

MICHIGAN ROSS // MICHIGAN ENGINEERING



SPOTLIGHT, TEAM PROJECT SHOWCASE AND SCHOLARSHIP COMPETITION

Spotlight! Presentation Schedule

Time					
11:00 am	Opening Ceremony				
	Transition (10 min)				
11:30 am	Boeing 737	Ford	Curation Foods	Microsoft (Team)	
		Transition (10) min)		
12:10 pm	Boeing Enterprise Metals	Brose	PepsiCo	Microsoft (Chang)	
		Transition (10) min)		
12:50 pm	Boeing Global Svc	GM	AB InBev	Microsoft (Jan)	
		Transition (10) min)		
1:30 pm	Boeing Quality Transformation	NCMS	DoorDash		
		Transition (10) min)		
2:10 pm	Pfizer	Stoneridge	Beyond Meat	Amazon New Site	
		Transition (10) min)		
2:50 pm	GE	Stanley Black & Decker	Target	Amazon Process Reliability	
		Transition (10) min)		
3:30 pm	Steelcase		FedEx	Microsoft (Lai)	
		Transition (10) min)		
4:30 pm	Closing Ceremony				

Welcome to 2020 Spotlight!

The Tauber Institute for Global Operations completed another year of actionbased team projects. In this past academic year 2019-2020, 57 students participated in 26 team projects featuring 19 sponsoring companies from a wide range of industries, including aerospace, Internet commerce, high tech, health care, automotive, energy and retail. The 2020 sponsors include Amazon, Anheuser-Busch InBev, Beyond Meat, Boeing, Brose, Curation Foods, DoorDash, FedEx, Ford Motor Company, General Electric, General Motors, Microsoft, National Center for Manufacturing Sciences, PepsiCo, Pfizer, Stanley Black & Decker, Steelcase, Stoneridge, and Target. As part of a comprehensive training program students participated in facility tours, and leadership and teamwork training modules leading up to their projects. As a result, 94% of students received a full-time offer of employment within 3 months of graduation, including 54% of students accepting full-time positions with Team Project sponsors or industry Advisory Board member companies.

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

Best Regards,

Herm or Mar

Hyun-soo Ahn Ford Motor Company Business Co-Director and Jack D. Sparks-Whirlpool Corporation Research Professor of Business Administration Ross School of Business

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

September 18, 2020



Hyun-soo Ahn



Larry Seiford



Ray Muscat

Ray Muscat Industry Director Tauber Institute for Global Operations



September 18, 2020



I am delighted to welcome you to the University of Michigan for the 27th *Spotlight!* Team Project Showcase and Scholarship Competition with the Tauber Institute for Global Operations. The Tauber Institute has had another wonderful year of facilitating new opportunities for our students and industry partners.

Students from the Stephen M. Ross School of Business and the College of Engineering have engaged in creative, analytical problem solving, working closely with some of the world's leading companies to develop real-world solutions to largescale operational challenges. Our students not only gained great experience but also helped to develop incredible solutions to these challenges that will help to make our world a better place. As a public university, we are proud to devote our strengths in research and education in service of society.

This year, Tauber Team Projects identified more than \$433.8 million dollars in savings, an average of \$31 million per project over three years. Such notable results demonstrate the power of what can happen when Michigan students are given the opportunity necessary to hone their talents as innovators.

Thank you to our friend and dedicated alumnus Joel D. Tauber, whose ongoing generosity and vision made this all possible. Thank you also to our industry partners for their support and mentorship of our students and their willingness to engage in these important collaborations.

I am sure you will enjoy learning more about all that our students and their teams have accomplished. Now more than ever, our world needs focused and creative thinkers. The pages you will read here show how Michigan students are rising to that challenge.

Sincerely,

Mark S. Schlissel University of Michigan President

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About the Tauber Institute

Industry identified a need. The University of Michigan responded.

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

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

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

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



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



"When I was honored with the naming of the Tauber Institute back in 1995. I never dreamed it would become the vibrant global network of operations professionals and thought-leaders that it is today. Thank you all for your contributions to this community that inspires me with its energy and its eagerness to embrace new ideas."

- Joel Tauber

Tauber team projects: on display at Spotlight!

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

Spotlight! is an ideal opportunity for corporate representatives to meet Tauber students, develop relationships, and explore how a future Tauber team project could improve operations at their organization. According to sponsoring company calculations, the Tauber team projects resulted in an average savings of \$31 million per project over three years, per company calculations. The total savings projected was \$433.8 million.



YEAR in **REVIEW**



SPOTLIGHT! 2020



We showcased the next generation of operations leaders.

Inventive solutions for tough operations challenges took center stage at the Tauber Institute for Global Operations' 2019 Spotlight! Team Project Showcase and Scholarship Competition.

The 2019 Tauber team projects resulted in **\$390.3 million in savings** according to sponsoring company calculations, an average of \$30 million per project over three years.

Microsoft and DTE received longevity awards recognizing their commitment to the Tauber Institute's mission through their team project partnerships. DTE reached a milestone of five years of team project sponsorship and Microsoft reached a milestone of ten years of sponsorship.







Tauber Alumni Board President Andrew Burgess awarded two scholarships of \$5000 each to students who demonstrate excellence in leadership and engagement in Tauber Institute activities. Congratulations to Robert Pakko (EGL BSE-CSE/ MSE-IOE) and Sarah Ting (MBA/MS-Aero)!

The annual Spotlight! event is a competitive presentation of operations solutions developed by Tauber Institute student teams during their 14-week team projects at top companies across the U.S. and around the world. A panel of distinguished judges from diverse industries selects the first, second, and third prize winners.

First Place: 2019 Team Ford Motor Company Charlie Manzoni (MBA) Hiroki Tanaka (MBA)

Second Place: **2019 Team General Electric** Federico Kulyckyj (EGL BSE/MSE Data Science) Mitali Linge (MSE-IOE) Jacob Siddall (MBA)

Third Place: 2019 Team Pfizer Clinical Manufacturing Andres Fuentes-Afflick (MBA) Jason Ji (EGL BSE-ChE MSE-IOE)



TAUBER INSTITUTE FOR GLOBAL OPERATIONS



"I quickly became a strong advocate for the institute because I saw the talent it had created within The Boeing Company by providing a large alumni group of Operations, Supply Chain, and Engineering leaders."

- Ed Petkus

Former Tauber Industry Advisory Board President

Boeing Commercial Airlines VP, **Engineering Airplane Development** (retired)

The Tauber Institute's relationship with industry partners allows the institute to anticipate industry needs and provide the skillsets most needed by today's Operations professionals. We would like to thank our outgoing Industry Advisory Board President Ed Petkus for his unwavering support over the past five years. Ed has generously shared his wealth of expertise in the aerospace industry, and repeatedly demonstrated his dedication to the mission of the Tauber Institute.

Thank you, Ed!



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We made an impact in our community.

The 9th annual Tauber **Community Service Day** brought together Tauber Institute students, alumni, faculty, and industry representatives to volunteer their expertise to community organizations. In 2020, Tauber Institute volunteers partnered with Habitat for Humanity ReStore, Ann Arbor Meals on Wheels, Shelter Association of Washtenaw County, and Arts & Scraps.

"Our goal each year is to serve the community in a tangible way by engaging in meaningful projects with socially impactful, community-oriented organizations in the Ann Arbor / Detroit area to improve operations and enhance value... These projects leveraged the skills and experience of the Tauber volunteers by applying tools including visual management, data visualization, scheduling, and facility layout."

- Community Service Day Chair Cross Pagano (EGL BSE/MSE-IOE '20)

We assessed operations across industries.

Tauber Institute's **facility assessments** expose students to operations and manufacturing processes practiced by a wide variety of organizations. Tauber students learn to perform a rapid audit of the state of an operation, judge the relative leanness of the operation, prioritize targets of opportunity for improvement, and develop an action plan to facilitate those improvements. This academic year, students toured operations at Delta Airlines, Ford Field, Zingerman's Mail Order, Western Washtenaw Recycling Authority, Ford Michigan Assembly Plant, and the Two James Distillery, and assessed additional facilities through virtual tours, including a VIP tour of Toyota's largest plant worldwide, Toyota Motor Manufacturing Kentucky.







Rate Lean: Fast

Evaluate operations efficiency during a brief plant tour.



Published by the Tauber Institute, **Rate Lean: Fast** provides busy professionals the skills needed to perform a Rapid Plant Assessment. It describes in detail how to plan a tour, rate an operation, and envision an ideal lean plant based on the concepts of the Toyota Production System.

Tauber Visiting Executive Emeritus R. Eugene Goodson first described his Rapid Plant Assessment process in 2002 for the Harvard Business Review. More than 1,000 plant tours and assessments later, Goodson applied the accumulated data to create Rate Lean: Fast, combining clear, direct instruction with real-world examples drawn from his extensive experience in industry, government, and academia.

Rate Lean: Fast is available for purchase through Amazon.

TAUBER INSTITUTE FOR GLOBAL OPERATIONS







YEAR in REVIEW

We brought together thought leaders in operations.

Thought leaders gathered at the Tauber Institute's 13th annual **Global Operations Conference** to discuss *Operations 2030: the next evolution of technology, sustainability, supply chain, and customer behavior.* The conference featured keynote addresses by forward-thinking leaders planning for the decade ahead, plus a series of industry panels comprised of operations professionals representing a wide range of

perspectives. Participants also enjoyed opportunities to network and to view finalist submissions to the annual **Global Operations Case Competition** that runs in conjunction with the conference.

Featured speakers included Emerson Automation Solutions VP/GM of Wireless Bob Karshina, Eckhart Inc. President & CEO Andy Storm, and Boeing Defense VP of Fabrication Susan Westenskow. Ross School of Business and Michigan Engineering faculty moderated robust panel discussions on *Technology Trends - Industry 4.0 in the Coming Decade, Sustainability through Innovative Operations, and Global Factors Influencing Supply Chains of the Future* featuring industry professionals on the front lines of Operations developments at Amazon, Amyris, Anaplan, Andonix, Bain & Company, Boeing, Deloitte, Ford, Emerson, Microsoft, and Oracle.





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TAUBER INSTITUTE FOR GLOBAL OPERATIONS



SPOTLIGHT! 2020



We created new products and thrived in the marketplace.

The **Integrated Product Development** course brings together students and faculty members from different disciplines for an innovative product design competition. It has been featured on CNN and written up in the New York Times, Wall Street Journal, and Businessweek.

The multidisciplinary course is managed by the Tauber Institute, and in 2019-20 was taught jointly by faculty members Eric Svaan of the Ross School of Business and Stephanie Tharp of the Stamps School of Art & Design.



