2023 EDELMAN GALA

Recognizing Distinction in the Practice of Analytics, Operations Research, and Management Science

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2023 EDELMAN GALA

FOR DISTINCTION IN PRACTICE

FRANZ EDELMAN AWARD

Achievement in Advanced Analytics, Operations Research & Management Science

Emphasizing Beneficial Impact

DANIEL H. WAGNER PRIZE

Excellence in Operations Research Practice

Emphasizing Innovative Methods and Clear Exposition

UPS GEORGE D. SMITH PRIZE

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Emphasizing Effective Academic Preparation

INFORMS PRIZE

Sustained Integration of Operations Research

Emphasizing Long-term, Multiproject Success

Aurora, Colorado | April 17, 2023

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HOST OF CEREMONY

Carrie Beam, University of California, Davis

The year was 1989, and Carrie Beam was an engineering undergrad, hunkered down in the library. Her study partner thumped his head on the desk. "There is no such thing as a 'just a little linear program!'" he exclaimed. She begged to disagree. The linear program on the homework looked small enough to fit on a single hand-written notebook page. Her prediction proved correct.

Many years later, as Dr. Carrie Beam, she brings this line of thinking to her role as director of the Master of Science in Business Analytics program at the University of California, Davis. She works with corporate partners to frame analytics projects suitable for student teams. She coaches student teams as they solve these problems. She teaches classes on business analytics problem framing, data storytelling, project management, and every so often, gets to chase down a Markov chain or ask ChatGPT to write some Python code.

Previously, she was a Teaching Associate Professor at the University of Arkansas in the Master of Science in Operations Management program. This position allowed her to teach as many linear programs as she could squeeze into the curriculum. She taught data analytics, lean production, decision support tools, and of course, statistics. She has been consulting as a fractional data scientist for more than 20 years.

Long before the University of Arkansas, she earned a PhD in industrial engineering and operations research at the University of California, Berkeley. Her thesis committee had an issue with her qualifying exam proposal about pricing mechanisms for Internet-based auctions. They weren't so sure Internet-based commerce would still be relevant by the time she completed her dissertation. Amazon.com had sold its first book the year before her qualifying exam, and e-commerce was a big unknown.

As to her first linear program? It was at Princeton University in that fateful fall of 1989, when, to her great surprise, she was actually wide awake in her 8:00 a.m. class. Why so alert, so early? The professor paced in front of the chalkboard and said, "We have min the sum over i of c_{ij} x_{ij}..." Then he gesticulated and proclaimed, "And then we get to optimality." She was sold.

When she is not negotiating partnerships with industry or encouraging a bright-eyed student project, she fills her head with memoirs, biographies, and first-person accounts of everything from the "Voyage of the Beagle" (Charles Darwin like he's always been) to "Libertarians on the Prairie" (Laura Ingalls Wilder like she's never been seen before).

Dr. Beam has been active in INFORMS for more than 20 years, beginning as a student member at Berkeley, and with the Franz Edelman Award since 2010. She served as Award Chair in 2021 and 2022, and is delighted to be the ceremony host for the 2023 Edelman Gala.

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ANALYTICS AND OPERATIONS RESEARCH TODAY

2023 EDELMAN PROGRAM NOTES

By Laura Albert, INFORMS President

It is my pleasure to welcome everyone – this year's awards finalists, meeting attendees, distinguished guests, valued sponsors, and all members of the INFORMS community – to the 2023 Edelman Gala! Throughout this year's Business Analytics Conference, we've had the unique opportunity to hear from leading analytics professionals and industry experts, learn about cutting-edge solutions to our most challenging business problems, and enjoy countless opportunities to grow our personal and professional networks, making valuable and lasting connections.

Tonight, we come together to celebrate excellence in analytics as we recognize the recipients of four of INFORMS' most esteemed awards: Daniel H. Wagner Prize for Excellence in Operations Research Practice; UPS George D. Smith Prize; INFORMS Prize; and the Franz Edelman Award for Achievement in Advanced Analytics, Operations Research, and Management Science.

The 2023 finalists – representing incredible contributions from across the globe – are the result of the collective impact of years of hard work and collaboration that not only showcase to the rest of the world the transformative power of operations research (O.R.) and analytics, but serve to guide and inspire the next generation of O.R. and analytics professionals, regardless of their career path.

From the top academic programs shaping the next generation of analytics professionals, to successful sustained integrations of analytics across all business operations, to the most impactful applications that are saving lives, saving money, and solving the world's most complex and significant problems, this year's finalists are truly an inspiration today and will continue to inspire future generations of O.R. and analytics professionals.

Daniel H. Wagner Prize for Excellence in Operations Research Practice

For more than two decades, the Daniel H. Wagner Prize has been presented to teams whose work demonstrates strong mathematics applied to practical problems that not only have a significant and lasting impact in application, but are also communicated with clean, intelligent writing.

During the 2022 INFORMS Annual Meeting in Indianapolis (our first fully in-person Annual Meeting since 2019!), the Wagner Prize competition was held among a group of previously selected finalists, including teams from the United Network for Organ Sharing and MIT Operations Research Center; Deutsche Post DHL Group; and Alibaba Group.

The prize was ultimately awarded to researchers from MIT and Anheuser-Busch InBev for their work that leverages physical retail experiments and a platform named "TestOps" to increase sales and revenue. The platform finds that when treatment effects are small, the environment is noisy

and nonstationary, and adherence problems are common, which results in roughly 100x increase of experimental power relative to alternatives. Their work with TestOps has seen a 1%-2% increase in sales and nearly $135 million in monthly revenue.

We are excited to recognize and celebrate their incredible contribution here tonight, along with our other INFORMS award finalists and winners!

UPS George D. Smith Prize

Named in honor of the late UPS chief executive officer, the INFORMS UPS George D. Smith Prize recognizes universities from across the globe that share the same focus: developing and maintaining strong relationships between their students and industry partners to help better prepare the next generation of O.R. and analytics practitioners.

This year's finalists are: Georgia State University, Institute for Insight, J. Mack Robinson College of Business; Purdue University, Mitchell E. Daniels, Jr. School of Business, Business Analytics and Information Management; and University of Toronto, Rotman School of Management, Master of Management Analytics.

INFORMS Prize

Each year, the INFORMS Prize is presented to an organization with a strong commitment to and effective integration of O.R. and analytics into its decision-making process, providing lasting impacts across multiple initiatives. Over the years, the INFORMS Prize has been presented to leading organizations including Amazon, UPS, Booz Allen Hamilton, Walt Disney Company, U.S. Air Force, Wayfair, and Intel. I am pleased to share the 2023 winner of the INFORMS Prize is Walmart.

Franz Edelman Award for Achievement in Advanced Analytics, Operations Research, and Management Science

The world's most prestigious award for achievement in the practice of O.R. and advanced analytics, the Franz Edelman Award annually recognizes organizations whose applications of O.R. and analytics have transformed the world around us. This year's Edelman Award finalists have made revolutionary contributions in software bidding systems; rideshare matching applications; e-retailer optimization technology; retail truck routing and load planning; delivery order dispatching; and streaming service traffic allocation. Finalists for the Franz Edelman Award have contributed to a cumulative impact of more than $400 billion since the award's inception and countless other nonmonetary benefits.

The 2023 Franz Edelman Award finalists are DHL Supply Chain; Huawei Cloud; JD.com, Inc.; Lyft, Inc.; Meituan; and Walmart.

DHL Supply Chain. A new software system, "The Transport Network Optimizer," has been developed with The Ohio State University Department of Integrated Systems Engineering that supports bidding on projects and positioning. It solves large-scale routing and is saving more than $98.6 million per year with a total past savings of $116.5 million.

Huawei Cloud. To minimize bandwidth cost while ensuring high-quality B2B livestreaming services in 60 countries, Huawei Cloud developed the GSCO system, integrating forecasting, network planning, and sequential offline-online traffic allocation. GSCO helped reduce 30% in bandwidth cost, or $49.6 million, while supporting a tenfold increase in traffic volume within two years.

JD.com, Inc. China's leading e-retailer operates a vast in-house logistics network of approximately 1,400 warehouses. They have developed three novel technologies: end-to-end optimization, intelligent risk management, and C2M (consumer-to-manufacturer). These technologies facilitate JD.com to achieve three levels of superior performances, including daily operational excellence, resiliency under disruption, and value creation for the ecosystem.

Lyft, Inc. During the height of the COVID-19 pandemic, Lyft changed the algorithm that matches passengers and drivers. The new approach uses online reinforcement learning to constantly self-improve, allowing drivers to serve millions of additional rides each year. The innovation benefited drivers, passengers, and the platform, and generated more than $30 million in incremental annual revenue.

Meituan. As a tech-driven retail company, they have a strategic focus on "Retail + Technology." Every day, more than 60 million on-demand orders are delivered through its leading minute-level delivery network. This relies on assigning massive orders to appropriate couriers in seconds. An intelligent dispatch system is built to continuously improve the assignment quality for couriers and consumers.

Walmart. The world's leading retailer used advanced optimization models to build a transformation roadmap for long-term supply chain capital investments as well as an application supporting daily decisions of truck routing and loading. The application avoided 98.6 million pounds of CO_2 and resulted in a savings of $91.5 million during fiscal year 2023.

Thank you again for joining us for the 2023 Edelman Gala and celebrating excellence in analytics. On behalf of the entire INFORMS community – staff, members, leadership, volunteers, our inspiring awards finalists – thank you for helping us spread the word of the many incredible ways O.R. and analytics are transforming our world, one exciting application at a time.

ANALYTICS CAN INDEED SAVE LIVES! THE FIGHT AGAINST COVID-19 IN CHILE

Reflections on Winning the 2022 Franz Edelman Award
By Leonardo J. Basso, Instituto Sistemas Complejos de Ingeniería & Universidad de Chile

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For anyone attending the 2022 Edelman Gala in Houston, the winner announcement may have been a tad different than previous years. When announced, the Chile team members yelled and cheered with joy, or "were mute with an unbelievable weight falling off their shoulders," as noted in *OR/MS Today*. Indeed, winning the 2022 Franz Edelman Award after two years of intense and stressful work amid the unpredictable and tempestuous times of COVID-19 was, in a sense, therapeutic.

There is no need to explain how the pandemic affected all of us: uncertainty, fear, confusion. There was an evident and urgent need for science-based decisions. The Chilean Ministry of Health and the Ministry of Sciences partnered with Instituto Sistemas Complejos de Ingeniería (ISCI) and telecommunications company Entel to develop innovative methodologies and tools that placed operations research (O.R.) and analytics at the forefront of the battle against COVID-19. We do not intend to explain everything here – I invite you to watch the video presentation and read our paper – but, in a nutshell, as the pandemic progressed, we used advanced methods from statistics, machine learning, and O.R. to:

- shed light on the actual effects of lockdowns in different municipalities and over time;
- help allocate limited intensive care capacity;
- significantly increase the testing capacity and provide on-the-ground strategies for active screening of asymptomatic cases; and
- implement a nationwide serology surveillance program that significantly influenced Chile's (and the world's) decision regarding vaccine booster doses.

Our project is probably unlike others you may have seen in the past, because it faced a large number of difficulties. First, solutions were needed urgently. Second, we needed to communicate and coordinate the efforts of quite a diverse group of people – from engineers, medical doctors and researchers, to political authorities and healthcare workers on the ground – who were all facing huge amounts of stress and were dispersed across the country. Third, as we dealt with very delicate information, results had to be communicated with care; media coverage for the project was vast. Yet, despite all these challenges, this large and diverse group of people managed to create and implement these analytics tools, a project that "provided fundamental support, which has saved lives and has allowed us to implement better public policies," according to Chilean President Gabriel Boric. Indeed, the project saved millions of dollars, avoided thousands of infections and, in a conservative estimate, saved more than 2,800 lives.

The impact of winning the Edelman Award was huge, both in Chile and elsewhere. In Chile, we were enormously content that science, analytics and O.R., applied to such a complex problem, were considered by our peers as the most important intervention of the year. We were of course proudly aware that our




professors at the University of Chile earned Chile's first Edelman Award in 1998. The new Minister of Health declared, "the pandemic made clear to us the need for science and analytics in the management of public policies, to better support decision-making and when facing other challenges as well." And, indeed, as extensively discussed in our Edelman paper (published in the *INFORMS Journal on Applied Analytics*), and currently being realized, the tools and insights developed have very important transportability potential: the knowledge we created will not be rendered useless after the pandemic has ended.

Internationally, the award gave us the opportunity to showcase the scientific and on-the-ground efforts of this small country, which had such concrete impact. A real example of the quite elusive triple helix, where the relation between the government, academia (represented by ISCI) and the private sector (represented by Entel), resulted in a powerful, game-changing collaboration. When asked how Chile managed to do unique things, we reflected that we had a somewhat distinctive case in which the private sector was willing to really collaborate with academia, who was also willing to adjust its innovative tools until they were deemed usable by authorities, who were willing to listen and implement. A "miracle" according to one Edelman judge – a path for the future, we hope.

There is also a lesson for everyone working on and with analytics: consider presenting your best projects in the Franz Edelman Award Competition. Not only is it a huge opportunity to display what you have done, it also provides you with the time to really assess the impact that analytics can have. Our project involved the work of hundreds of healthcare workers on the ground, and dozens of scientists, graduate students and professionals in both ministries and Entel. Our reflection on this today is that our team was able to move from multidisciplinary work to a truly interdisciplinary enterprise. This signals an important message: let analytics not only enlighten, but truly interact. What analytics brings to the table, if understood and adopted by others, will quickly receive feedback and insights that otherwise may never come.

There are particular lessons for the profession as well. Students in this project were not only highly capable, but they were also moved by the impact. They saw first-hand how their equations, simulations and codes resulted in lives saved: mothers, fathers, grandparents, uncles and aunts who, perhaps without knowing it, were able to stay with their families because of this analytics work. For us, in academia, in addition to sharing such profound insights with our students, there was also a message that sometimes, the societal problem comes first, then the innovation and then the publications, which for this project became many. Perhaps, at times, we do not need to think only about what the literature lacks.

We are deeply thankful to INFORMS, the judges, our coaches, and the entire community for receiving the 2022 Franz Edelman Award. We are both honored and humbled. We hope we helped to make it even clearer that analytics can indeed save lives.

OPERATIONS RESEARCH: BILLIONS AND BILLIONS OF BENEFITS!

By Jeffrey M. Alden, General Motors Analytics Research

More than $400 billion U.S. dollars of impact! That's impressive! How is it estimated? How broad is the impact? Is there more? Since 1974, Edelman Award finalists publish project accomplishments in the *INFORMS Journal on Applied Analytics*. While reviewing the 313 articles, their cumulative monetary impact was estimated under the following guidelines:

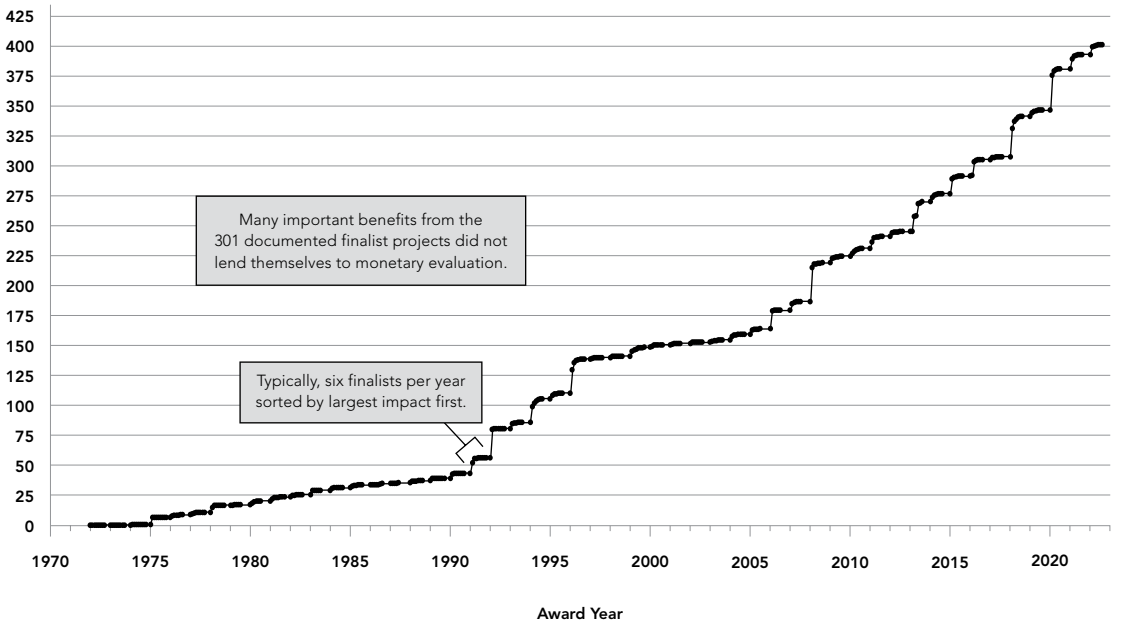
- Be objective and make conservative assumptions.
- Include reported impact plus at most two more years of anticipated impact.
- Include only one year of enormous impact (tens of billions) to downplay the huge budget of some organizations.
- Ignore relative impact even though saving $10 million for a small company may be more impressive than saving $100 million for a large company.

