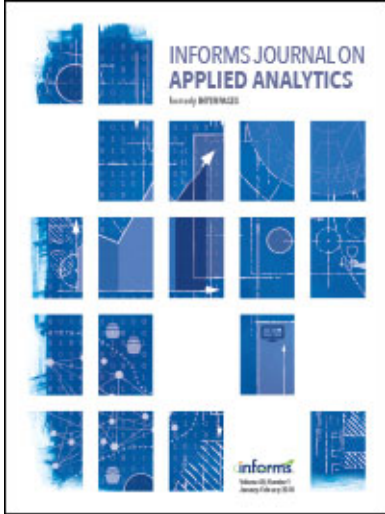




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THE FRANZ EDELMAN AWARD
Achievement in Operations Research

Introduction: 2016 Franz Edelman Award for Achievement in Operations Research and the Management Sciences

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Abstract. This special issue of *Interfaces* is devoted to the finalists of the 45th annual competition for the Franz Edelman Award for Achievement in Operations Research and the Management Sciences, the profession's prestigious award for the practice of operations research and business analytics. As in previous years, the six finalists this year cover a wide range of industries and functions.

Keywords: OR practice • business analytics • OR implementation • OR success stories

It is an honor for us to serve as special-issue editor and chair, respectively, of the 45th annual international competition for the Franz Edelman Award for Achievement in Operations Research and the Management Sciences. This is a competition that brings together the best in operations research (OR) practice. This year's competition was held on April 11, 2016 at the INFORMS Conference on Business Analytics and Operations Research in Orlando, Florida. Six finalist teams described how they applied OR and business analytics to solve diverse and difficult decision problems. The problem domains include bidding on search engine keywords, repairing combat equipment, routing trucks, reducing financial risk, scheduling soccer matches, and preventing and responding to criminal and terrorist activity.

These entries highlight not only the high-impact practical models the proponents have created, but also the remarkable and diverse ways these proponents have made OR modeling and analysis a part of strategic thinking and operational practice at their organizations.

About the Edelman Award Competition

The Franz Edelman Award Competition is jointly sponsored by INFORMS and CPMS, the Practice Section

of INFORMS. The purpose of the competition is to bring forward and recognize outstanding examples of OR, management science (MS), and advanced analytics practice. The award is named in honor of Franz Edelman, who established one of the earliest industrial OR/MS groups in North America at RCA. He worked at RCA for more than 30 years and is counted among the fathers of innovation in OR/MS.

The awards are for implemented work that has had significant, verifiable, and measurable impact. INFORMS presents trophies commemorating the award to the client organizations that used the finalists' work and presents medals and cash awards to the finalist authors. This year, the prize money totaled \$15,000, with \$10,000 going to the first-place winner. More important, the finalists have the honor and satisfaction of knowing their work has been recognized by their peers as the best in the profession. In addition to having their efforts described in this special issue of *Interfaces*, all finalists have their presentations made available on the INFORMS Video Learning Center website at <http://www.informs.org/Find-Research-Publications/Multimedia-Books/Edelman-and-Wagner-Videos>.

The Process

The Edelman Award process began with a call for entries in early September 2015. The number of people supporting the Edelman competition is large, with more than 40 participating on the finalist selection committee. To name them all would be difficult, but we thank them for making the competition a success, noting especially the hard work of the verifiers, coaches, judges, and the Edelman Award Gala Committee.

The selection committee reviews all entrants and selects a set of semifinalists. Verifiers then work behind the scenes to validate the claims made by each semifinalist, and to convey this information to the rest of the selection committee. The verifiers communicate directly with the entrant's OR team, the users of the work, and client management. Verification is a crucial element of the competition because it ensures that only the highest-achieving OR work makes it to the Edelman Award finals. All verifiers are provided with written guidelines and sample verification reports, and novice verifiers are paired with experienced verifiers. The verifiers this year were Layek Abdel-Malek, Susan Albin, Carrie Beam, Sudip Bhattacharjee, John Birge, Antonio Carbajal, Arnold Greenland, Mingguo Hong, Yingdong Lu, Irvin Lustig, Sven Müller, Anna Olecka, Ioannis Papadakis, Pelin Pekgun, Graham Rand, Anne Robinson, Randall Robinson, Jack Theurer, Michael Trick, Rajesh Tyagi, and Peiling Wu-Smith.