This year, the University of Michigan offered Integrated Product Development in both the Fall and Winter semesters, allowing 11 teams of students from the Stamps School of Art & Design, College of Engineering, School of Information, and Ross School of Business to work together to develop market research, new product concepts, technical solutions, production processes, pricing, inventory, and advertising. Each semester culminated in a trade show where student teams introduced their new products to potential consumers in a competitive marketplace.



Fall 2019 Product Challenge: Products to Improve Young Adult Health Habits. Advances in technology, delays in marriage and the onset on childbearing, and novel patterns of social interaction enabled by media have changed the life experience of young adults in the so- called millennial age group, now in their late 20s & early 30s. These changes invite creative design of products which will enable working adults to establish and maintain healthy living habits.

Winter 2020 Product Challenge: Technologyconnected household product to improve small living spaces. This semester, the students developed, designed, built, and marketed a brand-new product profitable at a cost of less than \$200. Students created products that not only made efficient use of limited space, but also promoted the well-being of users who might now be confined to their homes. Products included a portable lamp (Khamai), an ergo desk (Ergo), a "diffuser and sand haven" (ATMOS), and a tactile board (MOOD).





SPOTLIGHT! 2020



We learned directly from experienced leaders.

The Tauber Leadership Speaker Series is a student-organized initiative to bring high-level executives to the University of Michigan to share insights about their careers, the qualities leaders need to succeed in today's global economy, and the tangible steps students can take to achieve excellence in their own career paths.



This year the series featured Herman Miller Chief Technology Officer Jeff Kurburski's reflections on Digital Transformation: Experiences and Challenges of Navigating an Organization Through the Change and



the insights of private equity investor Joshua Cascade, who applied over 24 years of industry experience to analysis of the relationship between Private Equity and Operations.

We recognized and promoted operations excellence.

A panel of Tauber Institute business and engineering faculty selected the **51st annual TIME Dealer of** the Year Award finalists from each of the four National Automobile Dealer Association regions, and also the national award winner. In appreciation, 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.



The TIME Dealer of the Year Award is considered the most prestigious honor a new car dealer can receive, with fifty new car dealers - out of more than 16,000 dealers nationwide nominated for the award. Tauber Institute faculty evaluated competitors on the business practices in their dealerships and on their contributions to their community.

Congratulations to the 2020 TIME Dealer of the Year, Susan Moffitt of Porsche Shreveport.

Reducing Our Carbon Footprint – and More

A common purpose to mitigate the impact of human activity on climate change unites governments, organizations, and individuals around the world. As the President's Commission on Carbon Neutrality (see box) creates a road map for the University of Michigan, the Tauber Institute produces graduates with the expertise to make significant contributions to sustainability efforts, including reducing carbon emissions, at organizations throughout the United States and beyond.

Applying their expertise in operations management is a hallmark of the Tauber student experience. For more than 25 years, Tauber Team Projects have provided students with the invaluable opportunity to address complex, real-world issues, and sponsor companies with teams grounded in both the business and engineering components of manufacturing. Increasingly, issues that have an impact on climate **President's Commission on** change are taking priority: How do we reduce the use of water in our manufacturing process? How do we cut levels of greenhouse gas emissions in our processing lines? Larry Seiford, Goff Smith Co-Director In early 2019, the University of of the Tauber Institute, notes that, "In the early days, Michigan President Mark Schlissel many projects were manufacturing-focused and established the President's Commission addressed problems found within the four walls of the on Carbon Neutrality (PCCN). The plant. Today's focus on global operations opens up work plan states that, "The PCCN's possibilities for the entire supply chain. This coupled ultimate goal is to contribute to a with an increased awareness of environmental impact more sustainable and just world by has not only refocused their emphasis but increased creating approaches and solutions the impact manyfold." regarding U-M carbon emissions that are sustainable (environmentally, Like the PCCN at U-M, many of our sponsors have socially, and economically), involve the regional community, and can be scaled and replicated beyond the university." Going beyond U-M's current goals to cut greenhouse gas emissions, the PCCN has years demonstrates some of the innovative approaches a scope that includes carbon emissions and sequestration; energy sourcing; technology development and policy change; physical facilities, operations, In 2015, The Boeing Company brought in a Tauber and mobility; and behavioral change. Team to jumpstart a zero waste-to-landfill initiative at PCCN issued an interim progress report the 777X Composite Wing Center under construction in June; the final report due by the at the time. The plan included determining the end of 2020 will include reports and types and volumes of carbon fiber waste; creating recommendations from the wide range a collection and segregation process; and piloting of analysis teams that comprised the current and future reduction and recycling commission. opportunities through both internal and external

departments or initiatives dedicated to environmental and sustainability issues, and they publicly commit to measures that will reduce their carbon footprint. A sampling of Tauber Team projects over the last few to the complex, multi-faceted challenges facing organizations.

markets.

(continued on next page)

Carbon Neutrality (PCCN)

Reducing Our Carbon Footprint – and More (continued)



Verizon Wireless challenged its 2015 Tauber Team to improve efficiency in the cartonization process used to ship roughly 20 million cartons per year. Implementing the teams recommendations, which included standardization of distribution center processes, was projected to save 5% in shipping costs and reduce the number of boxes used annually by an equivalent of 2,200 trees.

Dow Chemical began developing sustainability goals more than a decade ago. In 2016, they turned to a Tauber Team to evaluate opportunities for further reductions in transportation CO2 within its global

supply chain. The team delivered a three-tiered strategy that included comprehensive communication with external stakeholders on the need to address transportation emissions; measurement and active management of Dow's CO2 emissions footprint; and external activities that Dow could leverage to drive and promote emissions reduction initiatives.

In 2017, Dell Technologies presented a Tauber Team with the challenge of developing an Asia-based ocean plastics supply chain for product packaging, designed to significantly reduce the total landed cost

of ocean plastic by 73% over the current state. The Tauber Team's solutions included reducing manufacturing costs by \$350,000 in one year by co-locating manufacture of the packaging with sourcing. The project earned Dell a spot on Fortune magazine's 2017 list of 50 companies that are changing the world. Dell's 2019 Tauber Team developed strategies to scale production of Pollution Ink-which uses harmful PM2.5 black carbon harvested from fossil fuel emissions-as pigment, thereby keeping it out of the ecosystem. They also developed an innovation incubator for suggestions for new sustainable solutions that can be used by any team or individual at Dell.





At PepsiCo, the 2018 Tauber Team recommended system modifications projected to yield both cost savings of \$660,000 annually and environmental benefits at a Gatorade plant in Atlanta, while the 2019 Tauber Team performed a technical and financial feasibility analysis for more than 600 sites across the US and Canada to identify attractive solar projects. The 2020 PepsiCo Tauber Team has already created savings at the Dallas Gatorade plant by implementing water projects, and they developed a plan for future initiatives by mapping water usage, analyzing process data, engaging with technical stakeholders, and modeling future water use projections.

This year, Anheuser-Busch InBev brought in a Tauber Team to advance progress on meeting their 2025 sustainability goals by addressing issues in their global barley supply chain: identify technological solutions that will result in a higher percentage of the barley meeting ABI's quality standards, thereby reducing waste.

Stoneridge brought in a Tauber Team this year to create value

and eliminate waste in the production of MirrorEye, its innovative Camera Monitor System. The team developed Value Stream Maps to increase process visibility, and they examined logistics and plant operations for opportunities to create long-term value and improve sustainability for Stoneridge and its customers.

The fundamental drive to improve efficiency and effectiveness is at the heart of operations management. As these Tauber Team projects demonstrate, it is a critical discipline in the quest to reduce the impact of human activity on climate change and to achieve a broad range of sustainability goals.





Tauber Alumni Make a Lasting Impact

The Tauber Institute philosophy reverberates across industry though our dynamic community of alumni. Our alumni make a positive impact on the practice of operations worldwide, and they give back to the next generation of Tauber students. They provide financial support through the annual Tauber Alumni Scholarship awards, routinely offer insightful advice and student mentorship, and have become some of our strongest team project champions. This past year, alumni problem-solving skills proved indispensable as the Tauber Institute coordinated with sponsors to ensure students could have a rewarding 2020 team project experience, despite complications caused by covid-19.

Alumni contributions to the Tauber experience ensure that we continue to be the Leaders & Best in the field of Operations.



"Perhaps the most valuable lesson I learned at Tauber is understanding how to not just work in, but to identify and leverage the key strengths of a team and how to engage with people in meaningful and impactful ways... key lessons I learned on achieving buy-in from stakeholders and navigating corporate culture are things I apply to this day."

Sneha Venkatachalam (MBA '16) Program Manager, Apple



Reuben Ong (BBA '05)



"As a student without an engineering background, I experienced culture shock. I always loved operations but I viewed it from a general management perspective. There were times this caused friction with team mates but it resulted in learnings and a widening of perspective on both sides."

"Self-understanding is the key to a fulfilling life. Once you understand yourself, do something outside your comfort zone, push yourself to your limit, and gain a new understanding of what you can do. Keep that cycle of personal growth going, always."

Ashley Merritt, FPA (MBA '06) Finance Manager, Terumo Medical Corporation



"As the supply chain manager in a start-up environment, I have to create from scratch many things that I might have taken for granted at a more wellestablished firm, but I really love the challenge."

"Be as collaborative as you possibly can, bring a sense of humor to the conversation, and always ask questions. As Michigan alumni, we all have strong technical skills, but sometimes the toughest stuff ends up being how we manage people and their expectations."

Alison Levy (MBA '17) Program Manager for an early-stage energy technology company in the Bay Area

"Most business problems are multi-dimensional so they need to be solved by considering all the functional perspectives; engineering, marketing, finance, supply chain, procurement, sales... I am grateful that the Tauber program really helped me to think that way."

Brian McDonnell (MBA '98)

Marketing Director, Global Product Management, Dell Technologies

"What I took away most from my time at the Tauber Institute is that the program will create special opportunities for us to develop as leaders and be part of causes and organizations much bigger than ourselves - We have the responsibility to better the lives of our co-workers, customers, and stakeholders and this can be achieved by simply conducting ourselves with the highest level of professionalism and leading with humility."

Director, Hanwha Asset Management

Tauber Industry Advisory Board

The Industry Advisory Board (IAB) ensures 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 institute in achieving its academic and research goals through industry leadership, cooperation, feedback, and acquisition of financial support.