These conservative guidelines exclude important yet difficult-to-quantify reported benefits, such as better legal dispute resolution, cancer treatments, food assistance, airline safety, epidemic disease control, on-time railways, space shuttle heat shielding, and water quality. For example, there are dozens of finalist papers with significant life and health benefits. Most are difficult to quantify, however, a CDC project on (future) U.S. epidemics expects annual savings of 6,000 lives valued at $12 billion,[1] one U.S. Army project estimates 4,500 avoided casualties by reducing requirements for helicopter and ground-convoy movements,[2] and a third estimated 3,000 lives saved during a recent Chile COVID-19 crisis with better use of ICU and screening capacity.[3] Nearly all finalist papers report nonmonetary benefits and often tout them as most important and longer lasting by establishing, for example, ongoing practices and organizational changes that improve health, safety, cooperation, decision making, timeliness, and job satisfaction. Great! Clearly, reported monetary benefits significantly understate the full impact of the Edelman Award finalist projects.

Another important indication of the influence of operations research (O.R.) is the impressive breadth of applications. Edelman Award finalists represent 154 different application areas, including aviation (safety, traffic), banking, canal operations, communications (broadband, broadcasting, radio spectrum), consumer products, crowd control, cruise lines, defense (Air Force, Army), delivery (express, truck), education, energy production and distribution (coal, electric, gas, nuclear, oil, wind), finance (contract bidding, fraud, investment, pension, settlement), fire protection, food assistance, forestry, healthcare (blood collection, cancer, diagnosis, disease control, elderly, hospitals, medical displays, pharmaceutical, surgery), hotel management, land use, manufacturing (computers, electronics, food, paper, seeds, steel, tires, vehicles), marketing, mining, printing, sanitation, security (airport, police), senior housing, social networks, sports, tax collection, transportation (airline, highway, outer space, railway, rental, school bus), treasure hunting, U.S. census, veterinary, waste management, water (flood, flow, resources, quality), and

Benefits More Than $400 Billion from Edelman Finalist Projects 1972–2022

(Conservatively quantified benefits. Realized plus at most 2 years anticipated, in 2023 U.S. dollars)



weapons dismantlement. The list goes on and on! In fact, 777 organizations from business, government, and academia are recognized and honored as supporting or benefiting from finalist projects.[4]

Finally, this is just the "tip of the iceberg" because the Edelman Competition only captures those O.R. professionals choosing to compete! Just think, the 1,537 Edelman finalist authors represent about 12% of the current INFORMS membership.[5] Undoubtedly, a vast number of projects with significant impact do not compete due to confidentiality, lack of internal support to compete (e.g., no one thought of it, too busy, no management support, inadequate documentation), or the team was simply unaware of the competition.

The impact is immense! O.R. professionals should be proud of their profession – you can say "hundreds of billions of dollars and tens of thousands of lives saved" when asked about the value of O.R.!

[1] For CDC: 6,000 lives/year ≈ 314M U.S. population * 5% epidemic penetration * 10% die under current practices * (100% - 80% fatality reduction under improved practices) * 1 epidemic per 200 years. Value of quality year of life in U.S. as least $2M/average life ≈ $50K/year (a standard value) * 78 years life expectancy * 50% average life lived. Total expected annual impact is $12B = 6,000 * $2M. See "Advancing Public Health and Medical Preparedness with Operations Research," *Interfaces*, Vol. 43, No. 1 (note Figure 6). Numbers are reasonable values offered by the author.

[2] "Bayesian Networks for Combat Equipment Diagnostics," *Interfaces*, Vol. 47, No. 1.

[3] "Analytics Saves Lives During the COVID-19 Crisis in Chile," *INFORMS Journal On Applied Analytics*, Vol. 53, No. 1.

[4] Some organizations and contestants have competed multiple times and are counted more than once.

[5] Interesting how the average number of authors per paper has grown from 1.8 over the first 10 award years (1973-1982) to 8.7 over the last 10 award years (2013-2022). Linear regression gives 0.17 annual growth in average authors per paper with $R^2 = 0.79$.

FRANZ EDELMAN AWARD

RECOGNIZING AND REWARDING REAL ACHIEVEMENT IN O.R. AND ANALYTICS

The Franz Edelman Award Competition is administered by the Practice Section of INFORMS.

For more than 50 years, the international Franz Edelman Award Competition has shined a spotlight on the most outstanding real-world applications of operations research (O.R.) and analytics that are transforming our approach to some of the world's most complex problems. Every year, organizations from around the world – both large and small, for-profit and nonprofit, business and governmental, private and public – compete for the Edelman Award. All selected finalists have realized substantial benefits that range from life-saving medical advancements to millions in cost savings and efficiency gains, all from the practical application of advanced methods of O.R. and analytics. Rich with insightful research, the abstracts from finalist papers are shared in *INFORMS Journal on Applied Analytics*. In addition, full-text versions and videos of the competition presentations are available online.

The history of the Edelman Award predates that of INFORMS. In 1972, The Institute of Management Sciences (TIMS), together with its College on the Practice of Management Science (CPMS), created the competition. In 1986, the award was renamed in honor of one of the earliest industry practitioners of O.R. in North America, Franz Edelman. When TIMS merged with the Operations Research Society of America in 1995 to create INFORMS, the Edelman Award became the flagship within a growing awards program.

Born in Germany not long before the rise of the Third Reich, Franz Edelman overcame significant adversity at a young age. After fleeing the Nazi regime as a teenager in the late 1930s, Edelman found himself in England, where his refugee status resulted in internment, and a hiatus of lumberjacking in Canada. After surmounting these obstacles, he received his undergraduate education at McGill University, and later earned a Ph.D. in applied mathematics from Brown University. He then joined RCA Corporation as an engineer concentrating on computational topics. Edelman began to visualize the extreme potential of computer systems designed to assist with management and business operations. By the 1950s, this insight led him to establish RCA's legendary Operations Research Group, one of the first in a North American corporation.

As he continued in his advancement of the O.R. profession, Edelman advocated that success in O.R. requires excellence in information technology (IT) – computer software, computer hardware, and communications. His passion for IT ultimately led him to his role as vice president of Business Systems and Analysis for RCA, responsible for IT as well as O.R. These ideals are still very much present in the current focus on "analytics" and "business intelligence," where strong analysis combines with strong IT.

After 30 years of service to RCA, Edelman retired and formed Edelman Associates, an O.R. consulting firm. Throughout his career, Edelman's commitment to advancing O.R. and his positive influence on others enhanced his legacy as a leader in the field of O.R. practice. Following his death, the Franz Edelman Award was named in his honor and continues to celebrate and raise awareness of the incredible contributions of the O.R. practice to which he contributed so much.

THE FINEST STEP FORWARD: JOURNEY TO THE FRANZ EDELMAN AWARD

Every year, the recipient of the Franz Edelman Award for Achievement in Advanced Analytics, Operations Research, and Management Science is selected from a pool of incredibly accomplished finalist teams, representing leading organizations from around the world. The finalist projects are the result of years of research, hard work, and collaboration for a transformative impact for each organization. The selection process at INFORMS also begins long before the award is ever presented.

After issuing a call for entries, INFORMS often receives more than two dozen submissions from organizations with a summary illustrating a practical operations research (O.R.) application in which the results had significant, verifiable, and quantifiable impact for the organization.

The Franz Edelman Award Committee comprises nearly three dozen O.R. practitioners and academics from leading O.R. programs – many of whom have been finalists and winners of previous years' Franz Edelman Award Competitions – including IBM, SAS, General Motors, Boeing, General Electric, UPS, Duke University, Virginia Tech, etc. By November of each year, the Committee will have narrowed the applicant field to a group of semifinalists, and by the end of each year, six are recognized as finalists.

Prior to being named finalists, each entry is carefully reviewed by a team of verifiers who work with the relevant stakeholders to validate the details of each award entry. The verifiers thoroughly examine the O.R. work presented in the assigned entry summary, as well as its potential impact, and convey this information to the rest of the selection committee. The verifiers communicate directly with the entrant's O.R. team, the users of the work, and client management.

Verification is a crucial step in the competition because it ensures that only the highest-quality O.R. will be represented in the Edelman Award Competition. All verifiers follow detailed written guidelines and sample verification reports to ensure a thorough process that is identical for each award entry.

Once the Edelman Award Committee has announced the six entries that will advance to the finals, each finalist prepares a journal-quality paper and a prerecorded 40-minute presentation that will be shared during the INFORMS Business Analytics Conference. A team of experienced coaches is assigned to each finalist team to guide them through each step of the process, and help ensure that the team's paper and presentation will convey the significance and monumental impact of the work to their panel of judges.

As the INFORMS Business Analytics Conference approaches, the finalist teams prepare for the final stage of the competition. The finalist papers are presented to the judges, who then begin the long review process. Each judge independently studies the papers and provides input to a group discussion. The finalists are assigned a focal point judge who conveys valuable feedback from the judging committee to the finalist coaches. This feedback helps each team identify areas with

potential for clarification or improvement for their recorded presentation, which is shared during the competition held on the second day of the INFORMS Business Analytics Conference.

On the day of the Edelman Competition, each team presents their 40-minute prerecorded video, followed by a 10-minute period of questioning by the judges. As they assess each of the team's presentations, the judges follow a strict set of guidelines, including the importance of the application, novelty and portability of the team's technical solution, quality and effectiveness of the implementation, and total impact of the project in both quantitative and qualitative terms. Once the final presentation is complete, the judges sequester themselves to carefully review all that they have heard and seen, until they unanimously agree on which finalist team best exemplifies the ideals and standards of the Franz Edelman Award and its legacy that represents more than 50 years of analytics excellence.

Following the Edelman Competition, the incredible achievements of all the finalists are showcased in the January/February issue of the *INFORMS Journal on Applied Analytics*, which is dedicated to improving the practical applications of operations research and analytics to decisions and policies in today's organizations and industries. In addition, the competition is recorded and all presentations are made available shortly after the end of the INFORMS Business Analytics Conference. During the INFORMS Annual Meeting in the fall, which attracts more than 6,000 O.R. and analytics professionals, academics, and students from around the world, the first-place team shares a keynote address, and the other finalists will again be invited to reprise their work to share during a meeting session.



World Food Programme



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EDELMAN FIRST-PLACE AWARD RECIPIENTS

2022 **Gobierno de Chile**
"Analytics Saves Lives During the COVID-19 Crisis in Chile"

2021 **U.N. World Food Programme**
"Toward Zero Hunger with Analytics"

2020 **Intel Corporation**
"Intel Realizes $25 Billion by Applying Advanced Analytics from Product Architecture Design through Supply Chain Planning"

2019 **Louisville Metropolitan Sewer District**
"Analytics & Optimization Reduce Sewage Overflows to Protect Community Waterways in Kentucky"

2018 **Federal Communications Commission**
"Unlocking the Beachfront Using Operations Research to Repurpose Wireless Spectrum"

2017 **Holiday Retirement**
"Revenue Management Provides Double Digit Revenue Lift for Holiday Retirement"

2016 **UPS**
"UPS On-Road Integrated Optimization and Navigation (ORION) Project"

2015 **Syngenta**
"Good Growth through Advanced Analytics"

2014 **U.S. Centers for Disease Control and Prevention**
"Eradicating Polio Using Better Decision Models"

2013 **Delta Programme Commissioner**
"Economically Efficient Flood Standards to Protect the Netherlands Against Flooding"

2012 **TNT Express**
"Supply Chain-wide Optimization at TNT Express"

2011 **MISO**
"MISO Applies Operations Research to Energy Ancillary Services Markets, Unlocking Billions in Savings"

2010 **Indeval**
"Mexican Financial Markets Benefit from Novel Application of Operations Research"

2009 **Hewlett-Packard**
"HP Transforms Product Portfolio Management with Operations Research"

2008 **Netherlands Railways**
"The New Dutch Timetable: The O.R. Revolution"

2007 **Memorial Sloan Kettering Cancer Center**
"Operations Research Advances Cancer Therapeutics"

2006 **Warner Robins Air Logistics Center**
"Warner Robins Air Logistics Center Streamlines Aircraft Repair & Overhaul"

2005 **General Motors**
"Increasing Production Throughput at General Motors"

2004 **Motorola, Inc.**
"Reinventing the Supplier Negotiation Process at Motorola"

2003 **Canadian Pacific Railway**
"Perfecting the Scheduled Railroad: Mode Driven Operating Plan Development"

2002 **Continental Airlines**
"A New Era for Crew Recovery at Continental Airlines"

2001 **Merrill Lynch, Inc.**
"Pricing Analysis for Merrill Lynch Integrated Choice"

2000 **Jeppesen Sanderson, Inc.**
"Flexible Planning and Technology Management at Jeppesen Sanderson, Inc."

