strategy team that outlines possible opportunities for PG&E's natural gas business. This market refresh included new analysis of potential market size, drivers and barriers to adoption, regulatory factors, and market trends on the following: hydrogen light-duty vehicles (LDV); medium-duty vehicles (MDV) and heavy duty-vehicles (HDV) fueled by hydrogen, natural gas, or electricity; marine applications; rail applications; fuel cells; propane to natural gas conversions; and micro-CHPs. This phase concluded with a recommendation from the Tauber team to focus efforts on the LDV, HDV, and MDV markets.

Since this conclusion was in line with PG&E's recent focus on alternative fuel vehicles, the second phase of the project came from the internal Clean Transportation Team's work plan. The scope of this phase was to explore fuel switching services within PG&E by mapping the existing process and making recommendations for an ideal future state, addressing electricity, natural gas, and hydrogen as alternative fuels. These services not only include advisory activities such as performing rate analyses but also core utility actions such as service planning to connect infrastructure to PG&E's grid or gas pipelines. Having completed more than 90 stakeholder interviews, the Tauber team created a detailed process map and an accommodating action plan which highlights six focus areas: coordinating and tracking clean transportation projects, continuing to build subject matter expertise, developing future strategic initiatives, marketing clean transportation externally, exploring preliminary siting capabilities, and formalizing the fuel-switching process through a newly developed position and training for existing employees.

Once implemented, this action plan is expected to have significant impact on PG&E's business and the California environment. Enabling the adoption of alternative fuel vehicles, this process improvement could increase PG&E revenue by $230 million and reduce California GHG emissions by 187,000 metric tons of CO2 equivalent in 2030, assuming that 10% of adoption will be successful due to these services.

STANLEY BLACK & DECKER

OPTIMIZING WAREHOUSE OPERATIONS USING SMART FACTORY TECHNOLOGY

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Stanley Engineered Fastening, a division of Stanley Black & Decker, manufactures and supplies fasteners for the North American auto industry out of its Chesterfield, MI plant and distribution center. As part of a company-wide effort to increase efficiency using Smart Factory technology and real-time data, the Chesterfield plant recently rolled out several "smart" initiatives that have enabled plant employees to operate more effectively and plant management to react to issues more effectively. Looking to expand the Smart Factory initiatives beyond the plant, SEF management tasked the Tauber team with increasing distribution center efficiency using Industry 4.0 technology, automation and real-time data. Stanley gave the team a goal of achieving a 20% increase in productivity (approximately $400K savings).

After value stream mapping the distribution center's shipping processes, benchmarking two Stanley facilities, and interviewing supervisors and employees, the team identified several opportunities for savings. First, the team determined that the process of verifying product before shipment was the bottleneck. The team designed a solution that would automate the scanning verification process, resulting in a 45% reduction in cycle time. Next, the team looked at ways to improve information flow by providing supervisors with real-time data to promote intuitive decision-making. The team developed three dashboards to help supervisors track the status of orders throughout the distribution center.

The team undertook three additional Smart Factory projects. These projects included improving the picking process through wearable scanners and voice technology, evaluating solutions for an automated line for weigh-packed product and implementing new RF scanners. The team also conducted an inventory analysis and recommended Kanban and a reorganization design that will help manage inventory levels, reduce out-of-stocks, and improve communication with the manufacturing plant.

The team's recommendations are estimated to save the Chesterfield distribution center more than $910,000 in one year, more than double the savings target. In addition to labor savings and increased efficiency, these projects will continue to promote the Chesterfield facility as one of Stanley's "lighthouse plants"—a model location for pilot concepts that may be rolled out company-wide.