3M Company, Doug Lane, Global Director

A.T. Kearney Inc., Doug Mehl, Partner and Leader, Automotive, Transportation, and Industrials Practice

Amazon, Gary Gou, Vice President of North America Fulfillment Operations

American Industrial Partners, Danny Davis, Partner

American Securities, David Horing, Managing Director

Beyond Meat, Sanjay Shah, Chief Operating Officer

The Boeing Company, Jason Clark, Vice President and General Manager 777 Program Boeing **Commercial Airplanes**

BorgWarner Inc., Christopher J. Lanker, Vice President and General Manager, Asia Pacific, Emissions, Thermal and Turbo Systems

Cardinal Health, Meredith Rarey, Vice President, **Global Engineering**

ConAgra Brands, Inc., Craig Weiss, Vice President of Supply Chain Planning, Programs & Logistics

CPP Global, Brian Tauber, CEO

Dell Inc., Piyush Bhargava, Vice President Global Operations

The Dow Chemical Company, Jeff Tazelaar, Digital **Fulfillment Center Director**

DTE Energy, Sharon Pfeuffer, Acting Vice President of Distribution Engineering and Construction

Ford Motor Company, Ron Johnson, Director, Americas Quality

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

Howmet Aerospace, Randall Scheps, President, Howmet Wheel Systems

Infosys Limited, Nitesh Bansal, Senior Vice President & Global Head Engineering Services

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

McKinsey & Company, Russell Hensley, Director

Microsoft Corporation, Andy Miller, Director of Business Development, WW Customer Success Unit

National Center for Manufacturing Sciences, Lisa Strama, President & CEO

Pfizer Inc., Robert Noack, Senior Director, Pharmaceutical Sciences, Drug Product Supply

Steelcase, Tom Dawson, Vice President, Global **Operations Services**

Target Corporation, Preston Mosier, Senior Vice President, Global Supply Chain & Logistics Field Operations

Tauber Enterprises, Joel Tauber, President

Whirlpool Corporation, Leonel Leal, Director, Global Advanced Manufacturing Engineering





Doug Mehl A.T. Kearney Inc.







Jason Clark The Boeing Company





Jeff Tazelaar The Dow Chemical Company



Brian Tauber

CPP Global



Daniel Grieshaber General Motors Company





Andy Miller Microsoft Corporation

Lisa Strama National Center for Manufacturing Sciences



Leonel Lea Whirlpool Corporation

Piyush Bhargava

Randall Scheps Howmet Aerospace

Dell Inc.











TAUBER INSTITUTE FOR GLOBAL OPERATIONS



Gary Gou Amazon.com, Inc.



Christopher Lanker BorgWarner Inc.





Nitesh Bansal Infosys Limited



Robert Noack Pfizer Inc.



Danny Davis American Industrial Partners



Meredith Rarey Cardinal Health, Inc.



Sharon Pfeuffer DTE Energy



Joe Dudas Mayo Clinic



Tom Dawson Steelcase



David Horing American Securities



Craig Weiss ConAgra Brands, Inc.



Ron Johnson Ford Motor Company



Russell Hensley McKinsey & Company



Preston Mosier Target Corporation

Education in Action

Tauber team projects provide students with opportunities to tackle operations-related challenges at top companies. Over the summer, 57 business and engineering students worked on 26 team projects sponsored by 19 global firms.

Tauber team project sponsors are leaders in a wide range of industries, including aerospace, internet commerce, high tech, automotive, energy, and retail. The institute is pleased to strengthen relationships with our 2020 project sponsors: Amazon, Anheuser-Busch InBev, Beyond Meat, Boeing, Brose, Curation Foods, DoorDash, FedEx, Ford Motor Company, General Electric, General Motors, Microsoft, National Center for Manufacturing Sciences, PepsiCo, Pfizer, Stanley Black & Decker, Steelcase, Stoneridge, and Target.

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

A successful project results in a significant return on a sponsoring company's investment. Initial sponsoring company calculations indicate the 2020 Tauber team projects averaged \$31 million per project savings over three years. The projected savings total was

\$433.8 million



How 2020 Team Projects Persevered

by Ray Muscat, Industry Director, Tauber Institute for Global Operations

The Tauber *Spotlight!* Showcase and Scholarship Competition has always been a time to celebrate the accomplishments of our students, sponsors, faculty and staff. This year *Spotlight!* takes on an even greater significance and gives us even more reasons to be grateful that we are part of this amazing community. In the face of unprecedented challenges, the Tauber Institute community came together in a powerful way to overcome every obstacle that arose as a result of the Covid-19 pandemic and the resultant economic disruption. Each challenge was met with creativity, perseverance and a commitment to making this year one of our best ever!

Just as students, sponsors and faculty advisors began working to finalize their summer project plans, it became clear that this would be an unusual year. On March 11, all Michigan classes were transitioned to remote learning platforms, campus events were cancelled and travel restrictions were implemented. Suddenly the 2020 Tauber team project experience had to be re-imagined.

During the next six weeks, many team projects were redesigned to become fully remote projects. Schedules were adjusted to accommodate the changes that many companies were undergoing to adjust to new business realities. Despite the best of efforts, a few projects were cancelled, but were quickly replaced with new projects, all the result of an extraordinary effort on the part of students, sponsors and staff.

The Tauber community pulled together in so many different ways to support our students throughout their project experience. For example, student summer income lost due to shortened project schedules was replaced by donations from the Tauber community, including alumni, Industry Advisory Board members, and faculty advisors. And Tauber alumni stepped up and volunteered to mentor our student teams as they navigated this new virtual project environment.





As we come together today, at virtual *Spotlight!* 2020, we are reminded of what makes the Tauber Institute special. We are a strong and vibrant community made up of engineering and business graduate students, alumni, faculty, staff and Industry partners working together as part of a premiere operations educational program.

On behalf of all of us at the Tauber Institute, Thank You to everyone who worked so hard to make this year so successful! All the best to our participants and welcome to all of our guests. We are so happy to have you join us!

TAUBER INSTITUTE FOR GLOBAL OPERATIONS



2020 Student Employment



Companies that hired Tauber students include:

3M AB InBev Amazon (2

American Airlines American Airlines American Express Apple Boston Consulting Group Canam Steel Capital One (2) Dell (2)

End to End Analytics FCA

Google (2)

Tauber partner companies (IAB members & project sponsors)

McKinsey and Company (4) Microsoft (6) Pfizer PwC Genda Roland Berger S&P SBD Stoneridge, Inc. Texas Instruments United Airlines Veoneer Walmart Inc Wayfair

Cultivating Thought Leadership

DEGREE PROGRAMS ASSOCIATED WITH TAUBER

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

All Tauber students are enrolled in one of the following degree programs:

ROSS SCHOOL OF BUSINESS

Master of Business Administration (MBA)

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

COLLEGE OF ENGINEERING

Engineering Global Leadership Honors (EGL)

This five-year honors program prepares students to enter a variety of firms as engineers, while giving them the necessary management skills to quickly assume business leadership roles. 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 MSE.

Engineering Graduate Programs (EGP)

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

RECRUITING STUDENTS

The *Spotlight!* Competition is one way to introduce yourself and your organization to the Tauber Institute's supremely qualified candidates. Some recruitment opportunities are listed below:

- Individual interviews with students.
- Permission to post job openings on the institute's website, accessed by current students as well as our expanding network of 1400+ alumni.
- A connection to career centers and employment events at the College of Engineering and the Ross School of Business.
- Access to the Tauber Institute's Student Advisory Board, which can assist you in developing networking opportunities such as tailgates, receptions, and speaking engagements.

THE TAUBER ADVANTAGE

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

- The Leadership AdvantageSM program of learning modules and workshops emphasizes leading and influencing an organization through collaboration, creativity, communication, and analytics.
- The Integrated Product Development course is an experiential, cross-disciplinary course that puts teams of students from Business, Engineering, Art & Design and Information in an economic competition and competitive product development environment.
- Facility assessments 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 the operation, prioritize targets of opportunity for improvements, and develop an action plan to facilitate those improvements
- The Global Operations Conference brings leaders in industry and academia together to strategize new ways to advance the practice of operations worldwide.
- The Leadership Forum allows Tauber students to learn about ethical leadership directly from current leaders in operations from top global firms.

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

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

AMAZON.COM, INC.





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AMAZON.COM, INC. - PROCESS RELIABILITY



Gonzalo Luna Jacobs MBA

ANHEUSER-BUSCH INBEV

Marcos

Coppa MBA

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Priti Singh MENG MFG Pg. 39



Michelle Pawlow EGL (BSE EnvÈ/MSE IOE)

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Sameer Kumar Reddy Gurijala MBA

Murat

MBA

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Cross Pagano EGL (BSE IOE/MSE IOE)

Andi

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Bustamante

Haley Clafton EGL BSE-ME/ MSE IOE

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Felipe Grossi MBA

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Jose Ignacio Prieto MBA



Carlos Sanchez MBA

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Riley McKeown MSE IOE





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EGL (BSE

ME/MSE-IOE)



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Deb Xavier MBA







GENERAL MOTORS COMPANY



Estefania Avila MSE ME

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Ariella Rose MBA Pg. 116



TAUBER INSTITUTE FOR GLOBAL OPERATIONS

AMAZON – NEW SITE

New Site Launch

Student Team:

Tae Keun Ane – Master of Business Administration Chris Lan – Master of Business Administration

Project Sponsor: Andrew Webster – Regional Portfolio Manager

Faculty Advisors:

David Kaufman – College of Engineering Joline Uichanco – Ross School of Business

Amazon is continuously improving customer experience by providing a shorter lead time of packages with delivery capability broadly expanded in North America, and the demand for building lastmile delivery stations, the final stops for packages before delivery vans transport them to Amazon's customers, has been growing tremendously and speedily to get packages closer to customers' doorsteps.

For each delivery station, a conveyer belt system, also called Material Handling Equipment (MHE), is configured and installed to automatically transport packages within the warehouse and load them to the delivery vans. Keeping equipment reliable is one of the most critical things to run a smooth operation, avoiding delays of parcel deliveries to customers. Because MHE's reliability replies on efficient maintenance and spontaneous repairs, it is vital to thoroughly and accurately build maintenance & repair capabilities for a site before it goes live. This summer, the Tauber team joined Amazon's Reliability Maintenance Engineering (RME) team and helped improve the quality and speed of implementing maintenance and repair capabilities for sites that will be launched from Aug. 2020 onwards.

The Tauber team tackled three main challenges that affected multiple sites: down time of conveyers, delay of launching RME capabilities, and disjointed launch processes and experiences for RME. The down time of conveyers is the potential risk to shut down part of or the whole conveyer belt system due to the unavailability of spare parts needed for maintenance or repairs. The delay of launching RME consists of not getting spare parts ready as planned and not getting RME teams ready in time. The disjointed launch processes and experience are the lack of standardization in launching RME in new sites and lack of working instructions for onsite RME team such as maintenance manager to follow.

By optimizing spare parts' inventory, streamlining parts receiving process and standardizing RME processes, the Tauber team were able to downsize procurement cost of spare parts of the conveyer system, improve parts' availability in newly built delivery stations, map out standard operating procedures and create a playbook for the RME team during the launch phase. Among these deliverables, The team implemented the first three of them with \$803,049.48 projected cost savings while finishing the design of the playbook, which is now under RME's review and will be published soon.