1999 **IBM**
"Extended Enterprise Supply Chain Management at IBM Personal Systems Group and Other Divisions"

1998 **Bosques Arauco, S.A.**
"Use of O.R. Systems in the Chilean Forest Industries"

1997 **Societé Nationale des Chemins de Fer Français and Sabre Decision Technologies**
"Schedule Optimization at SNCF: From Conception to Day of Departure"

1996 **South African National Defense Force**
"Guns or Butter: Decision Support for Determining the Size and Shape of the South African National Defense Force"

1995 **Harris Corporation (Semiconductor Sector)**
"IMPReSS: An Automated Production Planning and Delivery-Quotation System at Harris Corporation (Semiconductor Sector)"

1994 **Tata Iron & Steel Company, Ltd.**
"Strategic and Operational Management with Optimization at Tata Steel"

1993 **AT&T**
"AT&T's Telemarketing Site Selection System Offers Customer Support"

1992 **New Haven Health Department**
"Let the Needles Do the Talking! Evaluating the New Haven Needle Exchange"

1991 **American Airlines**
"Yield Management at American Airlines"

1990 **Health Care Financing Administration**
"Diagnosis Related Groups: Understanding Hospital Performance"

1989 **ABB Electric, Inc.**
"A Choice-Modeling Market Information System That Enabled ABB Electric to Expand Its Market Share"

1988 **City of San Francisco Police Department**
"A Break from Tradition for the San Francisco Police: Patrol Officer Scheduling Using an Optimization-Based Decision Support System"

1987 **Syntex Laboratories, Inc.**
"Sales Force Sizing and Deployment Using a Decision Calculus Model at Syntex Laboratories"

1986 **Southland Corporation (CITGO Petroleum Corporation Subsidiary)**
"The Successful Deployment of Management Science throughout CITGO Petroleum Corporation"

1985 **Weyerhaeuser Company**
"Weyerhaeuser Decision Simulator Improves Timber Profits"

1984 **Blue Bell, Inc. (dual)**
"Blue Bell Trims its Inventory"

1984 **The Netherlands Rijkswaterstaat & the RAND Corporation (dual)**
"Planning the Netherlands' Water Resources"

1983 **Air Products and Chemicals, Inc.**
"Improving the Distribution of Industrial Gases with an On-Line Computerized Routing and Scheduling Optimizer"

1982 **Arizona Department of Transportation**
"A Statewide Pavement Management System"

1981 **ANR Freight System**
"From Freight Flow and Cost Patterns to Greater Profitability and Better Service for a Motor Carrier"

1980 **Kelly-Springfield Tire Company**
"Coordinating Decisions for Increased Profits"

1979 **The Greater New York Blood Program**
"The Long Island Blood Distribution System as a Prototype for Regional Blood Management"

1978 **Cahill May Roberts, Ltd.**
"A Planning System for Facilities and Resources in Distribution Networks"

1977 **Syncrude Canada, Ltd.**
"Simulation of Tar Sands Mining Operations"

1976 **American Telephone & Telegraph**
"The Use of Management Science in Making a Corporate Policy Decision–Charging for Directory Assistance Service"

1975 **Xerox Corporation**
"Management Science's Impact on Service Strategy"

1974 **Canadian National Energy Board**
"Management Science in Energy Policy: The Trans Canada-Great Lakes Transmission Case"

1973 **The Babcock & Wilcox Company**
"Planning Nuclear Equipment Manufacturing"

1972 **The Pillsbury Corporation**

THE 2023 SELECTION COMMITTEE & VERIFIERS

We wish to thank the following individuals for their dedication and service as Selection Committee members and verifiers for this year's Edelman Award.

Each of the semifinalists is assigned a verifier who works behind the scenes, often with an associate verifier, to validate the claims made by their entry. A verifier's primary role is to understand an applicant's O.R. work and its impact in detail, and then convey this to the rest of the committee, both orally and in a written report. Verification is a crucial element of the competition because it ensures that only the highest-quality O.R. and analytics work with verified impact makes it to the Edelman Award finals.

- Rajesh Tyagi, *Chair, Edelman Award GE Global Research, Retired*
- Layek Abdel-Malek, *NJIT, v*
- Carrie Beam, *University of California, Davis, v*
- Ann Bixby, *Aspen Technology, v*
- Aaron Burciaga, CAP, *Amazon Web Services, v*
- Ulas Cakmak, *Infor, v*
- Manoj Chari, *Elon University, v*
- Carol DeZwarte, CAP, *Shopify, v*
- Goutam Dutta, *Indian Institute of Management Ahmedabad, v*
- Gul Ege, *SAS Institute*
- Ken Fordyce, *Arkieva*
- Michael Gorman, *University of Dayton*
- Ananth Iyer, *University at Buffalo, v*
- Mustafa Onur Kabul, *Aera Technology*
- Burcu Keskin, *University of Alabama*
- Don Kleinmuntz, *Kleinmuntz Associates*
- Matthes Koch, *Desior Consulting & University of Hamburg, v*
- Tim Lowe, *University of Iowa*
- Irvin Lustig, CAP, *Princeton Consultants*
- Aly Megahed, *Meta, v*
- Polly Mitchell-Guthrie, *Kinaxis, v*
- Sven Müller, *Otto von Guericke University Magdeburg, v*
- Chanel Murray, *PNC Bank, v*
- Patricia Neri, *UL Solutions, v*
- Yanni Papadakis, *Zoetis, v*
- Tulia Plumettaz, *Wayfair, v*
- Sanjay K. Prasad, *IBM*
- Michael Prokle, *Fortune Brands GPG*
- Mikael Rönnqvist, *Université Laval, Quebec*
- Inderjeet Singh, *Infor, v*
- Zohar Strinka, CAP, *Analytics Strategies LLC, v*
- Kermit Threatte, *Shopify, v*
- Joyce Weiner, *Intel*
- Erick Wikum, *Wikalytics, v*
- Xinhui Zhang, *Coupang Corp., v*
- Xiaodi (CoCo) Zhu, CAP, *New Jersey City University*

"v" Indicates verifiers

THE 2023 COACHES & JUDGES

We wish to thank the following individuals for their dedication and service as coaches and judges for this year's Edelman Award.

The role of the coach is to ensure each team's paper and presentation conveys the work in a manner that may be well understood by a general operations research audience. Often a coach is paired with an associate coach who lends another perspective to the process. The judges must work together, evaluating the evidence to determine which finalist is most deserving of the Franz Edelman Award for Achievement in Advanced Analytics, Operations Research, and Management Science. The award is for implemented work that has had significant, verified, and preferably quantified impact.

Franz Edelman Coaches

- Layek Abdel-Malek, *NJIT*
- Carrie Beam, *University of California, Davis*
- Ann Bixby, *Aspen Technology*
- Aaron Burciaga, CAP, *Amazon Web Services*
- Ulas Cakmak, *Infor*
- Goutam Dutta, *Indian Inst. of Management Ahmedabad*
- Ken Fordyce, *Arkieva, IBM, Retired*
- Matthes Koch, *Desior Consulting & University of Hamburg*
- Sven Müller, *Otto von Guericke University Magdeburg*
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- Zohar Strinka, CAP, *Analytics Strategies LLC*
- Kermit Threatte, *Shopify*
- Joyce Weiner, *Intel*
- Erick Wikum, *Wikalytics*
- Xinhui Zhang, *Coupang Corp.*

Franz Edelman Judges

- Rajesh Tyagi, *Chair, Edelman Award; GE Global Research, Retired*
- Victoria Chen, *University of Texas at Arlington*
- Carol DeZwarte, CAP, *Shopify*
- Michael Gorman, *University of Dayton*
- Ananth Iyer, *University at Buffalo*
- Don Kleinmuntz, *Kleinmuntz Associates*
- Irvin Lustig, CAP, *Princeton Consultants*
- Aly Megahed, *Meta*
- Chanel Murray, *PNC Bank*

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THE EDELMAN LAUREATES

The individuals who author Edelman finalist papers are deemed Franz Edelman Laureates.

Authors of finalist papers to be published in *INFORMS Journal on Applied Analytics*, are recognized as laureates and formally presented with the Franz Edelman Medal prior to the Edelman Gala.

Laureates are recognized for their significant contributions to work that was selected to represent the best applications in the world of analytical support for decision making. Laureates are expected to serve as role models and exemplify that challenges can be met and innovative applications of analytics can help every organization.

The Laureate recognition is distinct and separate from membership in the Franz Edelman Academy.

THE EDELMAN ACADEMY

Each year, participating organizations are inducted as members of the Franz Edelman Academy.

The primary client organization, or beneficiary of the finalist work, is inducted into the Edelman Academy at the Edelman Gala during the INFORMS Business Analytics Conference. Academy members serve as role models for other organizations.

In addition, organizations that played a major role in the work, and therefore deserve academy membership, may also be inducted. The most common example would be an organization that provided the professionals who did the majority of the analytical work.

The membership of the Franz Edelman Academy represents more than 50 years of extraordinary contributions to society through the innovative application of O.R. and advanced analytics.







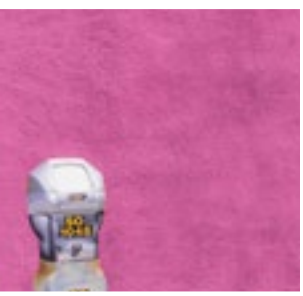
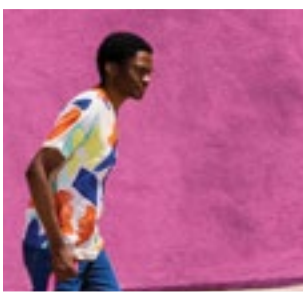


京东大药房




美团







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THE 2023 FRANZ EDELMAN AWARD FINALISTS

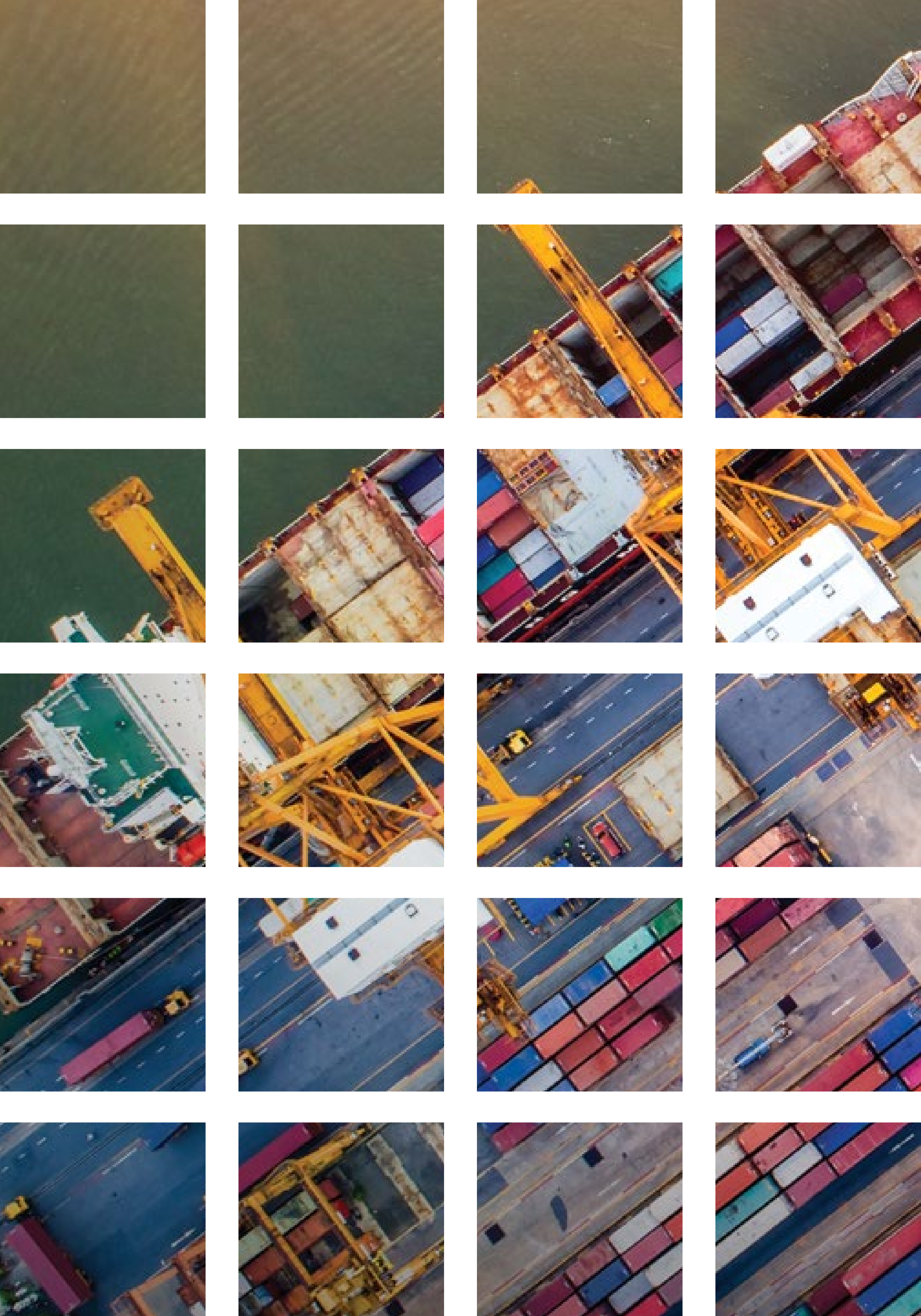
Introducing the six finalists for the 2023 Franz Edelman Award.

Over the past several months, these Edelman finalist teams, with guidance from their team coaches, have demonstrated to the Edelman Selection Committee that their work is among the finest examples of operations research and analytics practice in the world. One of these organizations will be recognized as the best in class, the first-place recipient of the 2023 Franz Edelman Award for their work to help save lives, save money, and solve problems.

A shortened summary of each of the 2023 finalist team's work is described in the following pages. Papers including the full project description will be published in the January/February 2024 issue of *INFORMS Journal on Applied Analytics*. This journal, published by INFORMS, is dedicated to improving the practical application of operations research and advanced analytics in today's organizations and industries.

The finalists for the 2023 Edelman Award include the following:

- DHL Supply Chain
- Huawei Cloud
- JD.com, Inc.
- Lyft, Inc.
- Meituan
- Walmart



DHL SUPPLY CHAIN

Network Mode, Mixed Fleet, and Staging Optimizations for the DHL Supply Chain

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DHL Supply Chain is the world's largest provider of third-party supply chain logistics, with 160,000 workers in more than 50 countries operating supply chains and delivering packages on behalf of other organizations, including critical vaccines and medicines.

Working together with researchers at The Ohio State University, DHL Supply Chain has created and implemented an innovative suite of software to save more than $116.5 million and 0.5 gigatons of CO2. The sheer scale of the routing problems being solved is itself innovative, and involves hundreds of thousands of delivery locations and hundreds of trucks.

DHL solves these significant challenges while maintaining run times typically less than one hour. Math programming algorithms routinely struggle on problems with only 200 packages or customers involved. Large-scale DHL solution methods are checked with small instances solved to optimality and are verified with generally less than 1% losses in the objective values achieved.

The operation of supply chains is changing dramatically. Factors include: (1) the increasing viability of electric trucks for select types of trips, (2) the COVID-19 pandemic and its aftermath, and (3) geopolitical decoupling between authoritarian and democratic blocks.

Perhaps the most important factor is (4) the level of sophistication needed for third-party logistics companies, who operate supply chains

on behalf of other companies, to both win bids and operate efficiently.

The analyses to support bidding processes and make improvements was time consuming and required days or weeks. Now, multiple desirable scenarios can be generated in hours for architecting customer solutions, which can include fleet sizing, positioning for pickup, and utilizing both inbound and outbound truck capacities on long trips. These savings at DHL Supply Chain have been achieved using an innovative suite of software and methods that we call the Transportation Network Optimizer (TNO).

The TNO suite supports bidding and operations planning using integer programming to support ground carrier operations. There are four modules:

- **Freight Optimization**, which aids in bidding and positioning resources for pickup by solving large-scale routing using an innovative type of two-color ant colony search and dynamic programming.

- **Fleet Size Optimization**, which helps to determine the number and type of vehicles to purchase, based on an iterative Freight Optimization variant.

- **Round Trip Optimization**, which seeks to fill trucks for both inbound and outbound operations based on clustering involving standard branch-and-cut methods.

- **Pool Point Optimization**, which uses iterative clustering for package positioning based on a modified genetic algorithm.

All the methods seek to reduce the number of trucks and amount of fuel used by DHL and additional parties, with which DHL Supply Chain itself engages.

The software represents multiple innovations relating to integer programming. For bidding and planning – including fleet sizing – an innovative type of two-color ant colony search progressively includes additional mode options, including third parties to DHL, and ensures efficiency using exact and approximate dynamic programming for subproblems.

For pool point positioning, an innovative combination of genetic algorithms and clustering permits further reductions to third-party costs. Similarly, DHL Supply Chain uses a combination of standard integer programming and heuristics to cluster the remaining partial truckloads and permit analysts to avoid empty inbound return trips for deliveries that span regional zones.

The savings include two main components. First, there is the savings that is achieved during the bidding process and locked into the contracts won. It is estimated that in over 2.5 years of using TNO, DHL has acheived approximately $96.5 million in savings ($38.6 million x 2.5 = $96.5 million).