TARGET CORPORATION

REDUCING AIR SHIPPED FROM THE SHIP-FROM-STORE NETWORK

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Target Corporation is an upscale discount retailer that provides high quality on-trend merchandise at attractive prices, generating $70B in annual revenue. Target has 11 fulfillment centers and 1,800+ retail store locations in the United States. With 50% of all Americans living within five miles of a Target store, Target launched the Ship-from-Store (SFS) capability in 2013 to fulfill guest (customer) orders quicker and cheaper. Currently there are 1,000+ stores enabled with the SFS capability, with plans to activate additional stores by year end 2017. Direct-to-guest fulfillment is expected to grow more than 30% this year and is a critical component of Target's omnichannel distribution strategy.

To rapidly roll out this SFS capability, a network-wide standard suite of seven boxes was selected to fulfill digital guest orders. This suite is a subset of the fulfillment center (FC) network's current suite and throughout the past three years has remained constant based on the external box supplier's analysis. Unlike the FC's box suites, the SFS suite was not optimized for the orders shipped, resulting in the delivery of excess void space (air) to guests. The Tauber team was engaged to conduct a gap analysis between the current and future state of void space shipped to guests via the SFS network, with the objective of reducing shipping and material expenses.

As Target embarks on the journey of continuous improvement to transform its supply chain, the team followed a DMAIC problem-solving methodology to structure the 14-week project. In the Define phase, the team established a baseline and set an improvement target driven by an industry benchmark. Through the Measure phase, the team learned 77% of void was the result of a suboptimal box suite. With this discovery, the team realized a box suite designed around guest orders was needed. As part of the Analyze phase, a box suite optimization tool—which minimizes void space shipped—was developed, allowing for the creation of an optimal suite. During the Improve phase, the tool was piloted, revealing an optimal box suite that reduced void space shipped by 13% and closed the gap between current state and the benchmarked future goal. The optimized box suite was tested in-store to validate the void space reduction.

Deploying the tool developed by the team to optimize box suites within the SFS network will avoid more than $10M per year in shipping and material costs. To fully realize the benefits presented by the tool, the team developed a three-phase implementation plan, to be rolled out between the end of the project and December 2018.

WHIRLPOOL CORPORATION

PURSUING DATA FOR GLOBAL PREDICTIVE ANALYTICS STRATEGIC FRAMEWORK

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Whirlpool is the world's leading global manufacturer and marketer of home appliances generating more than $20.7 billion in revenue in 2016. The Advanced Manufacturing (AM) team represents the innovative hub of Whirlpool's strategic push towards achieving Industry 4.0 standards across the enterprise. As part of this effort, the AM team sought opportunities to implement a predictive analytics program on a manufacturing process. The SARES Line in Cleveland, Tennessee, which manufactures oven cavities for the Minerva oven line, was identified as an ideal candidate for this project.

The oven cavity rib stamping press, the first value-add process on the SARES line, presented a unique challenge to Whirlpool's manufacturing team. For unknown reasons, oven cavities exhibited rib cracks resulting from the forming process. These cracks, which seemed to occur randomly and relatively frequently, represented component defects that resulted in scrap. Machine availability was also negatively impacted by rib cracking due to the required maintenance procedures following a rib crack instance. Solving this problem would allow Whirlpool to save over $150K annually on this one process alone.

To address this opportunity, the Tauber team used predictive analytics powered by a neural network to uncover fundamental relationships among a dozen variables that potentially contribute to rib cracking. The team first conducted thorough research and data collection to understand and characterize the stamping process. They then made several trips to Tennessee in order to observe conditions on the manufacturing floor, establish data acquisition infrastructure by reprogramming the machine controller, and manually collect over 5,500 rib height measurements. The accumulated data was synthesized and provided to the neural network; the results revealed underlying relationships between raw material properties, the stamping press operating parameters, and oven cavity design that could reduce the occurrence of rib cracking by 50% and improve OEE by nearly 18.5% on the SARES line.

The findings of the preliminary model contributed to the Tauber team's strategic framework for expanding the scope of predictive analytics applications. These strategic recommendations will allow Whirlpool an opportunity to recognize cost savings exceeding $12M globally over the next three to five years and gain valuable process insights. Additionally, these improvements will enable Whirlpool to continue to deliver the highest quality appliances to consumers around the world.

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