AMAZON – PROCESS RELIABILITY

Improving Reliability to Ensure Operational Readiness

Student Team:

Gonzalo Enrique Luna Jacobs – Master of Business Administration Priti Singh – Master of Engineering in Global Automotive and Manufacturing Engineering

Project Sponsor: Conrad Hernandez – Reliability Manager, Amazon Logistics

Faculty Advisors:

Hyun-Soo Ahn – Ross School of Business Albert Shih – College of Engineering

Amazon Logistics (AMZL) is the fastest growing division within Amazon, as this business unit fulfills the final mile commitment of accurate and timely deliveries. Strategically, AMZL is the closest Amazon gets to its customers by delivering millions of parcels to doorsteps seven days a week. This is possible through the AMZL Reliability, Maintenance, and Engineering (RME) group that ensures process and equipment reliability to operations.

To ensure Operational Readiness of the Last Mile, the last step of Amazon's package delivery supply chain, the Reliability and Maintenance Engineering team is strategically developing a competitive advantage by deployment of proactive reliability solutions. The RME teams support the fast growing number of delivery stations that complete the customers experience by sorting, routing, loading, and finally doorstep delivery by developing a competitive advantage through proactive reliability solutions.

To support these efforts, the Tauber Team worked to analyze the vast reliability data and build a Reliability Index Scoring tool. In order to do that, the team conducted stakeholder interviews and analyzed historical metrics data. The RIS tool utilizes quantitative and qualitative metrics to assess Delivery Stations' Operational Readiness in four focal areas - Equipment Maintainability, Process, Human, and Equipment Reliability. In addition to showing the reliability status of every Amazon asset, this tool deploys a machine learning model that predicts the likelihood of disruption that affects workplace safety and on time delivery. An automated online dashboard will help in identification of specific reliability focal improvement areas. The outputs will quickly guide the user, in order to facilitate reliability tactics.

The tool will utilize reliability inputs to minimize rolled volume and downtime at delivery stations by 10% through correctly predicting 87% of incidents that cause safety and financial risk. The dashboard will ensure continuous improvement through highlighting the weak areas for each site, which will serve as a Forward-Looking indicator through a "Risk Event likely" forecast.

ANHEUSER-BUSCH INBEV

Barley Valorization from Seed to Sip

Student Team:

Marcos Coppa – Master of Business Administration Murat Johnson – Master of Business Administration Michelle Pawlow – EGL (BSE Environmental Engineering/MSE Industrial and Operations Engineering)

Project Sponsors:

Marcelo Goncalez – Global Manager, Vertical Operations Adam Griffith – Vice President of Operations, Global Raw Materials Luke Mafazy – Operations Director, Global Raw Materials Alessandro Sperotto – Vice President, Global Vertical Operations

Faculty Advisors:

John Branch – Ross School of Business William Schultz – College of Engineering

Anheuser-Busch InBev (AB InBev) is a Belgium-based multinational corporation and is the largest beer company and maltster in the world. The company depends on a consistent supply of high-quality barley to brew beer and secure a resilient supply of grain, working with more than 16,000 direct farmers across 13 countries and 5 continents to grow natural ingredients. AB InBev is committed to source a majority of malt barley directly from its growers around the world, pledging its 2025 Sustainability goals to help make all of AB InBev's contracted growers skilled, connected, and financially empowered.

Established growing regions supply high-grade barley with realized contract acceptance rates greater than 85%. Animal feed markets, in turn, purchase the rejected material at or near the cost of production, enabling a sustainable and profitable model for all parties. The challenge arises in areas lacking development in grower practices, technology availability, feed markets, and supply chain conditions. AB InBev needs a solution to be able to accept all the contracted barley, without compromising beer quality and company profitability. The Tauber team was tasked with developing a plan to valorize the portion of barley historically rejected in order to create a more sustainable business model for both growers and AB InBev.

The Tauber team focused its analysis on three global malting facilities as the basis for our case study, representing the extremes of AB InBev malt houses around the world: Moorhead in the United States (Minnesota), Passo Fundo in Brazil, and Jinja in Uganda. For each of these regions, the team assessed the current main quality issues that lead to rejections or issues during the malting process, the market potential for barley by-products via fractionation efforts. The team proposed actions and implementation guidelines considering the operational and financial impacts to both ABI and the growers.

The team proposed new technologies to increase barley acceptance, creating a global roadmap to determine profit opportunities for malt-graded barley and by-products via new revenue sources and cost improvements. The team developed implementation guidelines based on four main levers to generate value from barley grains that can now be accepted without being malted. They are: separation (sorting out individual kernels based on quality), processing (treating kernels to reduce quality issues and recover the grain), fractionization (converting the barley into its subcomponent parts to sell as by-products), and barley homogeneity (malting barley with a reduced standard deviation in protein levels).

By implementing the technological changes proposed by the Tauber team, AB InBev will be able to accept an additional 380,000 MT of barley from its contracted growers annually, increasing the worldwide acceptance rate from 88% to 97%. These changes will save the company \$17.9 million and provide an additional \$13.3 million in revenue to growers annually.



BEYOND MEAT

Xuhao Dai – Master of Science in Engineering in Industrial & Operations Engineering Sameer Kumar Reddy Gurijala – Master of Business Administration

Project Sponsors:

Chris Peyre – Vice President of Global Supply Chain Sanjay C. Shah – Chief Operating Officer

Faculty Advisors:

Ekaterina Astashkina – Ross School of Business Izak Duenyas – Ross School of Business

Beyond Meat, a \$7.8B company, is a food company that provides plant-based protein in the form of beef burger patties, ground beef, crumbles, and sausages. The company sells its products to various customers in the retail and food service channels in the United States and internationally. Beyond Meat's mission is to improve human health, positively impact climate change, conserve natural resources, and respect animal welfare. Beyond Meat is a 500+ employee company, with one production facility located in Columbia, MO, and several contract manufacturers spread across the United States and Canada. The Operations team is responsible for planning, procuring, manufacturing and delivering great products at an affordable price.

With the rapid growth, Beyond Meat's team has been challenged with manual demand planning activities, disparate processes, and lack of integrated systems leading to silos of information, inaccurate demand forecasts, inventory imbalance and last-minute planning changes. One of the biggest challenges for the company was that it was not able to produce and store finished goods close to the demand leading to significantly higher transportation and storage costs, and the Supply Chain team did not have any visibility on the magnitude of the problem.

The Tauber team approached this challenge by conducting interviews with SMEs across the demand planning process to understand the current process and the problem better. Following these interactions, the team gathered production and transportation data for each sales order and created clusters based on the relative locations of CoMans, Warehouses and Customers to each other. The team developed two KPIs - In-cluster Fulfillment rate and Out-cluster Fulfillment rate - which helped assess the inefficiency of the process by extra costs and extra miles incurred. The Tauber team recommended to Beyond Meat to work with customers to gather regional demand (or apply a distribution methodology developed by the Tauber team in case customers can only provide aggregated forecasts). Then, using regional level demand, the team recommended to adjust production plan to minimize tolling and transportation fees. The back-tested pilot the team ran using a linear programming model yielded \$1.25M+ in annual saving across one production line.

BEYOND MEAT

Demand Planning Optimization

THE BOEING COMPANY – 737

Re-Engineering Quality Inspection Processes via ML-Enabled Toolkit

Student Team:

Andi Bustamante – Master of Business Administration & MS in Environment and Sustainability Haley Clafton – EGL (BSE Mechanical Engineering/MSE Industrial and Operations Engineering) Felipe Grossi – Master of Business Administration Cross Pagano – EGL (BSE & MSE Industrial and Operations Engineering)

Project Sponsors:

Lam Ma – Boeing Production System Integrator, BCA Manufacturing Excellence William Chen – Manufacturing Quality Standards, BCA Manufacturing Excellence

Faculty Advisors:

Richard Hughes – College of Engineering M. S. Krishnan – Ross School of Business

The Boeing Company (Boeing) is the world's largest aerospace company and leading manufacturer of commercial jetliners, along with other products and services. In 2018, the firm brought in \$101B in revenue. Boeing's iconic 737, the most successful selling commercial jet in aviation history with over 10,000 aircraft produced to date, is currently facing a number of production challenges. After emerging from a 5-month shutdown with a backlog of over 5,000 aircraft, the 737 program has set a production goal of 31 airplanes per month by 2022. It is crucial for the 737 production system to reduce flow time while maintaining or improving product quality to achieve this goal.

Currently, the Quality Assurance process at Boeing requires thousands of quality inspections per airplane, each of which is often delayed. On average, it takes 90 minutes from when a mechanic requests an inspection for that inspection to be completed. Of this 90 minute period, mechanics spend 51 minutes on average waiting for an inspector to acknowledge the inspection call. The Boeing 737 Tauber team saw an opportunity to reduce production delays by creating a scalable, predictive model to forecast and prioritize inspection call arrivals.

After examining the current quality sign-off process, the team identified that creating a tool as opposed to a dashboard was critical to establishing the model into Boeing's production system. This realization gave rise to the Tauber team's development of InspeQT - the Inspection Quality Tool. InspeQT's predictive model uses a Bayes machine learning algorithm to generate a predicted inspection call time for each job based on a variety of indicators. Through the tool's intuitive user interface, quality inspectors can visualize and efficiently plan their daily schedules. Meanwhile, quality managers are empowered to proactively and strategically allocate resources to balance production demand.

To ensure user feedback was incorporated into future iterations of InspeQT, the Tauber team successfully completed a pilot of the tool's Beta Version in the Renton Factory for three weeks of production. In addition to providing the team with insight on how to make InspeQT more usable in its current state, it allowed the team to walk through the tool with quality team members of other Boeing programs to determine its adaptability to programs other than 737 Final Assembly.

InspeQT's potential impact on the 737's production system was quantified through a set of regressions that showed how reducing the average time a mechanic spends waiting for an inspector to acknowledge an inspection call can affect labor hours and flow time hours. A 20% reduction in this average delay can reduce up to 120 mechanic labor hours per plane. At a future rate of 31 planes per month, this labor cost avoidance presents millions of dollars' worth of savings to Boeing. Additionally, this 20% reduction in the average inspection delay can reduce up to 80 hours of overall flow time per plane. These 737 program-specific figures indicate that implementing InspeQT across Boeing will magnify this impact enterprise-wide.

THE BOEING COMPANY – ENTERPRISE METALS CAPABILITY

Model for Guiding In-Sourcing Decisions

Student Team:

Sophia Marina Engstrom – Master of Science in Engineering in Industrial and Operations Engineering Carlos Sanchez Martinez – Master of Business Administration Jose Ignacio Prieto – Master of Business Administration

Project Sponsors:

Cherlyn Hernandez – Metals Capability Core David Piper – Supply Chain

Faculty Advisors:

Ariel Shwayder – Ross School of Business Dawn White – College of Engineering

Boeing Commercial Airplanes needed to restructure its make/buy framework for its Metals parts division as a way of increasing factory utilization. By developing a systematic way of reviewing large groups of parts, it intended to identify packages whose internal manufacture aligns closely to its long term strategy and also may provide a cost advantage.