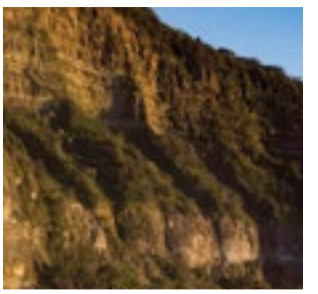
Second, a different group is applying TNO to streamline and improve existing projects. So far, this group has applied TNO to approximately 20 projects achieving $20 million in savings. This year, the expectation of continually optimizing 60 projects per year and achieving $60 million in new savings is being developed.

It should be noted that previous teams have achieved savings using precursor methods to TNO. However, it is unclear how many of the current projects, which have increased up to 15%, would have been won using the precursor methods, but the market is becoming dramatically more competitive.

Therefore, we estimate an ongoing savings of up to $38.6 million + $60 million = $98.6 million per year. Projecting forward two years, we see up to $116.5 million + 2 × $98.6 million = $314 million

in direct savings. That savings is accompanied by approximately 0.5 megatons of CO_2 reduction from simply using fewer trucks to do the same work through improvements in solution quality.

Together with the monetary savings, the DHL Supply Chain culture has become even more highly technical, with training times significantly reduced for many key operations.



ORGANIZATIONS

DHL Supply Chain

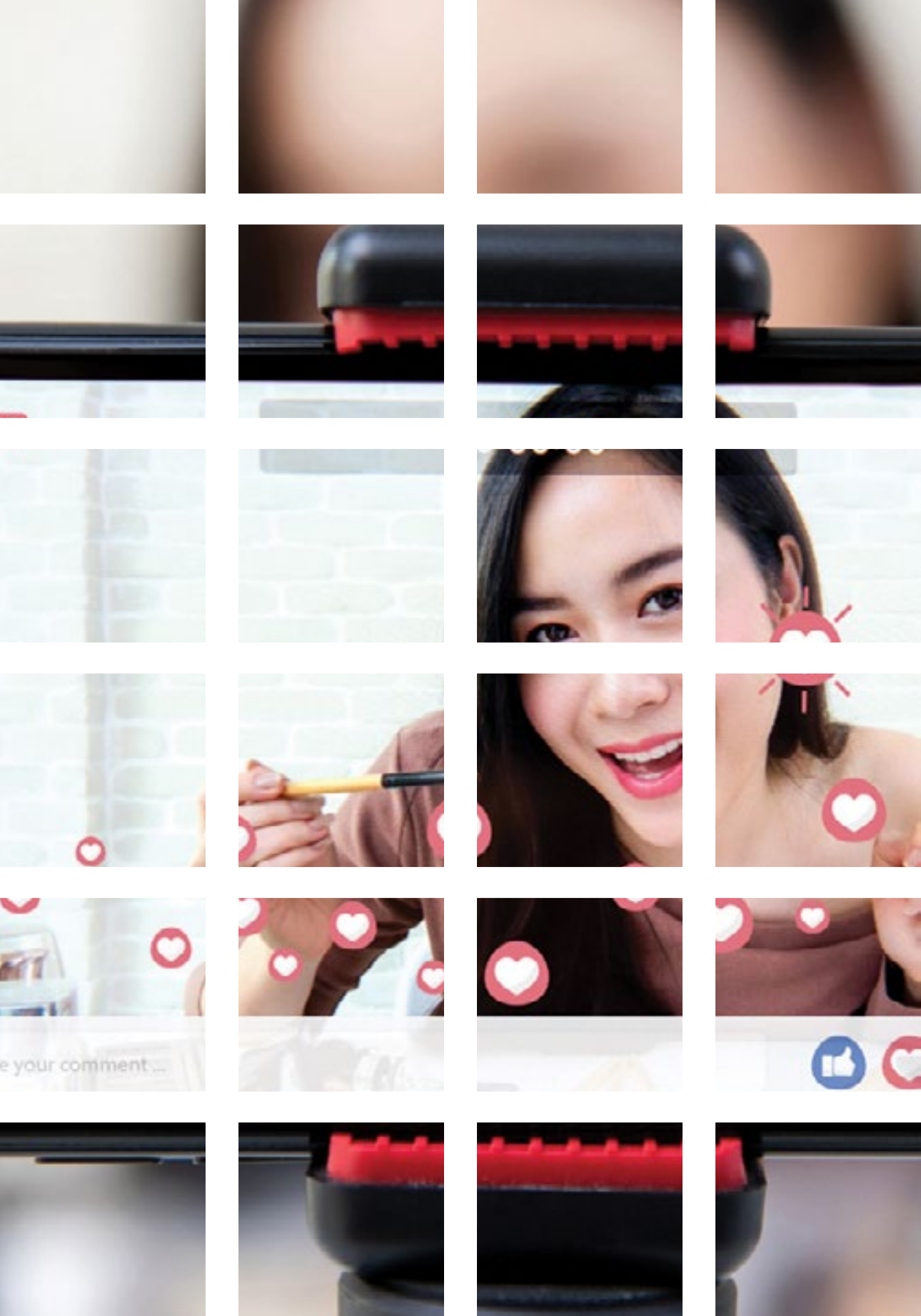
DHL Supply Chain is the world's largest provider of contract supply chain operations. The mission of DHL Supply Chain is to deliver prosperity, transport health, feed development, and bring joy. DHL Supply Chain is a division of Deutsche Post DHL, which has 510,000 employees.

DHL Supply Chain operates more than 2,000 trucks, 500 warehouses, and two control towers in North America. Overall, DHL Supply Chain has 15 million square meters of storage and approximately 160,000 supply chain workers. The company operates in 50 countries around the world.

The Ohio State University Integrated Systems Engineering Department

The Ohio State University Integrated Systems Engineering department is among the world's top programs in operations research and industrial engineering with more than 2,980 alumni, and 88% of undergraduates hired within six months of graduation.

U.S. News & World Report recently ranked its undergraduate program 11th in the USA and the graduate program 16th overall. The ISE department partners closely with companies including DHL Supply Chain, Honda Manufacturing, Intel, and many others.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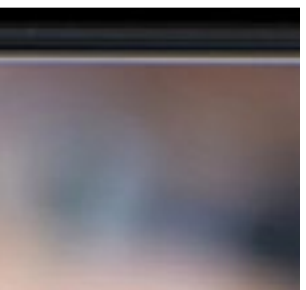


HUAWEI CLOUD

Huawei Cloud Adopts Operations Research for Livestreaming Services to Save the Network Bandwidth Cost: The GSCO System

Livestreaming delivers video over the internet in real time and supports applications such as sports broadcasting, interactive entertainment, and online education. As of June 2021, the number of online livestreaming users in China has reached 638 million, with an annual increase of 47%, which accounts for 63% of the total netizens.

Huawei Cloud has been providing livestreaming services in more than 60 countries since 2020. Today, Huawei's platform is supporting more than 10 thousand domains, with more than 15 million simultaneous online end-users globally. Huawei Cloud has helped major livestreaming platforms in China launch their livestreaming delivery services without building hardware stacks. To save bandwidth cost and enhance the quality of service (QoS), Huawei Cloud developed a traffic allocation system called GSCO, based on various operations research (O.R.) techniques, including continuous optimization, integer programming, graph theory, and scheduling, together with machine learning techniques.

Cost-effective traffic allocation problems in the livestreaming business are different from the traffic engineering problems arising in traditional O.R. scenarios, such as logistics management and transportation planning, mainly because of the complexity of the 95th percentile billing scheme for bandwidth resources and many peculiar requirements,

such as replicability of data packages and fast response time constraints. These novel problem features pose a number of challenges in developing the GSCO system.

One such challenge is that internet service providers (ISPs) charge Huawei Cloud by the 95th percentile billing scheme, which means only the 95th percentile of bandwidth utilization over a billing cycle is billed. This billing scheme results in a very difficult objective function in its optimization model, which is nonlinear, nonconvex, and nonsmooth. Indeed, the optimization model with an objective function deduced from the 95th percentile billing cost is NP-hard.

In addition, the mathematical models are of huge scale. There are more than 4,800 edge regions, 2,800 edge nodes, and 8,928 bandwidth usage sampling points in a billing cycle (31 days). This means there are about 120 billion binary and continuous decision variables in the corresponding models. Also, the traffic allocation decision must be made in milliseconds because access requests arrive sequentially and dynamically over the billing period. Therefore, high-speed algorithms with real-time solutions and high-performance programming are crucially required.

Another challenge is that the demand distribution is uncertain, so the forecast of future demand is complicated. A typical scenario is the sudden boom of access requests because of hot news. Finally, the underlying network is an overlay network with complicated (physical and managerial) structures. Thus, it is essential to excavate favorable structures from the network topology to design more application-tailored efficient algorithms.

To address these problems, led by Professor Xiaoming Yuan, The University of Hong Kong and Huawei Cloud have successfully represented the first optimization models for these challenging and new engineering problems and developed a series of novel algorithms. These models and algorithms have been well integrated into the GSCO system to offer QoS-guaranteed livestreaming services.

A series of traffic forecasting models have been integrated into the GSCO system to estimate future requests in combination with various machine learning techniques. The estimated access requests are essential to make traffic allocation decisions. In addition, a network planner has been implemented to determine the feasible network connections that satisfy the QoS requirements. It essentially alleviates the traffic allocation problem because only feasible connections are needed to be considered in the models, while QoS is naturally guaranteed.

A series of offline traffic allocation models have been developed. These models are of favorable structures, and thus some powerful ideas for algorithm design, such as decomposition and linear relaxation, can be applied meticulously. These models are solved efficiently by leveraging some contemporary operator splitting algorithms, such as the generalized primal-dual algorithm, balanced augmented Lagrangian method, and some extended versions of the alternating direction method of multipliers, together with some traditional algorithms such as the network simplex method. With sophisticated implementations of these algorithms, the offline traffic allocation problem can be solved within 10 seconds.

A series of real-time online traffic allocation algorithms have been integrated into the GSCO system. The online algorithms leverage the traffic allocation strategies produced by solving the offline models and generate the traffic allocation table for guiding the traffic allocation actuator within online time limitations. According to the




latest statistical information, the GSCO system guides the traffic allocation actuator to handle up to 8 million access requests in a minute.

The GSCO system has helped Huawei Cloud save about 30% network bandwidth costs with an accumulated saving of more than $49.6 million, and increased its peak bandwidth from 1.5 terabytes per second (Tbps) to 16 Tbps over the past two years. It has thoroughly reformed Huawei Cloud's traditional experience-based system with automatically produced traffic allocation strategies and helped Huawei Cloud significantly improve its management efficiency with a reduction of 98.6% of the workforce. The success of the GSCO system has also promoted the necessity of using O.R. techniques for various departments within Huawei Cloud. More and more departments in Huawei Cloud have started using O.R. techniques heavily for their daily research and development.

The development of the GSCO system could also be extended to a wide range of other scenarios, such as the content delivery network (CDN) service and real-time communication network (RTC) service. The reason is that their major costs are also bandwidth costs, and the traffic allocation problems for these different scenarios share some similarities in their mathematical models. For example, the objective functions of their respective optimization problems also consider the 95th percentile billing scheme. Collaborations with the CDN and RTC teams at Huawei Cloud have been initiated, and some promising joint research plans have been made. Methodologies and philosophies for designing the GSCO system could also be considered as a reference for other cloud service providers in the industry.

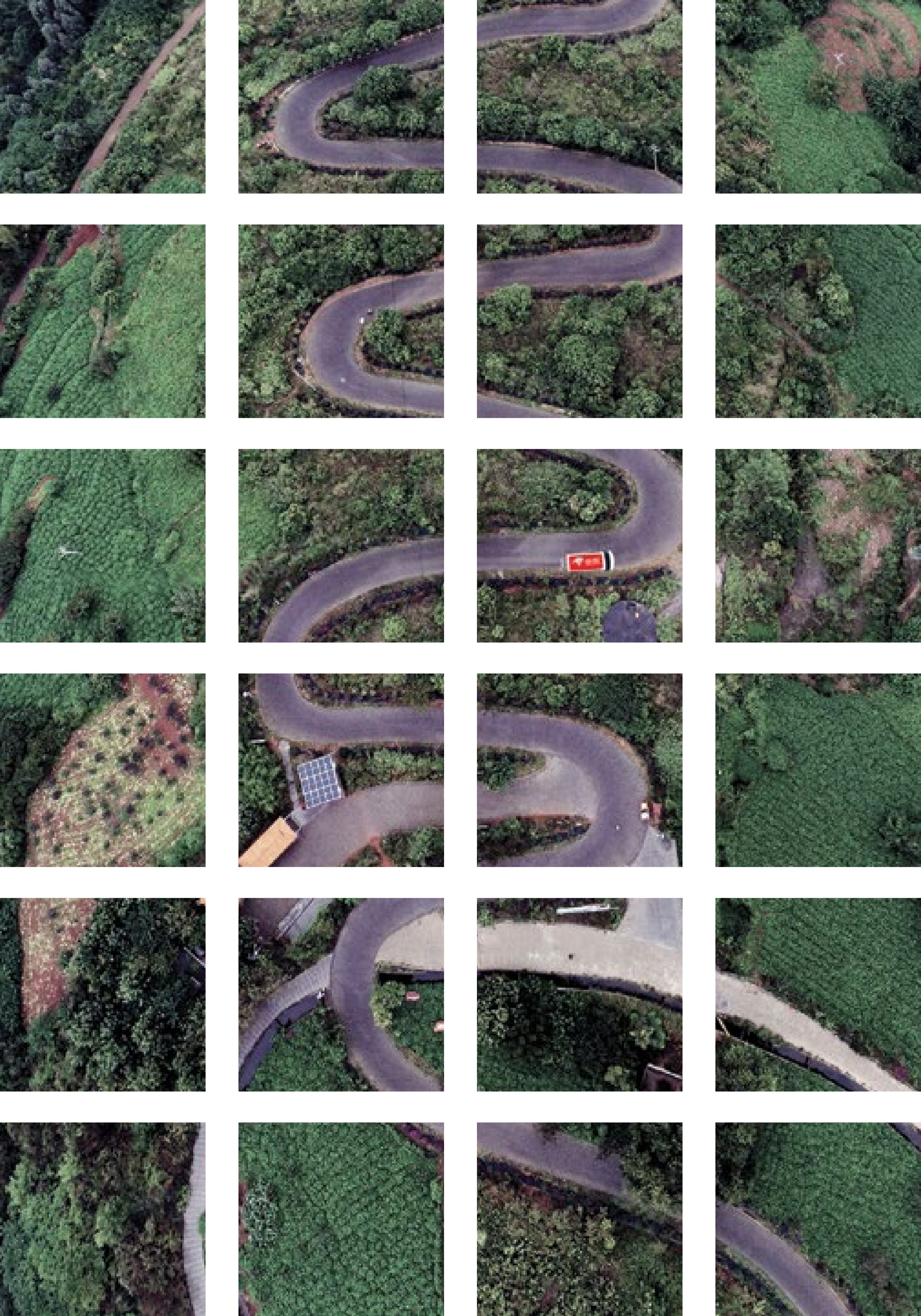
ORGANIZATIONS

Huawei Cloud

Huawei Cloud is Huawei's signature brand of cloud business, which provides customers with reliable, secure, and sustainable cloud services. According to Gartner's Market Share: IT service, Worldwide 2020, Huawei Cloud rose to No. 2 in the global IaaS market in China and No. 5 worldwide. To date, Huawei Cloud has launched more than 220 cloud services with 210 technical solutions and has attracted over 30,000 partners and 3 million customers from a broad range of industries, including media entertainment, manufacturing, healthcare, finance, and logistics.