The selection committee studies and discusses the verification reports to select the six finalists. Coaches are assigned to each finalist team; these coaches help the finalists improve their papers and presentations for the competition. The coaches this year were Carrie Beam, John Birge, Antonio Carbajal, Arnold Greenland, Yoshi Ikura, Ananth Iyer, Russell Labe, Sven Müller, Anna Olecka, Ioannis Papadakis, Pelin Pekgun, Randall Robinson, and Jack Theurer. Coach Carrie Beam helped edit one of the papers following the competition.

Judges study the papers, listen to the presentations, and then discuss the finalists' accomplishments until they reach a decision on which finalist best exemplifies the ideals and standards of the Franz Edelman Award. Relevant factors include the overall impact and value of the application, the level of technical innovation, the difficulty of the obstacles surmounted, and the work's portability to other application contexts. The judging

panel consisted of Michael Trick (chair), Susan Albin, Peter Bell, Srinivas Bollapragada, David Hunt, Irvin Lustig, Laura McLay, John Milne, and Jonathan Owen.

The Banquet

This was the 11th year that the Edelman finalists were honored at a gala banquet on the evening of the competition. The Edelman Gala Committee comprised Pooja Dewan (chair), Jeffrey Alden, Peter Bell, Ann Bixby, Allen Butler, Antonio Carbajal, Russell Labe, Robin Lougee, Julia Morrison, Jonathan Owen, Randall Robinson, Michael Trick, and INFORMS staff members Tracy Cahall, Jeff Cohen, Mary Leszczynski, Max Resnick, and Kara Tucker. Anne Robinson was the master of ceremonies.

At the banquet, authors of the Edelman finalist papers were designated as Franz Edelman Laureates and presented with medals in recognition of their achievements. Organizations that were significantly involved in the OR development and application were inducted into the Franz Edelman Academy, and high-ranking representatives from these organizations were honored on stage. The culmination of the evening was the announcement of the 2016 first-place team from UPS.

The Finalists and the Papers in This Issue

Here is a brief summary of the finalists listed in the sequence that their papers appear in this special issue.

UPS for UPS Optimizes Delivery Routes

UPS is faced with the daily problem of providing an optimized route for each of its 55,000 U.S. drivers. Given the number of packages a driver must pick up and deliver each day, even determining the travel distances between package stops and pickups is a challenging problem. Using truck GPS information, UPS was able to determine real travel times, and find optimal or near-optimal routes with a metaheuristic algorithm. A key feature of the UPS approach is limiting the magnitudes of changes from the base route—enabling consistency in both driver and customer experiences. GPS devices automatically collect data from the delivery trucks to improve the accuracy of their map data. The change management approaches helped UPS conquer many obstacles, including convincing

senior management to invest in building and deploying the software at a cost approximately \$295 million. UPS estimates that when this work is fully deployed, it will result in an annual savings of \$300–\$400 million.

360i for 360i Generates Nearly \$1B in Revenue for Internet Paid-Search Clients

360i manages Internet paid-search advertising for a variety of its clients. Optimization recommends prices to bid for keyword expressions (and positions) on search engine results pages. Natural language processing and clustering algorithms are used to aggregate keyword expressions into hierarchical groups to facilitate the management of advertising and marketing campaigns and—with a modification of Kalman filtering—to identify good bids for rare keywords based on their similarities with other keywords. Regression and other statistics are used to monitor the advertising performance and to proactively identify problems. 360i's application of these techniques has generated about \$1 billion in incremental revenue for its clients.