To address this challenge, the Tauber team developed a model based on three pillars: first, estimating internal fabrication costs through a linear regression to compare them with current purchase cost; second, creating a metric to identify the strategicness of internal manufacturing, combining different attributes such as supplier quality, delivery reliability and financial health, market competitiveness, market innovation and future forecast; and finally identifying required capacity through a part-based labor hours estimation.

Through the model and subsequent verifications with relevant stakeholders, the team identified 11 part families as good candidates for insourcing. They represented a 5-year-value of \$56M, estimated savings of \$18M, and an increase of 4 percentage points in utilization.

Finally, as a way of facilitating the expansion of this analysis from the market segment reviewed to the whole metals part list, the team created a Tableau dashboard. By enabling an straightforward update with current Boeing's data sources, this tool provides an easy and fast identification of most attractive parts for future insourcing decisions.

BOEING COMPANY - 737

BOEING COMPANY ENTERPRISE METALS CABABILITY

THE BOEING COMPANY – GLOBAL SERVICES

Standardizing Operations for Maintenance and Modification

Student Team:

Joseph Alvillar – Master of Business Administration Riley McKeown – Master of Science in Engineering in Industrial and Operations Engineering Jason Thompson – Master of Science in Engineering in Industrial and Operations Engineering

Project Sponsors:

BOEING COMPANY GLOBAL SERVICES

Larry Coughlin – VP, BGS Modifications and Maintenance Matthew Gomez – Sr. Manager, BGS Continuous Improvement

Faculty Advisors:

Joe Walls - Ross School of Business Pete Washabaugh - College of Engineering

Boeing is the world's largest aerospace company, competing in several segments of the industry. Boeing's commercial arm is structured into three commercial divisions: Boeing Commercial Aircraft (BCA), Boeing Defense Services (BDS), and Boeing Global Services (BGS). These divisions provide aircraft and services to both government and non-government entities across the globe. Within the aerospace industry, Boeing can compete with offerings for any customer's needs.

Within BGS, the Maintenance, Repair, and Overhaul (MRO) organization provides maintenance and modification services to its customers. MRO consists of several programs with specific responsibility for supporting an aircraft product line at sites across the United States. These programs were brought together under the unified leadership of MRO from both BCA and BDS divisions. Despite being organized under MRO, each program maintained their own processes and standards. This creates a challenge when developing visualization tools and implementing new procedures across the organization.

To address this opportunity, the Tauber team created process maps for several critical processes and identified key features to add to visualization dashboards. The team started by interview manufacturing managers across multiple programs to understand the current state. They identified the similarities across programs, best practices, and critical gaps. Next the team analyzed data inputs into BGS' systems and found several instances where data entry could be simplified and mistake-proofed. These findings led the team to develop business process maps that standardize operations across all of MRO, for both production operations and data entry.

These changes are designed to create a foundation for future software implementations and strategic changes. By standardizing processes across programs, MRO can scale operations with increasing demand. Using this foundation, metric reporting in dashboards can be automated and lead to a 25% efficiency gain in production.

THE BOEING COMPANY

Levers for Quality Transformation

Student Team:

Klara Mateju – Master of Science in Engineering in Industrial and Operations Engineering Hanna Vincent – Master of Business Administration

Project Sponsors:

Hector Silva – Director of Product Development and Quality Functional Excellence John Yu – BCA Leader for Quality Operating System

Faculty Advisors:

Len Middleton – Ross School of Business Prakash Sathe – College of Engineering

The scope of the **Quality Transformation** Tauber Boeing project was to understand the impact that Quality Levers have on the Boeing production system and their effect on stability and quality. The project focused on quality and manufacturing data from the 787 program when analyzing quality levers and creating the defect prediction model.

The project delivered three main items to the Boeing team. First, an analysis of quantitative and qualitative impact of quality levers on the magnitude of defects. The key Quality Levers identified were categorized into three groups: Program Maturity, Complexity, and Performance Metrics. Second, a Bayesian Machine Learning model predicting the level of future quality from mathematical relationships between key drivers and the magnitude of defects. Third, are report of findings and recommendations based on the key Quality Levers.

There were 3 main recommendations presented in this report. First, continue building out the Bayesian Machine Learning Model by adding more Quality Levers and creating a tool for users to learn the relationships between Quality Levers and future defects. The second main recommendation is to leverage the Quality Lever findings to work towards preventing defects over reducing defects. The third recommendation is to capitalize on the specificity of defects predicted based on customer expectation calculations to assist teams working on increasing customer satisfaction.

The exact impact of this project is not calculable because it depends on implementation schedule, implementation range and adoption rate across the organization. What can be estimated is the average number of defects expected on future airplanes. Boeing should expect to naturally obtain \$32M from 2021 through 2023 in cost avoidance due to their current learning rates. That corresponds to 2% of the combined Total Cost of Quality (TCOQ) for those years. Implementing the recommendations included here would serve to increase cost avoidance from these projected levels up to \$185M or more in the next 3 years. It can be expected that TCOQ under values actual costs, and that the potential impact of this project is higher than the estimated TCOQ cost avoidance calculations.

BOEING COMPANY QUALITY TRANSFORMATION

BROSE

Flexible Seat Track Assembly

Student Team:

Ji Hyun Kim – Master of Science in Engineering in Industrial and Operations Engineering Ben Roos – Master of Business Administration

Project Sponsors:

Derek Caldwell – Director of Product Unit, Front Seat Structures Joseph LaRussa – Director of Industrial Engineering, Seats Division Victor Perez – Manager, Industrial Engineering, Seats Division

Faculty Advisors:

David Chesney - College of Engineering James Price - Ross School of Business

BROSE is a family-owned global manufacturer of mechatronic automotive systems for seats, doors, and drives with 2019 sales revenues of €6.1 billion. Among the company's Seats, Doors, and Drives divisions, the Seats division continues to win more sales contracts from customers and needs to find solutions to better utilize the manufacturing capacity installed in its facilities.

Front row seat track products are divided among many variants, which can not be manufactured on a single assembly line with Brose's current equipment and result in substantial levels of underutilization. The project goals are to develop track assembly solutions that enable flexible production of the multiple categories of products, and enable capacity scalability to better match customer demand and improve the efficiency of capital expenditures.

To address this problem, the Tauber team first performed a capacity analysis to identify several consolidation opportunities in two of Brose's North American facilities. Second, the team developed a cost model to represent the cost of maintaining excess capacity, in order to communicate the financial implications of underutilized equipment. Third, the team drove suppliers to develop technical solutions that enable Brose's desired volume and variant flexibility, and analyzed the financial and strategic consequences of the new track assembly equipment.

The team produced a total of three recommendations. First, the team identified a 29% cost avoidance opportunity over the next six years in Facility 1, which does not require a novel solution. Second, the team developed and simulated a flexibility solution that would combine two programs in Facility 2 and avoid the purchase of a new manufacturing line, reducing capital expenditure by 35%, avoiding 26% of lifetime costs, and increasing average total utilization by 39%. Third, the team presented strategic recommendations for planned future projects using two new track line technologies that allow Brose to either scale track line capacity or flexibly produce all existing products on a single assembly line.

BROSE

Unlocking Bowling Green Plant Untapped Capacity

Student Team:

Joe Bertha – Master of Science in Engineering in Industrial and Operations Engineering Pablo Martinez - Master of Business Administration Deb Xavier - Master of Business Administration

Project Sponsors:

CURATION FOODS, INC.

Jim Buatte - Sr. Director of Continuous Improvement Jeff Korengel - Vice President Project Management- New Product Commercialization

Faculty Advisors:

Debra Levantrosser - College of Engineering Lisa Pawlik - Ross School of Business

A division of Landec Corporation, **Curation Foods** is a natural foods company producing plant-based fresh food, stocked in many national grocery chains. Curation's leadership identified the strategic need to close the underutilized manufacturing plant in Hanover, PA, and consolidate its operations into its manufacturing facilities in Guadalupe, CA and Bowling Green, OH by September 2020. In addition, Curation Foods is seeking to foster a culture of continuous improvement and operational excellence across its plants by rolling out its ZEST (Zero Mindset, Empowerment, Standardization, and Training) philosophy.

Curation Foods invited the Tauber team to its Bowling Green facility to identify and evaluate opportunities for increased production capacity through operational efficiency improvements, with minimal capital expenditure. The Tauber team took a systematic, data-driven approach for evaluating the facility, identifying analysis focal points, prioritizing potential solutions, piloting them and measuring projected impact.

In the first phase, the team focused on the analysis of the current state of the facility by creating current state maps for its salad and green beans production and identified the process' bottlenecks. After this, the team established a baseline for the bottleneck's overall equipment effectiveness (OEE) and calculated a target OEE necessary to absorb the Hanover, PA plant's production.

In the second phase, the team identified potential operational improvements through the ZEST framework, focused primarily on the standardization of processes, enabling continuous improvement, reducing waste, and improving overall safety at the plant. The team's primary proposals focused on improving the onboarding process to increase employee retention, implementing a daily OEE tracking and reporting method, streamlining changeovers, using a daily production scheduling tool to maximize machine availability, and improving safety through the installation of pedestrian and forklift pathways.

In the third phase, the team piloted some of the solutions to evaluate their viability and determine the next steps necessary for their implementation. With information gathered from these pilots and projections from previously gathered data, the team determined that these recommendations would yield sufficient OEE increase to allow for the absorption of the Hanover plant's production.

By freeing up the untapped capacity in the Bowling Green plant, this project has paved the way for smooth consolidation of production into one location. This results in an annualized expected savings for Curation Foods of approximately \$4.4M per year.

CURATION FOODS

DOORDASH, INC.

Quality Operations Improvement for Online Grocery Delivery

Student Team:

Estefania Avila-Anchondo – Master of Science in Engineering in Mechanical Engineering

Project Sponsors:

Daniel Han – Director of New Business Verticals at DoorDash Scott Maduri – Senior Manager of New Business Verticals Eun Ro – Senior Manager of New Business Verticals

Faculty Advisors:

Roman Kapuscinski - Ross School of Business

DoorDash was founded in 2013 as an on-demand prepared food delivery service. Since then, DoorDash has expanded its real-time on-demand logistics system and now has 9 main product offerings ranging from the traditional prepared food delivery service to commissary kitchen rentals. The online grocery delivery US market size is estimated at \$33 billion with a 16.5% growth in the past 5 years and faster growth expected in the future. The New Business Verticals Team is driving the efforts to build the Convenience and Grocery Marketplace offering on DoorDash.