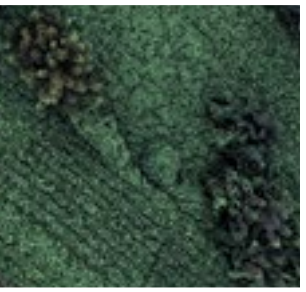
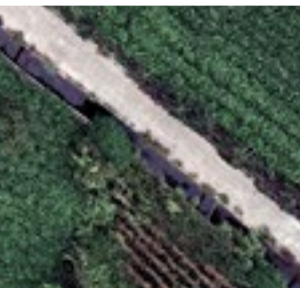
The University of Hong Kong (HKU)

The University of Hong Kong (HKU) is a public research university in Hong Kong. Founded in 1887 as the Hong Kong College of Medicine for Chinese, it is the oldest tertiary institution in Hong Kong. It has been ranked as the most international university in the world and one of the most prestigious universities in Asia. HKU delivers impact through internationalization, innovation, and interdisciplinarity. It attracts and nurtures global scholars through excellence in research, teaching and learning, and knowledge exchange.







JD.COM, INC.

Socially Responsible Planning Strengthens Supply Chain Capability for JD.com

The largest retailer in China by revenue, JD.com, has built an intelligent, integrated, and resilient supply chain to create value for consumers as well as all players within the retail ecosystem. The supply chain is anchored on advanced technologies with cutting-edge algorithms. By working closely with its partners, the intelligent supply chain system has achieved ambitious targets that benefit the members of the end-to-end supply chain. JD.com has strengthened its supply chain capability and resilience through the focus on supply chain efficiency and collaboration, and customer demands intelligence. The result of such laser-sharp focus is increased efficiency in cost, inventory, and speed; improved risk management; and tailored customization of products to meet customer preference. These benefits also extend to consumers and business partners.

Supply chain management today is very different from the ways supply chains were managed in the past. The exploding customer demands, emerging fulfillment channels, and sophisticated technologies to be deployed make the complexity of supply chain growth multifold: escalation of product variety, different means of order fulfillment, and an extremely extended supply network with many suppliers in multi-tiers. An overview of challenges that JD.com faces is summarized as follows.

- The increasing level of customer diversity, growing variety of products, and higher level of service required bring JD.com new challenges in inventory management. The uncertainty of consumer demands, the fact

that the supply chain is long and contains various of nodes and links, and the vast volume of stock-keeping units (SKUs) make the inventory management a tremendous challenging task. The traditional predict-then-optimize (PTO) solution framework decouples the prediction and optimization stages and misses useful information, contributing to substantial forecast errors.

- COVID-19 and natural disasters disrupt the supply chain. Consumers can be vulnerable to severe shortages of essential products and medical supplies. The precondition of recovering and maintaining smooth flow is to detect and identify the risks and disruptions as soon as possible. The severity of emergencies and policies to react to the events may differ across different areas. The information relied on manual reports can be out of date and loses the guaranteed reliability and accuracy.

- The supply chain is long with countless intermediaries between the manufacturer and consumer. The manufacturer cannot capture consumer preference, while designing new popular products in a timely manner. The traditional survey method is time-consuming and inevitably has deviations from real ideas and concepts of consumers. Manufacturers cannot directly access the complete consumer portrait. So, it is impossible for them to independently use data-driven techniques to investigate the consumer preference.

To address these problems and overcome the challenges, JD.com has developed innovative technical solutions based on operations research and AI tools to reduce operational costs, enhance efficiency, ensure supply chain resilience, and promote customer satisfaction.

These include a neural network-based end-to-end method for inventory management, which is proposed by optimizing the inventory replenishment decision directly from input data without any intermediate steps. The end-to-end model avoids error accumulation over middle stages, providing more accurate predictions and better inventory strategies in contrast with the classical PTO methods. In response, the end-to-end system of JD.com simultaneously outputs the predictions and inventory level, thus significantly improving the calculation effectiveness, and enhancing efficiency.

In addition, a risk management system, which intelligently classifies the current emergency level and helps the firm take measures in response, has been built by JD.com to ensure operational flexibility, gain supply chain resilience, and achieve customer satisfaction during the COVID-19 pandemic. A key indicator, i.e., order clearance days, which is the expected time for the new and on-hold orders to finish, is summarized and calculated in real time to monitor the states. Finally, according to the output indicators, the system divides the current state into four levels of emergency and suggests strategy modifications accordingly.




A C2M platform is also implemented by JD.com by incorporating state-of-the-art algorithms, which serves – but not limited to – the design of new products, identification of target consumers, as well as marketing and advertising strategies. With a consumer decision trees (CDT) model, JD.com quantifies the extent of importance of various product attributes in purchasing based on massive data of consumers and transactions, and provides feedback to manufacturers for product iterations. Then, a pricing model based on a clustering algorithm is proposed to suggest a good price for new products without historical data. Moreover, new product user and free trial selection models are proposed to find target groups of consumers and how to attract them.

The intelligent techniques have achieved billions of dollars in revenue increase, and tens of millions of dollars in cost savings. More importantly, they have enhanced customer welfare and benefited partners in the supply chain. By implementing end-to-end inventory management methodology, JD.com has significantly reduced the stock costs and improved operational efficiency. In response to events such as COVID-19, that cause significant supply chain disruption, JD.com made use of its intelligent techniques to strengthen critical partnership collaboration, and gain the necessary resilience. The C2M system has enabled JD.com to accurately identify customer demand and helped manufacturers design and produce more popular products, hence created values for the entire ecosystem.

JD.com's supply chain aspires to be the best in the industry, enhancing the welfare of all ecosystem participants and consumers.

ORGANIZATIONS

JD.com, Inc.

JD.com is a leading supply chain-based technology and service provider. The company's cutting-edge retail infrastructure seeks to enable consumers to buy whatever they want, whenever and wherever they want it. The company has opened its technology and infrastructure to partners, brands, and other sectors, as part of its Retail as a Service offering to help drive productivity and innovation across a range of industries. JD.com is the largest retailer in China, a member of the NASDAQ100, and a Fortune Global 500 company.

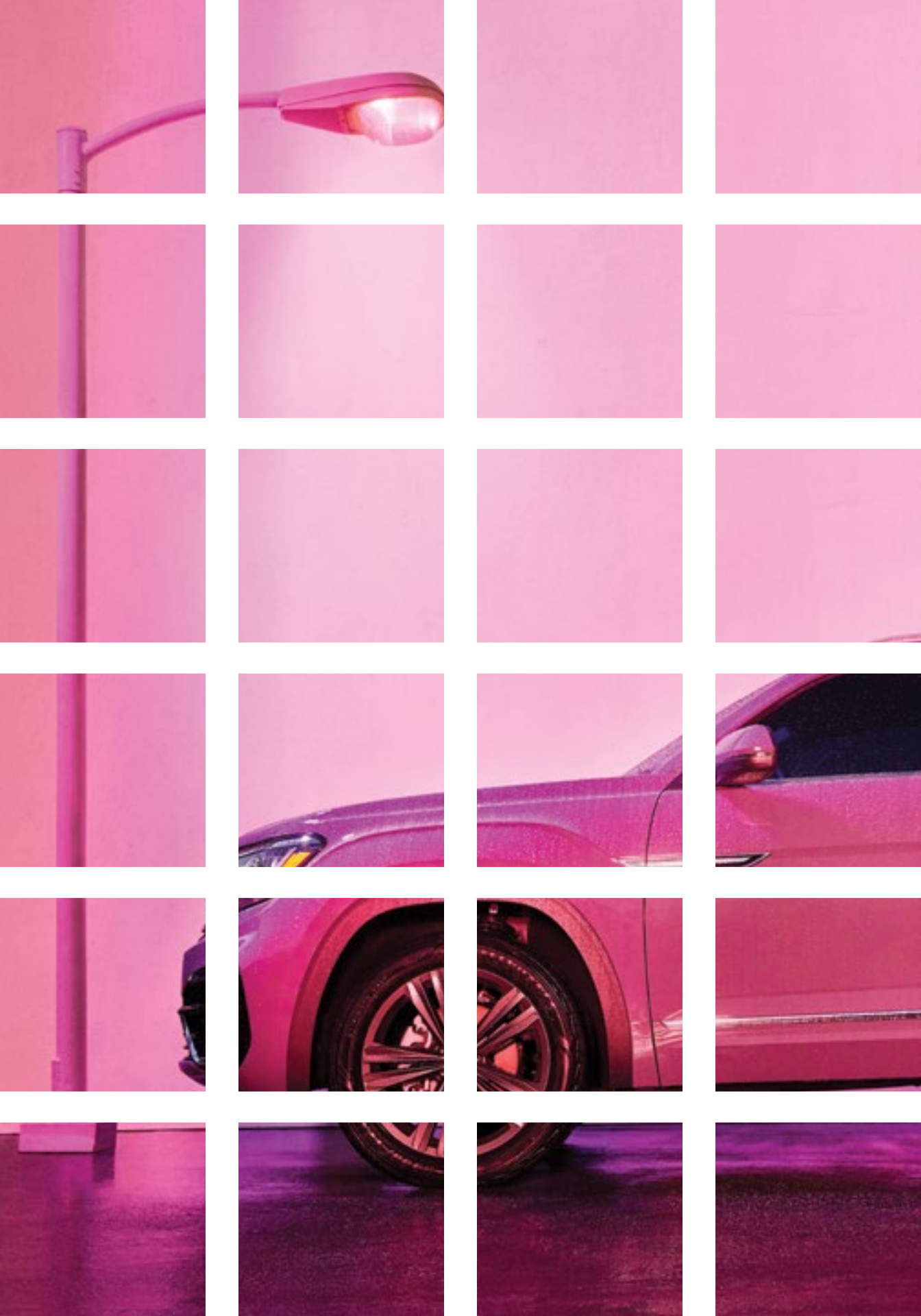
Stanford University

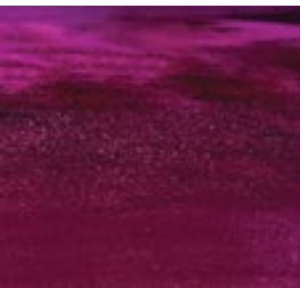
Stanford University is a private research university in Stanford, California. Founded in 1885, Stanford University is considered among the most prestigious universities in the world.

The University of Hong Kong (HKU)

The University of Hong Kong (HKU) is a public research university in Hong Kong, China. Founded in 1887 as the Hong Kong College of Medicine for Chinese, it is the oldest tertiary institution in Hong Kong. It has been ranked the most international university in the world as well as one of the most prestigious universities in Asia.





LYFT, INC.

A Better Match for Everyone: Reinforcement Learning at Lyft

When you request a ride on the Lyft ridesharing app, Lyft's algorithms will match you with an available driver. The efficient matching of rider requests with drivers is one reason behind the success of ridesharing platforms. Better matches benefit everyone: drivers can be more productive, and riders get a ride faster.

Lyft completely redesigned its approach to matching using "online reinforcement learning," a type of algorithm that can learn to improve over time. If you've taken a Lyft in the past two years, this algorithm likely helped you get matched to a driver. Then, within seconds, the data from your trip helped the algorithm improve and better serve future riders and drivers. This innovation was a "win-win-win" and benefited drivers, riders, and the platform. In particular, it enabled Lyft drivers to serve millions of additional rides each year, leading to more than $30 million per year in incremental revenue.

The problem of matching passengers with drivers in the best possible way is surprisingly complex. Simply assigning the closest available driver to a rider is not enough. For example, if available drivers are rare, the nearest driver may be particularly far away, leading to a long pickup time. Excess pickup time is not efficient for either party, and the driver may be better off waiting for a match with a different rider. Thankfully, matching algorithms that carefully select how and when to match drivers to riders can significantly improve these decisions, benefiting drivers (more rides and earnings)

as well as riders (shorter wait time). The matching algorithm is the most critical component of Lyft, handling hundreds of millions of requests each year.

The COVID-19 pandemic significantly impacted Lyft and raised questions regarding the status quo of its matching system. Early in the pandemic, there were massive and sudden drops in rider requests and drivers available, with heterogeneous patterns across space and time. Given this unprecedented situation, the existing matching algorithms had to be re-tuned to keep up with constantly changing demand and supply patterns.

This was when Lyft started to think about online reinforcement learning. Although these techniques are notoriously hard to implement, they could replace this manual tuning and continuously improve and adapt to real-time conditions. The need to improve on the status quo – which was the outcome of eight years of continuous algorithmic improvement – was an immense challenge.

The core of this idea was to estimate the "value function for a Lyft driver," an estimate of the future earnings of a given driver at a given time and location, including all the rides they may complete until they stop driving. If the driver's value function could be estimated reasonably well, then it can be known how much better it could be for a driver to be at one particular location than another. Because a Lyft ride is also moving a driver from one place to another, this information allows Lyft to understand which matches are the best for drivers (and riders) in the long term.

The online reinforcement learning approach works in an endless learning loop: constantly providing better estimates of the driver value functions. These improved estimates allow Lyft to enhance its matches, which leads to new estimates, etc. In fact, just a couple of minutes after you are successfully matched with a driver, Lyft's algorithm has already used this information to improve and find better matches in the future.

Online reinforcement learning is an active field of research with many success stories, but it can add significant challenges to traditional operations research. It is difficult to trust an algorithm that can change itself in real time, and examples of implementation in critical operational systems are rare. It is also tough to design an algorithm that can scale to the massive size of a ridesharing platform while still being fast enough to handle thousands of requests every minute.

It took many months and numerous iterations to roll out this system across all Lyft markets. Still, Lyft proved that online reinforcement learning could make a significant difference and benefit everyone. This work is the first documented deployment of a fully-online reinforcement learning algorithm for ridesharing dispatch.

Lyft measured the consequences of this change over a two-week span in 2021, running tests that switched between the new and old approach every few hours in most U.S. cities. This experiment showed that customers were happier: they were less likely to cancel and more likely to give a 5-star rating. They were more likely to find a driver: the number of requests that could not be matched was reduced by 13%. The drivers could serve more rides, leading to an estimated additional $30 million in revenue every year. Unsurprisingly, these changes were deployed to all Lyft markets shortly thereafter.

Usually, changes to platforms lead to complex tradeoffs: for example, to increase driver earnings,

it might be necessary to increase rider prices. This type of tradeoff happens in most of the changes at Lyft, which is why the experiment results were surprising: the reinforcement learning approach came without compromise, and all parties benefited from it. Motivated by this success, Lyft is currently exploring extending this approach to other products (e.g., shared rides) and systems. We hope our project can inspire other companies to take this step: Reinforcement learning comes with many challenges, but they are worth overcoming.

ORGANIZATIONS

Lyft, Inc.

Lyft was founded in 2012 with a mission to improve people's lives with the world's best transportation. Its founders imagined a world built around people, with less pollution and traffic, where parks prevailed over parking lots, and where people spent less money and had more fun getting around. Achieving this mission requires building a multimodal transportation network capable of reaching hundreds of millions of customers with diverse needs and constraints.

Lyft's network has achieved impressive scale over the past decade and is available to approximately 95% of the U.S. population and select cities in Canada. Lyft is committed to effecting positive change for cities by offsetting carbon emissions from all rides and by promoting transportation equity through shared rides, bike-share systems, electric scooters, and public transit partnerships.

Northwestern University

Northwestern University is a private research university founded in 1851 in Evanston, Illinois. It combines innovative teaching and pioneering research in a highly collaborative, multidisciplinary, and diverse environment.

MEITUAN

Meituan's Real-time Intelligent Dispatching Algorithms Build World's Largest Minute-level Delivery Network

In recent years, Meituan has been pioneering on-demand food delivery service, covering more than 3,000 cities with over 5 million couriers, serving more than 9.3 million merchants and 687 million consumers. Its minute-level delivery network is now the world's largest, delivering more than 60 million orders each day.

In the food delivery business, orders can be placed at any time from anywhere. To ensure food quality, orders should be delivered as quickly as possible. Specifically, the platform collects newly placed orders and assigns them to couriers every 30 seconds. A sophisticated equilibrium among key stakeholders is the goal: consumers want reliable services, merchants want their food served fresh, and couriers are pursuing a decent wage. Moreover, the accumulated daily traveling distance of all couriers is the equivalent of circling the earth 1,500 times. High-quality assignments can effectively shorten courier routes without affecting their income, thus leading to a significant reduction in carbon emissions. Therefore, improving assignment quality is a crucial issue.