Bank of New York Mellon for BNY Mellon Optimization Reduces Intraday Credit Risk by \$1.4 Trillion

In a financial repurchase (repo), a dealer (borrower) provides collateral to an investor (such as the manager of a money market fund) to secure a short-term loan. Bank of New York Mellon (BNY Mellon) facilitates these transactions by maintaining custody of the collateral securities and ensuring that all loan conditions are met. Prior to the U.S. Tri-party Repo Reform Program, investors typically received their cash back (plus interest) earlier in the day than the dealer provided it, with BNY Mellon providing intraday credit. To reduce this intraday credit exposure, BNY Mellon developed an integrated set of rules-driven software tools for its clients to use. Two mixed-integer programming (MIP) models are at the heart of these tools. One MIP simultaneously allocates dealer collateral from maturing trades to new trades and uses the funds from the new trades to repay the maturing loans. The second MIP determines a set of transactions to transition from a current portfolio of securities to a target portfolio. This program and associated business process changes have helped to reduce the intraday credit risk in BNY Mellon's U.S tri-party repurchase market by \$1.4 trillion.

Chilean Professional Soccer Association (ANFP) for Operations Research Transforms the Scheduling of Chilean Soccer Leagues and South American World Cup Qualifiers

Soccer games for the ANFP and South American World Cup Qualifiers are scheduled using mixed-integer programming (MIP)-based methods as a result of OR expertise and support from the University of Chile. By determining patterns in one MIP followed by assignments in a subsequent MIP, the approach described allows the efficient consideration of a wide variety of constraints and objectives including transparency, fairness, team preferences, geography (travel, weather), and television implications. The estimated economic impact is about \$60 million, and the qualitative benefits for the players and their passionate fans are at least as great. The work has been extended to schedule professional basketball and volleyball. In addition, it has had a significant impact on students in Chile as a result of outreach activities and the creation of content used by schools, universities, and the media.

New York City Police Department for The New York City Police Department's Domain Awareness System

The New York City Police Department (NYPD) uses analytics to create actionable insights based on billions of sensor readings (e.g., license plate readings, audio gunshot detection) and more than 100 million police records (e.g., 911 calls, warrants). A police officer responding to an emergency phone call can use a smartphone to see relevant history—a prioritized list of the call from the same location. Alleged terrorists and criminals can be found more quickly based on their driving patterns. Crime analysis using a predictive algorithm outperforms the NYPD's prior method by a factor of more than five—enabling better resource allocation of officers to locations where they are most needed. Officers were deeply involved in the development and deployment of this user-friendly system, which allows them to access the underlying records that influence the model's outputs. During the two-year period following the department-wide deployment of the software in 2013, the overall crime index in New York City fell by six percent, driven by 10,000 fewer burglaries, robberies, and grand larcenies.

U.S. Army for *Bayesian Networks for Combat Equipment Diagnostics*

Transporting experts to repair electronics equipment in remote combat locations is dangerous and expensive, and can result in delays that impede mission success. Consequently, the U.S. Army Communications Electronics Command used causal Bayesian networks to encode expert knowledge into mobile devices, thus enabling soldiers to diagnose and repair failed equipment on their own. The authors describe their process for capturing and encoding the experts' knowledge into the networks. The resulting system has prevented an estimated 4,500 casualties by reducing requirements to send repair experts on-site. The short- and long-term medical cost savings are over \$9 billion, and the cost of developing and deploying the system was a fraction of the cost savings in nonmedical expenses, such as labor.

Conclusion

The Edelman finalist papers make this issue of *Interfaces* special for both practitioners and academics. Practitioners can benefit in at least four ways. First, they

will find better ways of accomplishing their work using OR/MS models in a diverse group of organizations in both the private and public sectors. Second, they will find better ways to advocate their ideas to others in their organizations by pointing out the impact of adopting OR/MS modeling. Third, they will learn how to bring about change in an organization to make OR-based modeling and analysis an integral part of the culture. Finally, they can be inspired to tackle challenging problems and make the modeling choices necessary for their effective solution and deployment.

Academics will find validation of the advanced methodology they teach and will be able to demonstrate what can be achieved with OR/MS. Furthermore, these examples illustrate how model customization is often required to suit the problem context.

Acknowledgments

Selection committee members, verifiers, coaches, judges, and the Edelman Gala Committee all deserve thanks for the significant effort they put into making the Franz Edelman competition a success. We thank Alice Mack, the manuscript editor of this issue of *Interfaces*, and the INFORMS staff who helped with many aspects of the process.