The grocery delivery service at DoorDash consists of a new shopper system that integrates into DoorDash's greater delivery logistics system. Using two new mobile applications and several new on-the-ground operational roles, the shopper team picks a customer's grocery order and hands the completed order to DoorDash's existing pool of Dashers (drivers) to deliver. The mobile applications are expected to seamlessly integrate the grocery stores' digital catalog, their current inventory schedule, and customer orders. A high variety of the product offerings (often 20,000 plus SKU per store) paired with the immaturity of the applications, and lack of reliability on the partner's inventory schedule has led to high out of stock rates, lost sales, and therefore unsatisfied customers. Additionally, underdeveloped operational roles have led to significant cost savings opportunities by optimizing the auditing process.

To address this opportunity, the Tauber team performed a comprehensive root cause analysis on the sources of out of stock rates at one of DoorDashes high profile partners, Miejer. After narrowing down the most significant impacting sources of out of stock, the Tauber team helped optimize a real time inventory system for the shopper team to help mitigate customer dissatisfaction. Additionally the team created a feedback loop between Meijer's stocking teams and the DoorDash's catalogue team to reduce future lost sales. Lastly, the Tauber team acted as the sole Area Manager for the Chicago region, managing over 20 stores. Through this role the team was able to contribute optimizations to standard operating procedures for store launches, management, and auditing processes.

After implementing the out of stock improvement plan, DoorDash witnessed a 30% reduction in out of stock rates and a customer satisfaction increase of 12%. Similar results are expected as these cost saving procedures get rolled out to other DoorDash grocery partners. Additionally, with the optimization of standard operating procedures resulted in over 20 successful store launches in the Chicago area.

Quality Operations Improvement for Online Grocery Delivery

Student Team:

Victoria Glunt – EGL (BSE & MSE Industrial and Operations Engineering) Nicholas Lowe - Master of Business Administration

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Faculty Advisors:

FEDEX CORPORATION

Vijay Pandiarajan - Ross School of Business Oleg Gusikhin - College of Engineering

An industry leader in distribution, FedEx Express relies heavily on its fleet of approximately 680 aircraft to perform at the highest level to deliver consumer goods on-time. To put this in perspective, the number of aircraft flown by United Parcel Service (UPS) is around 260, roughly 2.5x smaller in quantity. Comparison to commercial airlines further demonstrates the magnitude of the FedEx airline. Ryanair, the largest airline in Europe, houses a fleet of around 450. United Airlines operates a fleet of 800 aircraft.

All aircraft are equipped with an Auxiliary Power Unit (APU), which is used to power the electrical system that moderate activities like air conditioning and starting the plane's engine. Unlike engines, APUs are not utilized when an aircraft is in-flight. Although FedEx currently has a sophisticated method of forecasting for engines, utilizing third-party software, the method it uses for APUs is far less robust and based on an outdated model.

The Tauber team focused on the Honeywell GTCP331-200ER APU, which is installed on both the Boeing 757 and 767 aircraft operated by FedEx. Through continual knowledge gathering on current best practices, processes, and tools, it became clear that there was an opportunity to significantly streamline and consolidate the process that was being used for APU forecasting.

Over 12 weeks, the Tauber team worked closely with members of Propulsion Planning & Analysis (PPA) and other related teams to develop an APU forecasting model. At a high level, the final APU forecasting model functions through a combination of SAS data, VBA coding, and other Excel functions and formulae.

Overall, the APU forecasting model produced by the Tauber team resulted in more accurate maintenance repair budgeting, process improvements, and time savings through the consolidation of information and automation of multiple data sources. The team was able to perform detailed analysis on maintenance repair costing from vendors, unscheduled engine removals, and the creation of a soft threshold to allow for increased accuracy compared to the current processes being used. Moving forward, this model will assist the PPA team with more precise budgeting for APU induction costs and the ability to visually track and manage spare APU components.

FEDEX CORPORATION

Student Team:

Project Sponsors:

Faculty Advisors:

FORD MOTOR COMPANY

Designing and Simulating In-Plant Logistics for the Factory of Tomorrow

Student Team:

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Project Sponsors:

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Faculty Advisors:

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Ford Motor Company is a leading global manufacturer of commercial and retail automobiles. To stay at the forefront of automotive manufacturing, the company invested \$45M to create its Advanced Manufacturing Center, a development hub supporting Ford manufacturing by designing and testing future technologies. To improve manufacturing flexibility and reduce costs, Ford is creating an unconstrained logistics process through automation.

Consumer preferences have led to a proliferation of vehicle models and configurations, increasing the complexity of in-plant logistics. An average vehicle consists of over 3000 components, most of which are added during Final Assembly and are unique to a specific vehicle. Ford is dependent upon their supply base to sequence component parts and must set a production schedule far in advance or face steep cost premiums. The Tauber team, therefore, was tasked with reviewing the current process and proposing a futuristic approach to increase manufacturing flexibility in the "Factory of Tomorrow".

A design-thinking approach was used to tackle this problem. First, the team thoroughly analyzed the current state to identify pain points and areas for improvement. Next, the team generated a future vision for unconstrained in-plant logistics, integrating emerging technologies and lean manufacturing principles. Then, the team developed a robust simulation model with a combination of agent-based and discrete event modeling to prove the feasibility of the proposed future vision. The model was also key toquantify future vision parameters and visualize the interaction between agents such as autonomous mobile robots and material picking stations. Simulated production enabled the team to obtain actionable insights and provide recommendations on the technical and technological requirements of the proposed innovations.

As thefuture vision will require a new set of operational indicators to evaluate the flexibility and performance of the new processes, the team created a suite of key performance indicators (KPIs) and a calculation tool with a visual dashboard to encourage continuous improvement. The simulation model was constructed to be a versatile tool capable of running multiple variants to test adjustments to the future vision processes and then compare performance versus the Tauber vision benchmark using the provided KPIs. Thus, the simulation supports Ford's manufacturing leadership in developing the optimal and most flexible logistics ecosystem.

The Tauber team's model confirmed their future vision can help Ford's Final Assembly plants meet the corporate reduction goal of (1) 30% cost, (2) 30% labor, and (3) 30% land. Within the Final Assembly plant, the future vision can reduce:

- 1) Inventory costs 67% and part delivery logistics costs 27%
- 2) Part delivery logistics labor 93%
- 3) Warehouse footprint 44%

Overall, the future vision could generate cost savings up to \$1.4M annually per Final Assembly plant.

FORD MOTOR COMPANY

Seth Guikema – College of Engineering John Silberholz – Ross School of Business

General Electric Company (GE) is a leading global manufacturer and provider of industrial equipment, technology, and software. GE's software for electric utilities is used to manage 40% of the world's electricity. The GE SmartSignal software monitors and provides early and actionable warnings of impending equipment and process problems on more than 16,000 assets, worth approximately \$37B across industries around the world.

SmartSignal detects and identifies events and abnormal behavior in industrial power generation equipment. SmartSignal provides exception-based notifications of developing problems to users, along with diagnoses and prioritizations. The Tauber Team was tasked with developing a new tool designed to work alongside SmartSignal. To ensure system availability, the new tool will notify utility providers of any system issues and estimate the time by which a maintenance action is required. Utility providers can use this Time to Action metric to determine how much remaining useful life exists on an asset and schedule maintenance activities appropriately.

To develop the Time to Action analytic, the Tauber team analyzed data from over 100 assets over a 2-year period and created a data set to build and train a machine learning model. The team navigated data gaps, using data interpolation techniques, and worked with experts in data analytics to create an algorithm that can beat a statistical median estimation of time to action 70% of the time, for the tested failure mode. An automated data pipeline and modeling technique has been implemented to ensure that this analytic can be tested and implemented on different power generation assets and sites, worldwide.

The implementation of this analytic across all assets and failure modes in a power plant will allow customers of GE to take a large step towards predictive maintenance practices. Implementing predictive maintenance, alongside SmartSignal technology, is estimated to provide a small utility operating a 250 MW power plant with \$1.4MM in operational savings over 5 years. Furthermore, GE is estimated to see top line growth in the Power Generation segment between \$2 and \$5 million annually within four years of analytic implementation as utilities upgrade their SmartSignal solutions to include predictive capabilities.

GENERAL ELECTRIC COMPANY

GENERAL ELECTRIC COMPANY

Developing Analytics to Predict Maintenance Needs for Electric Utility Assets

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Devang Gandhi – Senior Staff Data and Analytics Scientist Mahesh Asati – Senior Director of Data and Analytics Matt Schnugg – VP Data Science and Analytics Engineering

GENERAL MOTORS

Improved Dashboards for Throughput Analysis

Student Team:

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Project Sponsors:

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General Motors (GM) is a \$193B company which has pushed the limits of transportation for over 100 years. Recently, however, the company's manufacturing department has faced issues with throughput bottleneck analytics due to inconsistencies in data structures and analysis methods used within a plant and across plants. Specifically, an internal project conducted in 2019 found that 27 tools are used across all 14 GM North American (GMNA) Vehicle Assembly Plants with different sources of raw data are used for the total plant analysis due to varying preference, familiarity, or availability of the expert. No tool currently exists that directly compares the results of various methods side-by-side, and enabling technologies are complicated for use by the end-user. Furthermore, subject matter experts expressed concerns about spending large amounts of time manually identifying data collection issues and bottlenecks.

To address these enhancements, the team first created a single dashboard aggregating results from two different analysis tools, WebTIP and the Bottleneck Indicator Tool (BIT), which are both used in finding bottlenecks at a plant. Second, the team implemented a navigation tool and flexible date and shift selectors that enable users to easily move between reports and select desired date ranges or shifts of interest. Third, the team created functionality to automatically confirm the credibility of data values from WebTIP and BIT during the chosen time and shift. Lastly, recommendations such as methods to implement the dashboard through GM IT servers were documented and shared with the team.

The team faced challenges such as a 4-week delay, adapting to a virtual work environment, and issues working with raw data. However, the team created a polished dashboard and was able to iteratively receive feedback from project stakeholders and potential end-users at a GMNA manufacturing plant. The feedback received was immensely positive and the team had time to adapt the dashboard to feedback. In the future, the dashboard will act as a framework to build other reporting tools at all plant levels.

As a result of utilizing the proposed dashboard, the pilot plant which offered feedback could save \$0.36M per year with avoidance of overtime and the organization could avoid \$5.7M as a fixed cost for tool development and maintenance. The tool could then be rolled out to all 14 plants in GM North America in the future to generate \$5.0M per year in cost avoidance.

MICROSOFT CORPORATION

Assessing Digital Transformation Opportunities in the Semiconductor Manufacturing Industry

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Microsoft is a leading software company with a mission to empower every person and every organization on the planet to achieve more - unlocking unprecedented opportunity as technology disrupts every industry and has the power to make a difference in everyone's lives. To empower customers on their digital journey, the Microsoft Services team envisions new possibilities for delivering and supporting customers' solutions that result in the right business outcomes.