The order assignment procedure is formulated as a multiperiod, multiobjective optimization problem. It mainly seeks to address the following three challenges. First, a balance should be maintained among multiple operational objectives, including consumer satisfaction, courier experience, and platform efficiency. A common method is combining multiple objectives into a single weighted objective. However, finding suitable weights to guarantee long-term optimality is nontrivial, especially in an uncertain and dynamic online setting.

Second, unlike the assignment problem in ride-hailing, where drivers are only assigned one order at a time, Meituan's problem is NP-hard, with couriers often assigned several orders at a time. Furthermore, the matching degrees between couriers and orders are nonadditive, namely, the matching degree of simultaneously assigning several orders to a courier does not equal the sum of matching degrees of separately assigning the orders to the same courier. Therefore, modeling the assignment problem requires computing matching degrees of arbitrary order combinations and couriers, which is unrealistic, thus bringing greater challenges to the already complex problem.

Finally, to ensure assignment quality, the problem must be solved within 10 seconds. Traditional supply-chain optimization problems, though suffering from large-scale searching space, are allowed to be solved in hours. Their techniques are not suitable for on-demand delivery.

Meituan addresses these challenges through technological innovations, including building a real-time intelligent dispatch system to continuously improve assignment quality. The system decomposes the multiperiod, multiobjective problem into a series of single-period, single-objective ones, and solves them independently through weight adaptation. The problem is further reorganized by two subproblems, in which the inner-level focuses on local route planning and the outer-level on global assignment based on the results of the inner. Both problems require developing algorithms with acceptable solution quality and computational efficiency.

First, a target-oriented, multiobjective balancing framework is implemented to adapt the weights of different objectives to the online dispatch process, guiding the system states converging to a long-term, near-optimal solution. Risk-averse decision techniques are also introduced to improve system robustness in the face of inevitable uncertainties.

Second, in practice, each inner-level routing subproblem needs a high-quality solution in milliseconds. Accordingly, our algorithm designs a two-stage solution procedure. First, an inverse reinforcement learning method is developed to learn the courier-wise objective for the planning problem, further improving the consistency rate between the planned routes and the real ones. Then, a searching policy adopting expert knowledge is designed to improve solution quality.

Next, for the outer-level assignment, a "Super Brain" develops a "divide-and-conquer" solution framework. It decomposes the original problem into a series of subproblems solved sequentially, resulting in an online progressive solution procedure. Each subproblem is simple enough to solve in polynomial time. The decomposition is carefully controlled by a coordinator, constructed by machine learning methods. The expert solutions, served as labels, approach global-optima and are obtained by a well-designed offline operational research algorithm.

Furthermore, to effectively detect active order combinations and prune searching space, the algorithm constructs a high-quality delivery graph with the most effective combinations from the view of top experienced couriers, and develops a graph representation learning method to compress these combination patterns as representative vectors for online order combination.

After years of trials, Meituan's algorithm has successfully created a win-win situation for all the stakeholders. For couriers, it has effectively shortened their daily routes, and improved their work experience. Since 2016, the average daily order deliveries for full-time couriers has increased by 109%. Moreover, the reduction of couriers' daily travel distance compared to 2016 is nearly 32.2 million kilometers, the equivalent of circling the earth more than 804 times, leading to a huge carbon emission reduction. For consumers and merchants, it has significantly reduced the

average delivery time by 20.7%. And for Meituan, consumer loyalty has greatly increased due to fast and reliable service, enabling it to stay competitive in the on-demand delivery business. According to Meituan's CEO, the algorithm plays an indispensable role in these achievements.

The vision of Meituan is to help people eat better and live better. In this sense, the value of the intelligent dispatch system is even higher. It enables other business formats of digital economy in Meituan to thrive, such as shopping, groceries, and drugs. Notably, the reliable minute-level delivery network and intelligent real-time dispatching capability helped Meituan quickly respond to COVID-19 events, which now has evolved to be one of the most important infrastructures in China.

ORGANIZATIONS

Meituan

As a tech-driven retail company, Meituan has a strategic focus on "Retail + Technology" and adheres to the mission of, "We help people eat better, live better." Since its establishment in March 2010, Meituan has advanced the digital upgrading of services and goods retail on both supply and demand sides to provide quality services for consumers. Meituan has been and will always be a customer-obsessed company. Meituan will continue to increase R&D investment in new technologies and collaborate with partners to fulfill social responsibility and create more value for society.

Meituan Waimai

Launched in November 2013, Meituan Waimai focuses on consumers' "food" needs and provides quality and diverse food delivery services. While strengthening its own platform, Meituan Waimai is committed to using digital technology to promote the supply-side structural reform of the catering industry. It works upstream and downstream of the industry chain to create a mutually beneficial cooperation ecology, giving the catering industry a fresh start in the digital era and giving consumers a more efficient dining experience.

Meituan Delivery

Meituan's on-demand delivery platform, Meituan Delivery, meets the diverse needs of merchants and consumers. It can complete more than 60 million daily orders and connect 9.3 million merchants, 687 million consumers, over 5 million couriers, and various ecosystem partners. It establishes an on-demand delivery network with the highest coverage and density in China, covering 3,000 cities with more than 10,000 delivery stations, providing customized and efficient delivery solutions for merchants of different scales and models.

Tsinghua University

Tsinghua University is a national public research university in Beijing, China, and is funded by the Ministry of Education. The university is a member of the C9 League, Double First Class University Plan, Project 985, and Project 211.















Walmart
Save money. Live better.




BENTONVILLE, ARKAN








WALMART

Optimizing Walmart's Outbound Supply Chain from Strategy to Execution – A Grocery Case Study

On July 2, 1962, the first Walmart store opened in Rogers, Arkansas, with a strategy to build it on an unshakeable foundation: the lowest prices anytime, anywhere. In the 1980s, the first Walmart Supercenter opened, combining a supermarket with general merchandise; and later in the 1990s, the supercenter model that redefines convenience and one-stop shopping was rolled out nationwide in the U.S. Today, Walmart is expanding the ecosystem that supports customers, enhancing processes that enable them to shop wherever and however they choose, through an omnichannel retailing transformation. At each step of Walmart's evolution, one of the critical foundations for success is the applications and systems to support supply chain management across the decision tiers from strategy to execution.

Currently for grocery products, customers can choose shopping in store, pickup at curbside, or delivery from store to home. The introduction of new shopping channels significantly changes the demand patterns faced by the 4,700+ brick-and-mortar stores and creates great challenges for its supply chain to meet the demand. Meanwhile, the recent advancements of warehouse automation technologies, especially in the cold-chain space, have unlocked huge potential to revolutionarily improve productivity. The need to strategically and quickly transform the supply chain network at a larger scale is more imperative than ever.

At the execution level, Walmart has a long history of adopting industry leading supply chain optimization technologies to help continuously drive down operational costs.

It has reached a point where any incremental cost reduction on standalone systems becomes very challenging. For example, for dry grocery commodities, Walmart's trucks were nearly fully utilized in terms of weight and space capacities in the year 2021, providing little room for further utilization increases. A breakthrough in optimization technologies is desired to drive continuous improvement.

Walmart identified opportunities between network strategy and execution-level optimization technologies. A supply chain network designed for higher efficiency could unlock greater potential of the optimization applications; on the other hand, faster optimization applications can enable more simulation runs, which allow more scenarios to be evaluated, and thus improve the chances for the recommendations to be adopted by executive decision makers. However, this is not easy to achieve, primarily because of two reasons: 1) considering the most granular level of operating costs at strategic planning level makes the problem intractable and 2) optimization applications need to run much faster to evaluate more scenarios.

Compared to general merchandise, the complexities of outbound grocery product distribution, from network design to daily routing and loading execution, are significantly greater, which creates larger room for improvement on efficiency as well as customer and associate experience. Walmart developed models that are applicable to general merchandising products, but scenario building, recommendations, interpretations, and plan execution are generally kept separated primarily because of the critical difference in temperature requirements.

Walmart built and rolled out an outbound routing and loading planning and optimization system named "Load Planner" to solve truck routing and loading problems in one shot. At its core, Walmart developed a metaheuristic-based framework integrating a suit of algorithms, including various neighborhood searches, heuristics, and mixed-integer programming (MIP) models. At each decision step, the best algorithm and parameter settings are selected based on learning from extensive experimentations with historical data. The framework provided the flexibility to add incremental features, as well as high computational efficiencies, which has been a general challenge when solving NP-hard problems. The optimization system was tested and validated in the past couple years, and is proven to outperform the existing application from both computation time and optimality perspectives.

To support the design of future networks, Walmart developed two MIP models. The first determines the optimal long-term end-state network in terms of distribution center (DC) locations, DC capacities, and DC-to-store alignments. The second multistage model creates the transformation roadmap with time steps, and provides concrete recommendations on how and when to initiate different transformative steps to achieve the end-state network. Both models face challenges to scale up when problem sizes are large. We applied heuristics to considerably reduce the problem size without significant loss of quality and enable running tens or even hundreds of scenarios with different input assumptions and risk levels to arrive at a well-informed set of decisions.

In FY23, with the full network rollout of Load Planner, Walmart was able to avoid 72 million pounds of CO2 and save $75 million by avoiding extra miles and truck loads needed. Given the long range of its planning horizon, the direct effects of this network strategy won't materialize in the short term, so Walmart will measure its benefits primarily based on business adoption. In the same fiscal year, the network strategy and transformation roadmap were approved for implementation, which will require substantial investment planned over the course of the next several years. So far, the program has received






approval and funding for construction of three perishable DCs. The future is full of uncertainty and the transformation model enables sensitivity analysis across multiple variables, providing executive leadership with confidence that the strategy and roadmap are sound, regardless of unforeseen changes that may come.

ORGANIZATIONS

Walmart Global Tech

Walmart Global Tech develops and manages the foundational technologies on which Walmart is built – including cloud, data, enterprise architecture, DevOps, infrastructure, and security. It's also a world class enterprise services organization, including service operations and technology solutions for Walmart's 2.3 million associates worldwide. More than 230 million customers and members rely on Walmart every week. With time-saving solutions that make life easier, from pickup and delivery to virtual try-on and digital solutions for your family's health and wellness, Walmart Global Tech provides solutions to the business' toughest challenges and makes them a true partner on the day-to-day.

Walmart Supply Chain Operations

Walmart Supply Chain Operations is comprised of a complex system of facilities in the U.S. Their distribution and fulfillment centers are hubs of activity for the business. The distribution operation is one of the largest in the world servicing stores, clubs, and direct delivery to customers. The supply chain ships general merchandise and groceries along with other specialty categories to consumers daily. With cutting-edge systems and unrivaled scale, they're able to serve customers quickly and offer more choices for how they'd like to eceive their orders – shipped to their homes or picked up at local stores for free. Thanks to Walmart's private fleet, they're able to move goods to and from distribution centers with a skilled staff of truck drivers. Walmart thinks their team of drivers is the best in the world. They're part of one of the largest and safest fleets, and every year, they drive 1.1 billion miles to make millions of deliveries to our stores and clubs.

THE WAGNER PRIZE

DANIEL H. WAGNER PRIZE HISTORY

For Excellence in the Practice of Advanced Analytics & Operations Research

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The Wagner Prize is awarded annually in honor of the late Dr. Daniel H. Wagner. During his years as president and principal owner of Daniel H. Wagner Associates, Dr. Wagner brought many high-quality mathematicians into the operations research community. This led to significant advances in the firm's fields of endeavor and delivery of significant applications to the Navy, Coast Guard, and other clients. Many of the applications are still in service today.

Dr. Wagner earned his PhD in mathematics from Brown University in Providence, Rhode Island, in 1951. His dissertation, "On Free Products of Groups," was published in 1957 in the journal *Transactions of the American Mathematical Society*. Dr. Wagner joined the Navy's Operations Evaluation Group at the Pentagon, working on operations research for naval warfare. He worked there until 1956, with a one-year leave of absence for postdoctoral research on free algebras at Massachusetts Institute of Technology.

Dr. Wagner then joined the Burroughs Research Center, where he directed a group of mathematicians performing analysis for the development of digital computers.

In 1957, Dr. Wagner and John D. Kettelle formed the partnership of Kettelle and Wagner, which was dissolved in 1963. That same year, he formed a new company, Daniel H. Wagner Associates, Inc. This company applied itself to cutting-edge work in the mathematics of naval tactics, especially antisubmarine warfare, detection theory, and search planning.

After retirement from the firm he founded, Dr. Wagner held various teaching and research positions with the U.S. Naval Postgraduate School and the U.S. Naval Academy.

Dr. Daniel H. Wagner was a member of INFORMS (and its predecessor ORSA) for more than 40 years. He passed away in March 1997.

2022 Wagner Prize Committee

- Margret Bjarnadottir, *Chair, Wagner Prize; University of Maryland*
- William J. Browning, *Applied Mathematics, Inc.*
- C. Allen Butler, *Daniel H. Wagner Associates*
- James Cochran, *University of Alabama*
- Greg Godfrey, *Metron Inc.*
- Jun Li, *University of Michigan*
- Emily Tucker, *Clemson University*
- Willem van Hoeve, *Carnegie Mellon University*

2022 WAGNER PRIZE FINALISTS

The 2022 Wagner Prize competition took place during the 2022 INFORMS Annual Meeting. Four teams gave presentations to the INFORMS Practice Section judging committee seeking to demonstrate that the quality of their analysis in a real-world application qualifies them to win this award for outstanding practice of operations research and advanced analytics. The judging committee announced the winner during the Annual Meeting, and the winning team of the Daniel H. Wagner Prize will reprise their presentation during the 2023 INFORMS Business Analytics Conference.

Dr. Wagner strove for strong mathematics applied to practical problems, supported by clear and intelligible writing. This prize recognizes those principles by emphasizing good quality writing, strong analytical content, and verifiable practice successes within analytics and operations research.

All Wagner Prize finalists' presentations can be viewed on the INFORMS YouTube Channel. A special issue of *INFORMS Journal on Applied Analytics* will publish the winning paper along with those of the other three finalists listed below:

AI vs. Human Buyers: A Study of Alibaba's Inventory Replenishment System

- Shuyi Lin, Jiaxi Liu, and Yidong Zhang, *Alibaba Group*
- Linwei Xin, *University of Chicago Booth School of Business*

Human-Centric Parcel Delivery at Deutsche Post with Operations Research and Machine Learning

- Ugur Arıkan, Thorsten Kranz, Baris Cem Sal, Severin Schmitt, and Jonas Witt, *Deutsche Post DHL Group*

Applying Analytics to Design Lung Transplant Allocation Policy

- Dimitris Bertsimas, Theodore Papalexopoulos, and Nikolaos Trichakis, *Massachusetts Institute of Technology*
- James Alcorn, Rebecca Goff, and Darren Stewart, *United Network for Organ Sharing*

2022 WAGNER PRIZE WINNER

The 2022 Daniel H. Wagner Prize for Excellence in the Practice of Advanced Analytics and Operations Research first-place winners are Tianyi Peng, Patricio Foncea, Luis Costa, Jingyuan (Donna) Gan, and Vivek F. Farias from the Massachusetts Institute of Technology, and Ivo Rosa Montenegro, Ayush Garg, Dusan Popovic, and Kumarjit Pathak from Anheuser-Busch InBev. The winners presented and received recognition at the 2022 INFORMS Annual Meeting in Indianapolis.

Generalized Synthetic Control for TestOps at ABI: Models, Algorithms, and Infrastructure

- Tianyi Peng, Patricio Foncea, Luis Costa, Jingyuan (Donna) Gan, Vivek F. Farias, *Massachusetts Institute of Technology*
- Ivo Rosa Montenegro, Ayush Garg, Dusan Popovic, Kumarjit Pathak, *Anheuser-Busch InBev*

This prize-winning paper describes a novel optimization-based approach to learning from experiments conducted in the world of physical retail. This approach solves a long-standing problem of learning from physical retail experiments when treatment effects are small, the environment is highly noisy and nonstationary, and interference and adherence problems are commonplace. Based on this approach, the team developed a new large-scale experimentation platform called "TestOps," which has been broadly deployed at Anheuser-Busch InBev (ABI), the world's largest beer producer. The results have been tremendously impactful and positive: the platform currently runs experiments impacting approximately $135 million in revenue every month at ABI. It regularly assists ABI in uncovering strategies that lead to a 1%-2% rise in sales, which would have gone unnoticed using traditional statistical techniques.

The analytics challenge behind TestOps lies in accurately estimating the effect of an experiment, taking into account (a) the potential presence of arbitrary, highly correlated noise; (b) the ability to handle data corruption; and (c) maximizing statistical power. The Massachusetts Institute of Technology (MIT) team recently made a major advancement in this area by approaching the problem as learning in panels with general intervention patterns and noise, and presenting a robust theoretical solution. TestOps is the first large-scale implementation that generalizes this breakthrough and renders it practical.

The TestOps platform has been live in Mexico for one year, running an average of 42 large-scale experiments per month. Each experiment typically affects around 8,000 test stores with interventions that range from store-specific assortment recommendations to personalized promotions. The platform yields an approximately 100-fold increase in power compared to alternatives. Given its resounding success in Mexico, TestOps is already being scaled out to ABI's Middle America zone – which includes all of Central America – and a global rollout is expected in the next year.

This work represents a significant pioneering effort in developing experimentation platforms that aid in uncovering effective innovations in noisy retail environments. The concept and framework are flexible enough to be valuable in other domains, such as healthcare delivery and public policymaking, where experimentation faces similar challenges.

AMPL

Experience the difference.

Large-scale, natural optimization system

MODEL INTUITIVELY.

AMPL's intuitive syntax allows for clean model creation - defined in the way you think about your optimization problems.

INTEGRATE.

No need to abandon your preferred language with our API integration.

CONNECT.

Connect to your data sources directly.

OPTIMIZE.

Switch between solvers by changing a single line of code.

COPT · IBM CPLEX · GUROBI · FICO · KNITRO · ARKI · BARON · MOSEK

Traditional informal algebraic description of a model:

R : a set of raw materials
P : a set of products

a_{ij}, $i \in R$, $j \in P$: input-output coefficients
b_i, $i \in R$: units available
c_j, $j \in P$: profit per unit
u_j, $j \in P$: production limit

x_j, $j \in P$, $0 \le x_j \le u_j$: units of j produced

$$\text{maximize} \sum_{j \in P} c_j x_j$$: total profit

$$\text{subject to} \sum_{j \in P} a_{ij} x_j \le b_i, \; i \in R$$: limited availability of material

Model naturally with AMPL

```
set R; # a set of raw materials
set P; # a set of products

param a {R, P} >= 0; # input-output coefficients
param b {R} > 0; # units available
param c {P} > 0; # profit per unit
param u {P} > 0; # production limit

var x {j in P} >= 0, <= u[j]; # units of j produced

maximize total_profit:
    sum {j in P} c[j] * x[j]; # total profit

subject to supply {i in R}:
    sum {j in P} a[i,j] * x[j] <= b[i]; # limited availability of material
```

Single-letter names for illustration purposes only! With AMPL you can use meaningful names for better model maintainability!

COLLABORATE.

Easily generate ideas and share results with your team.

DEPLOY.

Deploy and use AMPL with any solver, anywhere, with a variety of deployment options.

Start free now

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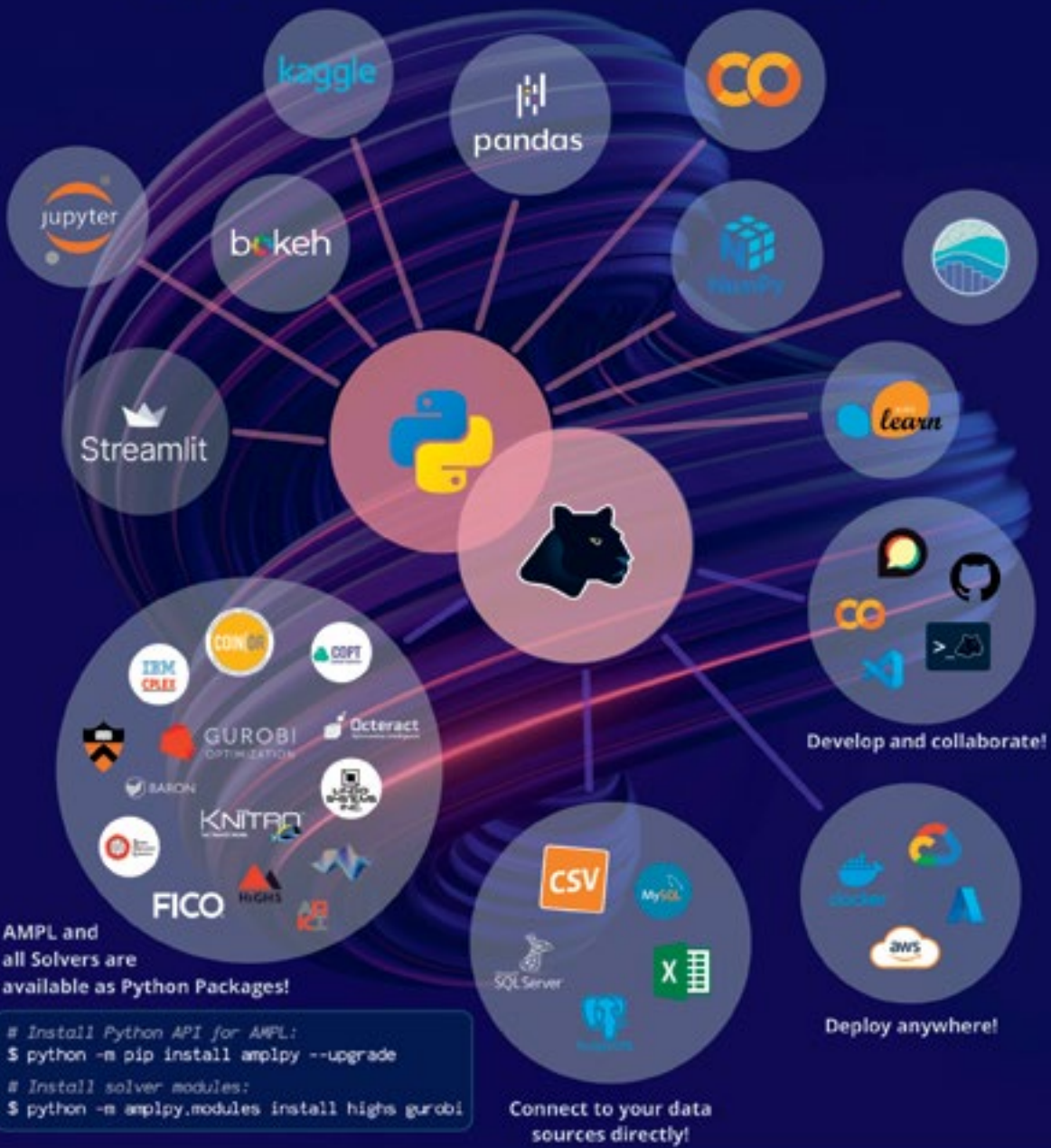
AMPL+Python

FOR LARGE-SCALE OPTIMIZATION




```
# Install Python API for AMPL:
$ python -m pip install amplpy --upgrade
# Install solver modules:
$ python -m amplpy.modules install highs gurobi
```

Natural mathematical modeling syntax + natural python integration

The speed of heavily optimized C code without losing model readability

UPS GEORGE D. SMITH PRIZE

UPS GEORGE D. SMITH PRIZE HISTORY

The UPS George D. Smith Prize is awarded to an academic department or program for effective and innovative preparation of students to be good practitioners of operations research, management science, or analytics. It is accompanied by a $10,000 award. The prize committee is pleased to announce the 2023 finalists:

- Institute for Insight, J. Mack Robinson College of Business
  Georgia State University
- Mitchell E. Daniels, Jr. School of Business, Business Analytics and Information Management
  Purdue University
- Rotman School of Management, Master of Management Analytics
  University of Toronto

The UPS George D. Smith Prize is an exciting award created in the spirit of strengthening ties between industry and the schools of higher education that graduate young practitioners of operations research (O.R.). This prize has been named in honor of the late UPS chief executive officer who was a patron of operations researchers at the leading Fortune 500 corporation. George D. Smith was the second CEO of UPS, holding the position from 1962 to 1972. He joined UPS as an accountant in 1925 and at some point in his long and illustrious career held almost every functional title within the company.

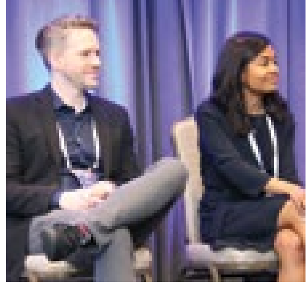
While his background was steeped in finance, George Smith had a keen engineering mind. In the late 1940s, after learning about O.R., Smith realized that intuition alone would not be enough to help UPS master the many issues it faced as it grew in size from a regional to nationwide carrier. Smith recognized O.R. as an engineering approach to making decisions, and started advocating the use of O.R. concepts at UPS. Quantitative analysis became the bedrock on which the UPS engineering function was built. Because of Smith's vision, UPS now employs thousands of engineers whose focus is efficiency, sustainability, and service.

He was a strong believer in investing in our younger generation. For him, nurturing them was the key to sustained prosperity. This prize embodies Smith's beliefs: to recognize the importance of O.R. in practice, and ensure that members of our younger generation get proper exposure to its value, and in turn benefit society.

2023 UPS Smith Prize Committee

- Andrew Wasser, *Chair, Smith Prize; Carnegie Mellon University*
- Michelle Li, *Massachusetts Institute of Technology*
- Patricia Randall, *Princeton Consultants*
- Anne Robinson, *Kinaxis*
- Fidel Rodriguez, *LinkedIn*
- Aurelie Thiele, *Southern Methodist University*







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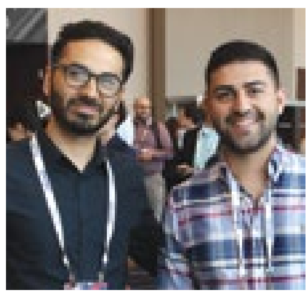



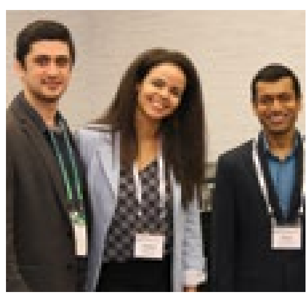




2023 SMITH PRIZE COMPETITION

Since the earliest days of operations research (O.R.) and analytics, to support the developing technology and research, it became increasingly important to prepare young O.R. and analytics professionals to further the growing impact of these fields. The UPS George D. Smith Prize recognizes the importance of a strong partnership between industry and academia in preparing students to be effective practitioners. The diversity, quality, and innovation of this year's finalists presented the committee with an encouraging and exciting glimpse of the future of the profession.

"As we grow in size, our problems increase geometrically. Without operational research, we would be analyzing our problems intuitively only, and we would miss many opportunities to get maximum efficiency out of our operation." – George D. Smith

SMITH PRIZE PAST WINNERS

2022 Master of Industrial & Applied Mathematics
Eindhoven University of Technology

2021 Tippie College of Business
University of Iowa

2020 Smith School of Business
Queen's University

2019 Department of Operations, Business Analytics & Information Systems
University of Cincinnati

2018 Haslam College of Business MSBA
University of Tennessee

2017 Operations Research Program
United States Air Force Academy

2016 H. John Heinz III College of Information Systems & Public Policy
Carnegie Mellon University

2015 Sauder School of Business
University of British Columbia, Centre for Operations Excellence

2014 Leaders for Global Operations
Massachusetts Institute of Technology

2013 Department of Operations Research
Naval Postgraduate School

2012 Tauber Institute for Global Operations
University of Michigan

Discover the **Robinson**

Master of Science in Data Science and Analytics

#7 AMONG PUBLIC UNIVERSITY PROGRAMS (TFE TIMES, 2022)

A STEM program housed in a top business school that prepares students to become leading data scientists and analysts with business knowledge. Our students:

- Build the skills companies desperately need with our rigorous and innovative curriculum.
- Develop domain expertise in our Innovation Labs (FinTech, Social Media, Legal Analytics and Operations Analytics Labs)
- Partner with leading companies on real projects to solve problems that matter.
- Tailor the program to their unique needs with flexible full-time and part-time options.
- Choose one of two tracks: *Data Scientist* or *Citizen Data Scientist*.

Georgia State University | J. MACK ROBINSON COLLEGE OF BUSINESS

PROUD TO BE A 2023 FINALIST

INFORMS UPS George D. Smith Prize

PREPARING LEADERS

IN BUSINESS ANALYTICS AND INFORMATION MANAGEMENT

TOP 10 MOST INNOVATIVE UNIVERSITY IN AMERICA
U.S. News & World Report, 2022

#4 MASTER'S IN BUSINESS ANALYTICS
BestValueSchools, 2022

Purdue University's Daniels School of Business is a thriving ecosystem that celebrates the best of operations research practice.

Using an analytic approach to management education, Purdue's business school has prepared thousands of students for successful careers in a data-driven world.

2023
UPS GEORGE D. SMITH PRIZE
FINALIST

RESEARCH GIANTS

Faculty in the Quantitative Methods and Management Information Systems areas are leading researchers in their fields whose discoveries enhance student learning, particularly in business analytics, machine learning, and artificial intelligence. Faculty scholars conduct their research through our Krenicki Center for Business Analytics & Machine Learning, which brings together companies, faculty and top business analytics students for data-centric projects that deliver actionable insights.

EXPERIENTIAL LEARNING

Daniels School students apply their knowledge in hands-on learning opportunities including case competitions, research, and consulting projects with corporate partners. We've created the Future Edelman Impact Award, an analytics contest that helps students produce their best data work and prepares them to compete for a future INFORMS Edelman Award. Students also benefit from participating in the Purdue Data 4 Good competition, sponsored by INFORMS CAP, Microsoft, SIL International, and our Krenicki Center. The international competition offers $25,000 in prizes. Purdue students graduate with so much more than classroom learning. They bring real-world experience to their careers.

NUMBERS DON'T LIE

Our strengths in operations management and analytics are well known. The MS in Business Analytics and Information Management program has been ranked the #1 data science master's program by *CIO* magazine, and our 2022 graduating class had a 99% placement rate and an average starting salary of $124,138. One-hundred percent of our 2023 MSBAIM graduates will be INFORMS aCAPs.

PURDUE UNIVERSITY | Mitchell E. Daniels, Jr. School of Business

www.business.purdue.edu

Rotman School of Management
UNIVERSITY OF TORONTO

Master of Management Analytics

The Master of Management Analytics (MMA) is a practical degree designed for quantitatively strong students.

During the 11-month program students develop the advanced data management, communication skills and business understanding needed to launch their careers in the field of management analytics. The TD Management Data and Analytics Lab is a key element of the Rotman School's mission to become a leader in the field of management analytics. Drawing on data from both private and public sources, the lab is an invaluable resource to students of the MMA program.

Technical skills gained include working with *Python, R, SQL, Hadoop,* data structuring and visualization, statistical methods for predictive analytics, "big data" clustering, segmentation, and text analytics and experience with planning tools and optimization modeling.