As the COVID-19 crisis disrupts supply chains and chips manufacturing gets more sophisticated, semiconductor manufacturers start developing digital initiatives to improve their research, supply chain, and talent functions. Microsoft service team quickly identifies the emerging opportunities in the semiconductor industry and brought together their Research team, Sales, Industry Architects to help semiconductor clients make digital decisions today that impact long-term investment strategies.

To capture this opportunity, the Tauber team performed a comprehensive analysis of the semiconductor industry's digital transformation opportunities, including deep-dive analysis on a leading semiconductor company. First, the team identified digital opportunities in semiconductor clients by conducting market research, customer survey, and stakeholder interviews. Next, the team developed a digital transformation roadmap for the semiconductor client by analyzing organization digital maturity, opportunity sizing, and 3-year roadmap. Based on this work, the team recommended Microsoft and its semiconductor client to invest in three digital themes and a horizon-based transformation journey that focus on intelligent factory operations, enhanced employee productivity, and improved customer engagement. Finally, to illustrate the potential impact on semiconductor client, the Tauber team chose a semiconductor client's product line to demonstrate the digital transformation opportunities, implementation plan, and assess performance improvement potential.

After implementing the digital transformation strategy on the chosen production line, Microsoft's semiconductor client expected production cycle time reduction was 20%, and expected equipment downtime reduction was 35%. The product scrap could be mitigated by 70%, potentially saving production costs by 25.2M per year.

SPOTLIGHT! 2020

MICROSOFT

Improving Efficiency In Microsoft Payment Incentives

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Microsoft Incentive Operations (MIO) is responsible for launching, improving, and supporting multimillion dollars' worth of annual partner transactions globally. The complexity of these processes has grown exponentially as partners, payment options, products, and regulations have increased. The Tauber team successfully created an anomaly detection tool to identify inconsistencies in upstream data, used Robotic Process Automation (RPA) to automate manual tasks, and developed dashboards to provide comprehensive views of payment processes. These tools have not only promoted cost and time savings, but improved the accuracy of payments to partners.

During each payment cycle, a percentage of the transactions MIO manages are impacted by calculation and payment issues. Within the calculation process, there was previously no system built for program owners to proactively monitor data quality. Furthermore, issues found in the calculation process previously took on average 31 days to resolve. In a 45-day end-to-end payment cycle, this provided a huge risk for the On-Time and Accurate (OTA) payment metric that MIO is measured on. To solve this, the Tauber team built an anomaly detection dashboard that uses upstream pre-calculation data to model and flag abnormal data points. The model is continuously trained and has allowed MIO a 10-day head start for proactive data monitoring. This anomaly tool would have detected 32% of the total calculation errors and 92% of data ingestion errors found in FY20. Converting to financial savings, the tool has a \$2.7 million impact on the incentive program it is implemented on. If scaled to all 40 programs, direct financial impact could potentially equate to \$12.8 million in savings.

Adjustments are performed when payment amounts need to be modified. Most incentive programs process these types of adjustments each month. The tasks to complete the adjustment processes were manual, repetitive and time consuming as vendors would spend nearly 20 hours a month per program. As a result, the Tauber team used RPA to increase the quality of payments, decrease the processing time, and reduce overhead costs. The team built a tool that was the foundation of Minimal Viable Product (MVP) and would save 10 hours per month per program. When scaled to other MIO processes, RPA would save 16+ hours per month per program.

Additionally, in order to provide end-to-end views of the payment processes, the Tauber Team built dashboards based on three different payment periods: Pre-Payment, Active Payment, and Post-Payment. The dashboards have provided visibility on OTA 10 days earlier than before and assisted MIO to identify and perform proactive interventions.

MICROSOFT CORPORATION - RESILIENCE

Establishing Resilience with Cloud Computing

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With Microsoft's dedication to cloud computing, the Microsoft Consulting Services team is responsible for helping companies and organizations around the world, providing guidance and advice on incorporating tech solutions and facilitating digital transformation in their supply chains and operations. Given the disruptions in supply chain brought about by the COVID-19 pandemic, architects at Microsoft Consulting Services were interested in understanding the role of cloud computing and digital transformation in addressing challenges and opportunities brought about by these disruptions. The student was tasked with the objective of producing a white paper that would provide insights into this.

To address the opportunity, the Tauber student needed to evaluate the landscape by understanding the needs of Microsoft's clients as well as gain an understanding of how a company could leverage digital capabilities. Accordingly, the Tauber student conducted interviews with architects and other stakeholders around Microsoft, as Microsoft's supply chain had gone through a digital transformation in the past few years. Discussions with Microsoft's supply chain team enabled a better understanding of how Microsoft's manufacturing and supply chain team responded to recent disruptions. Discussions with solution architects revealed a strong desire for clients to develop supply chains that can be resilient, having the ability withstand and handle unexpected disruptions besides just the COVID-19 pandemic.

Based on these investigations, the white paper outlines an approach to incorporate resilience in supply chains. The first part of the approach stresses the importance of the various attributes needed for a resilient supply chain, as well as the accompanying tools and technologies that would fulfill these attributes. The second part emphasizes the need to incorporate these attributes in a certain order, given their importance and priority. The white paper will guide architects in producing solutions that guide clients on their digital transformation journeys while addressing their needs, especially in a world defined by uncertainty and disruption.

MICROSOFT CORPORATION RESILIENCE

MICROSOFT CORPORATION INCENTIVE OPERATIONS

Microsoft Corporation, a technology company that delivered more than \$125 million in revenue in 2019, seeks to empower every person and organization on the planet to achieve more through its product and service offerings. In the past decade, Microsoft has been investing heavily in cloud computing and enterprise software, focusing on its Azure Services Platform and helping clients digitally transform their corporate operations, with 95% of Fortune 500 firms running on the Azure platform.

MICROSOFT CORPORATION

Go to Market Strategy for Consumer Goods Industry

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Microsoft Corporation, delivering over \$125B in revenue in 2019, is one of the largest technology companies in the world. Lead by their mission to empower every person and every organization on the planet to achieve more, Microsoft has helped organizations in every industry innovate and grow utilizing their platforms and tools. Microsoft Services, with more than 17,700 employees, works with customers of all sizes to accelerate their digital journey, from envisioning new innovative possibilities to delivering scalable solutions and support. Focused on digital transformation, the team brings the best of Microsoft and exercises a growth mindset to deliver strategic business outcomes, maximize the value of cloud technology, and drive greater consumption of products and services

The Services team focuses on numerous industries: Financial Services, Government, Healthcare, Manufacturing and Retail & Consumer Goods. The team identified an opportunity to further the digital transformation narrative for the Consumer Goods industry, enabling every company to be a digital business. Specifically, Microsoft has developed 4 Industry Priority Scenarios: Optimize Brand Performance, Deliver Sustainable and Operational Excellence, Connect your Enterprise, and Accelerate Innovation.

The objective of the project was on developing Accelerate Innovation. Throughout the time of the project, the Tauber Student performed intensive research on the following topics: Consumer Goods Industry Trends, Consumer Goods Vertical Category Breakouts, Commerce Trends and Enterprise Ecosystem. The primary deliverable was a strategic framework on Connected Innovation for Consumer Goods. The presented framework comprises of Horizon 1: Connected Insights, Horizon 2: Connected Engagement, and Horizon 3: Connected Innovation and the value add of Microsoft solutions during a company's digital transformation journey. The result of the framework was developed into a client facing presentation that would be utilized by numerous internal parties within Microsoft such as Digital Advisors, Account/Sales Teams and Industry Architects during client conversations.

NATIONAL CENTER FOR MANUFACTURING SCIENCES (NCMS)

Digital Additive Manufacturing Ecosystem: Use Case

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NATIONAL CENTER FOR MANUFACTURING SCIENCES

Raed Al Kontar – College of Engineering Mohamed Mostagir – Ross School of Business

Virtual, secure collaboration has become increasingly vital to the way organizations operate, which has been amplified by the COVID-19 global pandemic. As a non-profit organization dedicated to improving the strength and competitiveness of US manufacturing, the NCMS is a thought-leader on responding and adapting to changing environments and emerging situations. One of NCMS' strategic initiatives is its partnership with the Army Research Laboratory via the Advanced Manufacturing, Materials, and Processes (AMMP) program to realize next-generation advanced manufacturing breakthroughs.

In June 2020, NCMS implemented the Digital Proving Ground: a cloud-based digital infrastructure enabling industry/academic/government users to collaborate on complex projects utilizing state-of-theart tools and systems consolidated in an interconnected, cloud-hosted environment. This platform is designed for multiple offerings, with its first capability being a robust software suite and novel process for additive manufacturing design. This unique and groundbreaking tool allows users to remotely, securely, and collaboratively design, simulate, test, assess, and plan for the manufacturing of additively manufactured parts.

As part of the initiative to validate this offering, the objectives of the Tauber project were to refine the process for additive manufacturing design and then to demonstrate the benefit of the Digital Proving Ground to strategically position NCMS for rapid, widespread adoption of the capability. The Tauber team assessed the additive manufacturing design process using lean manufacturing principles to identify and reduce waste, making the process more efficient. Utilizing a case study method, the Tauber team partnered with Sikorsky – Lockheed Martin to identify a helicopter component with a troublesome supply chain and redesign it for additive manufacturing via the Digital Proving Ground. To test and validate the process, the team partnered with subject matter experts at both Sikorsky and Siemens to redesign the component, validate the design, and create the manufacturing plan. Finally, the Tauber team partnered with the University of Texas – El Paso to print the redesigned part.

This geographically dispersed team, with team members in Michigan, New York, Connecticut, Massachusetts, Virginia, Arkansas, Texas, and Ohio, utilized the Tauber-modified process for additive design, redesigned the Sikorsky component, and released it for production in only 62 total labor hours—a 39% reduction from Sikorsky's additive manufacturing redesign process time. This reduction in process time serves as a validation of the potential value that the NCMS Digital Proving Ground offers its users to increase efficiency and cut costs.

PEPSICO

Gatorade Water Use Optimization

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PepsiCo is a Fortune 100 food and beverage company that has publicly committed to 2025 Sustainability Goals which include significantly reducing the amount of non-product water used in the Gatorade production process. These goals are particularly important to water-stressed locations like Dallas where water usage will be reduced by 30%. The Tauber team developed a path for the Gatorade plant in Dallas to achieve PepsiCo's 2025 water usage sustainability goal by evaluating the full extent of their current status, reviewing proposed initiatives, recommending new water saving initiatives, and implementing approved projects.

To understand the plant's current status, the team updated water usage data by taking measurements of flow, analyzing existing data, and confirming the accuracy of data already being recorded. The team then collected and reviewed water-savings initiatives in order to evaluate the potential savings of future projects. These estimates were used to create a phased plan that will lead the plant to their water use goals. Forecasted changes in production were also modeled and the resulting change in water use can be employed to build in flexibility to the plant's pathway to achieving their sustainability goals.