Program Curriculum

Structuring and Visualizing Data for Analytics

- Modeling Tools for Predictive Analytics
- Big Data Analytics
- Tools for Probabilistic Models and Prescriptive Analytics
- Leveraging AI and Deep Learning Tools in Marketing
- Analytics for Marketing Strategy
- Analytics Insight Using Accounting and Financial Data
- Optimizing Supply Chain Management and Logistics
- Frequent colloquia (mini courses) during the program help students understand management challenges and develop trends in data by covering topics such as:
  - Ethics and Legal Issues in AI
  - Neural Network: Causal Modeling
  - ML Operations

Experiential Learning

- Students embark on a 12-week practicum project where they work on a real management analytics problem in industry.

Our Current Program Partners

The following organizations are involved with the MMA program.

BMO
Bell
Canadian Tire
CBRE
CIBC
Cymax
Desjardins
DevCycle
Dr. Neilank Jha
Facebook
Four Seasons
FreshBooks
IBM
IG Wealth Management
Infosys
Interac
IQVIA
Janssen
Manulife
MasterCard
Ministry of Health of Israel
Northbridge Financial
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Razorfish
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Sobeys
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Synctera
Taplytics
TD Bank
The Bay
The Ministry of the Attorney General (MAG)
The Regional Municipality of York (York Region)
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Veeva Systems
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Contact us to learn more about the MMA program and our students:

mma@rotman.utoronto.ca
www.rotman.utoronto.ca/mma

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As an analytics professional, you solve extremely complex challenges every day. You're an expert problem solver. And you rely on mathematical optimization to get the job done.

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Visit Booth #217 to experience the power of Gurobi for yourself and to play the Burrito Optimization Game.

Congratulations to the 2023 Franz Edelman Award Finalists

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INFORMS PRIZE

INFORMS PRIZE HISTORY

The INFORMS Prize has been honored during the Edelman Gala for 16 years. While the Edelman Award and the Wagner Prize recognize single projects that demonstrate outstanding accomplishments in O.R. practice, the INFORMS Prize complements them by recognizing long-term, multiproject achievements. The INFORMS Prize is awarded annually to recognize effective integration of O.R. into organizational decision making. It is awarded to an organization that has repeatedly applied the principles of advanced analytics in beneficial and long-lasting ways.

2023 INFORMS Prize Committee

- Nilay Noyan, *Chair, INFORMS Prize; Amazon*
- Sharon Arroyo, *Boeing*
- Bryan Flietstra, *General Motors*
- Mehmet Gumus, *McGill University*
- Shane Henderson, *Cornell University*
- Yulia Vorotyntseva, *St. Louis University*
- Chris Weimer, *U.S. Air Force*

INFORMS PRIZE WINNERS

2023 Walmart
2022 Wayfair
2021 Amazon
2020 UPS
2019 Booz Allen Hamilton
2018 BNSF Railway
2017 The Walt Disney Company & U.S. Air Force
2016 General Motors
2015 Chevron
2014 Mayo Clinic
2013 Ford Motor Company
2012 Memorial Sloan Kettering Cancer Center
2011 Sasol
2010 Jeppesen
2009 Intel Decision Technologies Group
2008 GE Global Research Risk & Value Management Laboratory
2006 Schneider National, Inc.
2005 Air Products & Chemicals, Inc.
2004 Procter & Gamble
2003 UPS
2002 Hewlett-Packard
1999 IBM
1998 Lucent Technologies
1997 Merrill Lynch Private Client Group
1996 Pfizer Inc
1995 Bellcore
1994 AT&T and U.S. West Technologies
1993 New York City Office of Management and Budget & United Airlines
1992 San Miguel Corporation
1991 American Airlines & Federal Express

Notes: Prior to 1995, the award was called the ORSA Prize. No prize recipients were chosen in 2000, 2001, and 2007.

INFORMS PRIZE CRITERIA

The INFORMS Prize selection committee is comprised of seven members as well as the past committee chair, consisting of practitioners and academics, providing a broad representation of the operations research community.

Variety of Advanced Analytics and O.R. Applications.
Implementations in diverse applications, using a wide set of methods, led to greater opportunities to improve organizational performance.

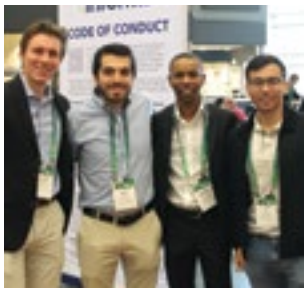
Strategic Advantage for the Organization.
Analytics and O.R. permeate the parent organization's operations and are considered integral and a source of strategic advantage.

Substantial Impact.
Over the years the total amount of beneficial impact on the organization has been substantial. This impact was delivered through some one-time and some recurring projects; its amount could be described sometimes by numerical measures and sometimes by statements without numbers.

Model for Success.
The organization provides an excellent example of successful analytics and O.R. practice for others to follow. An important reason for success has been to contribute in a variety of basic functions; for instance, in a business organization these functions likely will include finance, marketing, production, and planning.

Top-Management Endorsements.
Strong submissions include personally written endorsements from top-level executives.

High-Quality Application.
The best applications are well written. And they are complete, with all supporting references and endorsements included.



2023 INFORMS PRIZE WINNER

From our humble beginnings as a small discount retailer in Rogers, Arizona, Walmart has opened thousands of stores in the United States and expanded internationally. Through innovation, Walmart is creating a seamless experience to let customers shop anytime and anywhere online and in stores, as well as cultivating opportunities and bringing value to customers and communities around the globe. Each week, approximately 240 million customers and members visit more than 10,500 stores and numerous e-commerce websites in 20 countries. With fiscal year 2023 revenue of $611 billion, Walmart employs approximately 2.1 million associates worldwide. Walmart continues to be a leader in sustainability, corporate philanthropy, and employment opportunity.

Every Day Low Price (EDLP) is the cornerstone of Walmart's strategy. Walmart's price focus has never been stronger. From grocery and entertainment to sporting goods and crafts, Walmart provides the deep assortment that customers appreciate – whether they're shopping online at Walmart.com, through one of Walmart's mobile apps, or shopping in a store. Walmart currently operates three primary store formats in the U.S., each custom-tailored to its neighborhood.

A variety of operations research (O.R.) and analytics-based services empower Walmart associates to manage large quantities of diverse merchandise. The history of O.R. and analytics at Walmart dates back more than 50 years. In 1975, Walmart started using an IBM 370/135 computer system to manage inventory. In 1992, Walmart deployed the "Retail Link" system to forecast demand and inventory levels.

Projects of interest in recent years include planning routes for "pickers" at Walmart Fulfillment Centers, recommending box sizes for e-commerce shipments, last mile delivery routing and scheduling, assortment selection, and predicting the arrivals of online order customers, among others.

Taking assortment selection as an example, Walmart developed and uses an O.R. service to help Walmart merchants select which products to sell and how much space to allocate for each of these products in each Walmart store. Inputs derived from market basket analysis and natural language processing allow Walmart to forecast sales as a function of assortment. The assortment selection tool guides purchasing decisions, store layouts, and labor planning. Assortment decisions directly affect sales volume, revenue, profit, and customer experience.

By leveraging these applications and more, Walmart is dedicated to continuing its legacy by enhancing its business operations through O.R. and analytics.

Walmart

Congratulations to all **2023 Edelman Award finalists.**

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ANALYTICS
CONFERENCE

SAVE THE DATE!

April 14–16 | Orlando, Florida

Join INFORMS next year in sunny Orlando for the 2024 INFORMS Business Analytics Conference, April 14–16! Designed for analytics and data science professionals who want to empower organizations to make data-driven decisions, this conference provides access to more than 100 presentations and numerous networking opportunities with other leaders and experts in analytics, data science, AI, machine learning, and other decision sciences. The 2024 conference will also feature:

- Franz Edelman Award and other global competitions celebrating the tremendous economic and social impact of analytics
- A multiday Career Fair connecting top analytics talent at all career stages with leading organizations across all industries
- Pre-conference events including technology workshops, Early Career Professionals' Network, Meeting of Analytics Program Directors, and more.

https://meetings.informs.org/wordpress/analytics2024

INFORMS

ABOUT INFORMS

The Institute for Operations Research and the Management Sciences

From increased efficiency in business processes that leads to billions in savings, to lifesaving advancements in medical treatments and support of at-risk populations, to revolutionized transportation and delivery systems, the data and decision sciences are truly saving lives, saving money, and solving problems. At the heart of these growing fields is INFORMS, the leading professional society for a vibrant community of more than 11,000 operations research (O.R.), analytics, and data science professionals, academics, and students – representing more than 83 countries around the world – whose impact on the economy and society has been, and continues to be, nothing short of remarkable.

INFORMS is dedicated to encouraging, facilitating, and awarding excellence in its membership. Formed in 1995 when the Operations Research Society of America (ORSA) and The Institute of Management Sciences (TIMS) merged, INFORMS strives to provide opportunities of inspiration and collaboration among its members, fostering the life-changing ideas of the O.R. and analytics leaders of the future.

INFORMS hosts several meetings and events, including its Annual Meeting, Business Analytics Conference, International Conference, Healthcare Conference, and Security Conference. During the COVID-19 pandemic, INFORMS pivoted to transform its meetings from in-person to virtual settings, starting with the 2020 INFORMS Business Analytics Conference, originally slated to be held in Aurora, CO. Three years later, INFORMS has come full circle with its return to Colorado for the 2023 Analytics Conference.

The growing INFORMS advocacy program leverages the expertise of members to provide policymakers in Washington, D.C., with valuable insights regarding the importance of data-driven decision-making. INFORMS publishes 17 scholarly, peer-reviewed journals, more than one-third of which are featured on the *Financial Times* list of 50 top academic journals, highlighting the latest O.R. and analytics methods, research, and applications. In addition, continuing education and Certified Analytics Professional (CAP®) and Associate CAP (aCAP) certification programs provide opportunities for professional advancement at every career stage. With 26% of Fortune 100 companies now employing professionals who have earned the CAP, these certifications enable industry leaders to identify and employ top talent.

INFORMS provides many resources to organizations of all sizes seeking information on the benefits of analytics, connecting them with the latest research and discoveries as well as analytics and operational research professionals who have the expertise they require. In addition, within the INFORMS membership are smaller, specialized subdivisions dedicated to a common theme or technical interest, many of which directly pertain to analytics and operations research applications for industry. INFORMS members are embracing complex problems and unlocking the valuable data needed to enhance decision-making processes and improve day-to-day operations in almost every industry sector.

INFORMS would like to congratulate and thank tonight's honorees, both for their incredible contributions today, as well as inspiring the great discoveries and advancements of tomorrow.

Passionate about supporting causes that make our world a better place.

UPS is proud to support
2023 Franz Edelman Gala

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University of CINCINNATI

CENTER FOR BUSINESS ANALYTICS

2023

The University of Cincinnati Center for Business Analytics congratulates the

Franz Edelman Award Finalists

- DHL Supply Chain
- Huawei Cloud
- JD.com, Inc.
- Lyft, Inc.
- Meituan
- Walmart

PROBLEM SOLVE WITH ANALYTICS

In collaboration with the Carl H. Lindner College of Business, the Center for Business Analytics empowers business problem solving in industries ranging from banking and finance to manufacturing and logistics, retail, healthcare and entertainment.

Join our mission by becoming a corporate member. Contact **Glenn Wegryn**, executive director, at **Glenn.Wegryn@uc.edu**.

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business.uc.edu/analytics-center

ADVANCING THE PRACTICE OF O.R. & ADVANCED ANALYTICS

By C. Allen Butler,
President of INFORMS Section on Practice

Tonight, we have all gathered to celebrate outstanding achievements in operations research (O.R.) and advanced analytics. This Edelman Gala and the competitions for the Edelman Award, Wagner Prize, and UPS George D. Smith Prize are all conducted by volunteers of the INFORMS Section on Practice. You can learn more about these competitions and this year's finalists in this program book.

The Practice Section promotes the practice of operations research and advanced analytics through the stewardship of competitions dedicated to highlighting the best practices of our profession. In addition, we organize a set of practice-related presentations at the INFORMS Annual Meeting each fall, publish quarterly newsletters for Section members, and host monthly happy hours and webinars to bring awareness of the value of applying analytics to real-world problems.

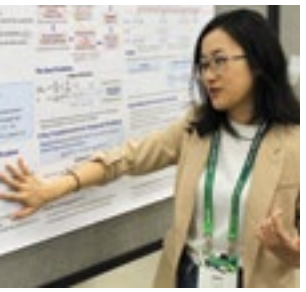
Members of the Practice Section are a diverse and inclusive group of volunteers from across the globe and represent a wide spectrum of industry, academia, government, and more. Regardless of your career path – whether you are just beginning your career or looking to stay up-to-date on the latest applications – all are welcome to be a part of the Section as we pursue our mission of improving the world by using operations research and analytics to save lives, save money, and solve problems.

We invite you to join the INFORMS Section on Practice and share your own unique experience and perspective. The opportunities for networking and collaborating to help advance our profession are endless and extremely rewarding.

Throughout the year, the Practice Section hosts a number of informative (and fun) events for its members that enable us to learn and grow together, regardless of where we are located around the world. During the COVID-19 pandemic, our virtual happy hours became a source of connection and community that continue to bring value to this day!

In addition, the Practice Section hosts a webinar series that covers a wide range of topics and applications, as well as valuable new insights and best practices. Please visit the Practice Section website at connect.informs.org/practice for more information and to join the Section, and to learn about all of its activities throughout the year.

If you are interested in volunteering with the INFORMS Section on Practice, or have suggestions for new activities that are not currently sponsored by the Practice Section, please send an email to me at: allen.butler@va.wagner.com. We look forward to hearing from you and welcoming you to our community!



CALL FOR INFORMS AWARD SUBMISSIONS

Descriptions of INFORMS awards and prizes, and submission deadlines listed here.

Daniel H. Wagner Prize

Excellence in Operations Research Practice

The Daniel H. Wagner Prize emphasizes the quality and coherence of the analysis used in practice. This prize recognizes those principles by emphasizing good writing, strong analytical content, and verifiable practice successes.

2023 Submission Deadline: Monday, May 15, 2023

Franz Edelman Award

Achievement in Advanced Analytics, Operations Research, and Management Science

The purpose of the Franz Edelman Competition is to bring forward, recognize, and reward outstanding examples of impactful O.R., management science, and advanced analytics practice in the world.

2024 Submission Deadline: Sunday, October 1, 2023

UPS George D. Smith Prize

Strengthening Ties Between Academia & Industry

The UPS George D. Smith Prize is awarded to an academic department or program for effective and innovative preparation of students to be good practitioners of operations research, management science, or analytics.

2024 Submission Deadline: Saturday, October 15, 2023

INFORMS Prize

Sustained Integration of Operations Research

The INFORMS Prize is awarded for effective integration of advanced analytics and OR/MS in an organization. The award is to be given to an organization that has repeatedly applied the principles of advanced analytics and OR/MS in pioneering, varied, novel, and lasting ways.

2024 Submission Deadline: Friday, December 1, 2023

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RESILIENT MISSION AUTONOMY
INSIGHTFUL DATA ANALYTICS
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CONGRATULATIONS *to the* 2023 Franz Edelman Award Finalists!

WAKE FOREST UNIVERSITY

CENTER *for* ANALYTICS IMPACT

The Wake Forest University Center for Analytics Impact (CAI) is focused on the **impact of analytics.** As the first academic center to go beyond methodology to emphasize the non-technical aspects of the effective use of analytics, the goals of the center are:

- To be the leading authority on empirical research in the success or failure of analytics and its impact on organizations and society.
- To be the premier provider for continuing education in the areas that can mitigate the difficulties posed by issues that inhibit the success of analytics.
- To host world-class seminars and conferences that will disseminate thought leadership around analytics impact.

Scan to learn more.

RESEARCH | EDUCATION | PROMOTION

ACKNOWLEDGMENTS

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Carrie Beam, *University of California, Davis*

Our government is just getting started. We are very excited to continue these collaborations using science and analytics to support decision making in the pandemic and, why not, in other public health challenges we need to address.

— María Begoña Yarza, Former Minister of Health, Chile

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