The Tauber team then began implementation of water savings projects to ensure the site remains on target to achieve annual goals and jump start the plant's water saving initiatives. The targeted efforts included optimizing water use during flavor changeover, reducing wasted water in the steam system, and reclaiming water during weekly cleaning processes. The water savings from the implemented projects account for an estimated 6.5MM gallons of the estimated 60MM gallons that need to be saved by 2025.

PEPSICO, INC.

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Project Sponsors:

PFIZER, INC.

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Faculty Advisors:

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Pfizer Inc. is the world's largest research-based biopharmaceutical company. This project took place at one of Pfizer's two primary R&D clinical supply manufacturing facilities, in Groton CT. The project focused on the Portable Continuous Miniature and Modular (PCMM) platform, a first-of-a-kind, transportable, manufacturing facility for continuous oral solid dose pharmaceutical development. PCMM accelerates the speed of tablet production and enables smaller, more flexible continuous processing. PCMM is the epitome of Pfizer's goal to drive for Breakthroughs that change patients' lives because continuous manufacturing will enable them to accelerate the timeline to bring lifesaving therapies to patients.

Demand for PCMM was set to double from 2019 to 2020 so the Tauber team was tasked to standardize efficient work processes, visualize capacity utilization, and establish schedule adherence. With uncertain clinical manufacturing and demand expectations, PCMM faced challenges with establishing and enforcing production schedules. Further, the team didn't have formal processes to efficiently update schedules when faced with process upsets and delays. Additionally, the PCMM team could not view true free capacity and identify process inefficiencies as they were unable to distinguish between productive and non-productive downtime. With an unreliable view of capacity, the Tauber team focused on delivering a strategy for updating data tracking and establishing scheduling tools.

The team created a flexible Excel-based capacity model to understand capacity limits and schedule demand. The model enabled the Tauber team to run scenarios and recommend strategic improvements to improve process understanding of key large batches on the horizon in 2021. The team also designed a daily downtime tracker to track non-productive delays, which with the scheduling tools, enabled Pfizer to view their true current capacity. Finally, the team created a highvolume production strategy by identifying work processes that warranted updates to enable longer run times required by the high-volume demand that PCMM would encounter in 2021 while increasing production capacity.

When applied, the dynamic capacity model, downtime tracker, and high-volume production strategy will have the potential to avoid the cost of outsourcing up to 20 batch equivalents to external manufacturers which could cost upwards of \$2 million. They will increase visibility and efficiency in scheduling PCMM operations and clinical manufacturing with an anticipated 50% increase in utilization of yearly manufacturing capacity with the enforcement of the downtime tracker and highvolume production strategy. These initiatives with PCMM support Pfizer's strategic goal to lead the industry in rapidly delivering a large portfolio of life changing therapies to market.

PFIZER, INC.

Optimizing Continuous Drug Product Manufacturing With PCMM

STANLEY BLACK & DECKER

Industry 4.0 – Connected Factory Data Analytics

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Stanley Engineered Fastening (SEF), a division of Stanley Black & Decker (SBD), manufactures and supplies fasteners for the North America industrial and automotive industries. Looking to increase efficiency and labor productivity using real-time factory data and Industry 4.0 technologies, SEF tasked the Tauber team with creating a standardized roadmap around analytics of the generated data that could be used to drive improvement at any site. Stanley gave the team a goal of achieving a savings of \$350k minimum across three SEF plants, Chesterfield Plastics and Metals, Montpelier and Westridge.

After conducting benchmarking in the plants that have completed the deployment of Industry 4.0 technologies, the Tauber team cooperated with the Process Engineering(PE) Team to create a playbook that can facilitate the implementation process of such Industry 4.0 factory technology, which shows real-time data of machines. The team is responsible for developing several documents in the playbook package. First, to ensure plants can fully utilize the Industry 4.0 technology and react to issues in a timely manner, the team provided guidance on how to adjust thresholds appropriately for the displays to reflect the real production and for the alert function to be helpful. Secondly, instructions for creating issue response protocols were developed to reduce the time needed for resolving a machine issue and help plants quickly identify the stakeholders that should be notified when certain issues happen. Third, the team collaborated with the PE team to develop rules for creating downtime and defect code lists, an informational document explaining the meaning of OEE and the dimensions it includes, and instructions for reviewing data generated from the Industry 4.0 technology.

Moreover, the team is tasked to create a tool that can estimate the business value behind implementing Industry 4.0 technologies and track the savings progress of any improvement opportunities that use data from this technology. The team interviewed various stakeholders to know how each plant measures the key performance indices, then a template was created for all plants to calculate savings generated from implementing such technology. In addition, an evaluation rubric was developed to monitor the competency of operators in using the technology correctly.

In 2020, 10 SEF sites will have LiveView implemented. The LiveView implementation playbook and cost saving template are estimated to reduce 5% downtime and 10% late shipment cost in one plant, resulting in \$375k direct saving for in the first year. In the next two years, LiveView will be implemented in an additional 34 SEF sites around the world. If the playbook and cost savings template are also deployed in these 34 sites, the resulting annual savings would be \$543k.

The Digital Operations Transformation Strategy

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As a global leader in the office furniture and workplace solutions industry, **Steelcase** seeks to maintain its standing by accelerating the efficiency, effectiveness and consistency of its global operations. The project's objective is to identify key technologies based on perceived value and develop plans to validate the potential impact of selected solutions. To become an innovative leader, Steelcase is defining and pursuing a Digital Operations Transformation (DOT) strategic initiative. The 2020 Tauber team executed Phase one of the three phase DOT strategy as part of the Steelcase's Operations Strategy team.

The Tauber team's work is composed of three main steps: establishing the technologies, capabilities and innovations that compose the DOT strategy (referred to as building blocks), developing the business case for specified building blocks, and prioritizing those that offer highest value and feasibility.

As part of the Steelcase Operations Strategy team, the Tauber team, selected the overall set of building block technologies and capabilities. The analysis was informed by ongoing work at Steelcase, a competitive landscape analysis, and research about industry 4.0 and digitalization. With the technologies defined, the Tauber team developed the structured innovation plan for 10 of 25 blocks to determine the potential value at stake and summarize key information including a current state analysis, future vision, viability of adoption, and potential piloting strategy. Five of the 10 prioritized technologies—exoskeletons & wearables, automated quality inspection, digitized non-core processes, predictive maintenance, and the Industrial Internet of Things-arefeatured in today's presentation. The opportunities identified as part of the DOT strategy could unlock more than \$10M in savings through safety, quality, delivery, and cost operations improvements through only two of the Tauber team's highest priority building blocks, with a much higher total to be determined across the full set of 25 digital technologies and capabilities.

STANLEY BLACK & DECKER

STEELCASE

STEELCASE

STONERIDGE, INC.

Value Stream Mapping and Waste Elimination In the MirrorEye Supply Chain

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Stoneridge Inc. is a leading global Tier 1 supplier of electrical and electronic components for use in automobiles, motorcycles, and commercial vehicles. In recent years, Stoneridge's Electronics Division (SRE) has spearheaded the development of an innovative Camera Monitor System called MirrorEye. This highly engineered product allows commercial truck operators and manufacturers to replace side view mirrors with cameras that relay video, including full color night-vision, to the driver through a set ofin-cab monitors. Early tests of this system indicate a 2-3% fuel efficiency gaindue toimproved cab aerodynamics. In addition, increased driver visibility is projected to reducetrucking-related accidents by up to 30%.

As one of only two companies to obtain an exemption from the Federal Motor Carrier Safety Administration (FMCSA) to replace side view mirrors on commercial vehicles, Stoneridge is uniquely positioned to become a market-leader in Camera Monitor Systems. To capitalize on this momentum, Stoneridge will launch a second iteration of this product, MirrorEye 2, in January 2021. With demand forecasted to grow rapidly in the next few years, Stoneridge realized that its supply chain must adapt to meet the needs of their most complex product to date. The Tauber Team was brought in to map the MirrorEyevalue stream while looking for opportunities to reduce waste and create additional value.

To address this opportunity, the Tauber Team first created Value Stream Maps as requested. Next, the Team analyzed the supply chain's production capabilities by building a simulation model and creating a capacity planning framework to plan out the investments required to meet demand. The Team also recommended a consolidation of North American distribution flows at the El Paso site, while also providing suggestions to improve quality checks along the supply chain. Finally, the Team developed research-based recommendations for Stoneridge to improve its Sales & Operations Planning process.

The implementation of these recommendations is expected to yield significant benefits, including an increase in inventory turns of 282% and a reduction in days of inventory of 68% over five years, while drivingmajor efficiency and quality improvements throughout Stoneridge's MirrorEye supply chain.

STONERIDGE, INC

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Target Corporation is an upscale, discount retailer business that provides high-quality, on-trend merchandise at attractive prices, generating \$75.4B in annual revenue through online and in-store sales. Target has a vast distribution center network, operating 42 distribution centers, to replenish both stores and Fulfillment Centers (FC), which deliver e-commerce orders straight to guests. Its Regional Distribution Center (RDC) network receives goods from more than 8,000 vendors and replenishes both Target stores and Target.com. Target maintains both small-format discount stores and SuperTarget hypermarkets, totaling 1,871 locations in the U.S. and employing over 360,000 people. The company sells a variety of merchandise, including beauty and health products, bedding, clothing and accessories, electronics, food, furniture, jewelry, lawn and garden, pet supplies, shoes, small appliances, and toys and games.

As Target's digital business continues to grow at a substantial rate, the company requires improved store inventory accuracy to support the digital fulfillment processes. RDC-to-store trailer defects directly lead to inventory discrepancies in Target's stores. Items missing from store inventory contribute to lost sales with in-store guest purchases, canceled digital orders due to the inventory not found during store fulfillment, and excess labor needs as time is spent researching and resolving discrepancies.

Seeking to resolve this issue, Target implemented a pilot program to capture trailer load defects. The Tauber team validated that the current pilot captures defects that result from an unreliable scan-to-load verification process, preventing the ability to effectively detect legitimate trailer load defects. To address this, the team anchored towards designing a new process that was capable of scanning 100% of conveyable cartons loaded onto the trailer.

The Tauber team's proposed solution was to extend pilot testing to compare two scan-toloadprograms: an optimized presentation scanner and a wearable wrist-mounted computer. Upon successful testing, the team recommended a phased rollout to a select number of RDCs within the legacy replenishment network and then across the entire network. If scaled across the network, this program will reduce up to \$960M worth of trailer inaccuracies annually.

TARGET CORPORATION

Improving Trailer Load Accuracy

Claire Foley – BSE Mechanical Engineering, MSE Industrial and Operations Engineering Rachana Modi – Master of Business Administration

> TARGET CORPORATION



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