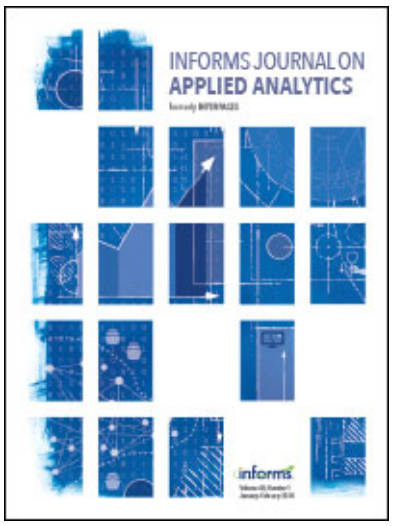

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Introduction: 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice

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Competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice provided the six finalist papers featured in this special issue of *Interfaces*. The prestigious Wagner Prize—awarded for achievement in implemented operations research and advanced analytics—emphasizes quality and originality of mathematical models and clarity of written and oral exposition. Researchers from MIT, Duke University, Cornell University, and the client organization, Ford Motor Company, won the competition for the design and successful implementation of a novel risk-exposure model that more accurately assesses the impact of potential major disruptions originating anywhere in the firm's supply chain. The remaining finalist papers describe work to improve funding of new-product-development projects, assignment of airline pilots, organization and management of emergency vaccination facilities during a pandemic, reformulation of laundry products, and allocation of deceased-donated livers to transplant patients.

Keywords: professional: comments on.

One way CPMS, the Practice Section of INFORMS, strives to help advance OR/MS and analytics is by making practice success stories available to the profession. We are therefore pleased to present the results from the 2014 competition for the Daniel H. Wagner Prize for Excellence in Operations Research Practice, an INFORMS prize administered by CPMS and established in memory of the late Dr. Daniel H. Wagner.

Dan Wagner earned his PhD in mathematics in 1951 from Brown University. His dissertation, "On Free Products of Groups," was published in 1957 in *Transactions of the American Mathematical Society* (Wagner 1957). He began his career in the U.S. Navy's Operations Evaluation Group (OEG) at the Pentagon, where he worked 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 MIT. Dr. Wagner then joined Burroughs Research Center, where he directed a group of mathematicians performing analysis for the development of digital computers.

In 1957, Dr. Wagner's entrepreneurial spirit took over and, together with John D. Kettelle, he 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 did leading-edge work in the mathematics of naval tactics, especially antisubmarine warfare, detection theory, and search planning.

During his years as president and principal owner of 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 Navy, Coast Guard, and other clients—many of these applications are still in service today.

After retirement from his eponymous company, Dan continued his commitment to the field of operations research, serving in various teaching and research positions with the U.S. Naval Postgraduate School and the U.S. Naval Academy. He was an active member of ORSA, and then INFORMS, for more than 40 years.

The idea for this prize began at Dan's memorial service in April 1997, where many of his former colleagues gathered. Following the agreements made on that day and subsequent pledges, the firms Metron, Inc., Daniel H. Wagner Associates, Inc., and Applied Mathematics, Inc. generously donated a total of $51,000 as an endowment to ensure the availability of a cash award in perpetuity. Each of these companies is an outgrowth in large part of Dan's early efforts.

Metron, Inc. (President and CEO Tom Corwin, http://www.metsci.com) is a scientific consulting company dedicated to solving challenging problems in national defense through the development and application of advanced mathematical methods. Problem solutions are realized using computer software with graphical interfaces that allow a user to understand and act on the results without having to comprehend the models' intricacies.

Daniel H. Wagner Associates, Inc. (President and CEO Allen Butler, http://www.wagner.com) specializes in innovative mathematical solutions to problems in government and business. The firm provides consulting services in operations research, mathematics, and related software development. It also offers a variety of ready-made products for financial analysis.

Applied Mathematics, Inc. (President Bill Browning, http://www.applmath.com) develops and implements mathematical models that its clients use to help them better understand their systems and processes to improve performance. Current application areas include submarine warfare, search and tracking, sensor-data fusion, search and rescue, clinical informatics, uncertainty quantification, and vineyard analytics.

We are grateful to the judges who donated their time to evaluate the entries and select the winners of this year's competition: C. Allen Butler, Daniel H. Wagner Associates, Inc. (Committee Chair); Susan L. Albin, Rutgers University; William J. Browning, Applied Mathematics, Inc.; Joseph H. Discenza, SmartCrane LLC; Russ Labe, Bank of America; Uday Rao, University of Cincinnati; Randall S. Robinson, Special Issue Editor; and Lawrence Stone, Metron, Inc.

The judging committee selected semifinalists on the basis of their abstracts and verification of success in practice. The semifinalists were then invited to submit drafts of their full papers. Based on the draft papers, the judging committee selected the finalists, who presented their work at the 2014 INFORMS Annual Meeting and whose papers constitute this special issue. Judging of the final papers and selection of the winning entry were based on the following criteria: quality and coherence of analysis and originality of mathematical solutions, quality and clarity of writing, utility or success of the work in one or more real-world practice applications, and quality and clarity of the oral presentation.

The finalists this year represent a mixture of industrial and public sector organizations, and the papers describe innovative operations research applications in diverse worlds.

Our winner, a team from Ford Motor Company, Massachusetts Institute of Technology, Cornell University, and Duke University, developed new methods to anticipate and better manage disruptions in complex supply chains. Useful not only in the automotive industry but also in many other industries, the methods implemented at Ford focus on both extreme external disruptions, such as those caused by hurricanes or earthquakes, and operational disruptions, such as those from sourcing problems or transportation breakdowns. Blending simulation and optimization, the team's approach to risk exposures in Ford's large, multilevel chain of suppliers has enabled Ford to identify high-impact-if-disrupted supplier sites not previously recognized, identify low-impact supplier sites receiving excessive amounts of Ford's risk-management and mitigation-planning resources, and reallocate such resources accordingly. The new methods complement rather than replace Ford's traditional supply chain risk analyses.

Intel Corporation sponsored an advanced analytical effort to address the perennial problem of wisely allocating limited funds to competing product-development projects. A team from Intel and Arizona State University applied simulation and optimization methods to model important combinatorial complexities, including a single project that supports multiple products, projects that share common deliverables, products that either reinforce each other or compete, and products that serve single or multiple markets. Further, the team developed explicit facilitators to take advantage of the experience and judgment of

decision makers, thus enhancing actual decision making that combines analytical results with considerations not covered by the models. Trials of the new methods indicated a significant increase in anticipated net present value, a shorter time to reach decisions, and greater understanding of the reasons behind decisions.

A team from the analytical unit of Sabre Corporation developed a new procedure to solve the problem of optimally assigning pilots to flights. Their approach considers the most complicated situation in which more than two, pilot and copilot, may be needed for safety or longer trips, and the assigned individuals may change at stops along the way. This classic airline problem is known as cockpit crew pairing with augmentation and crew splitting. Comparing their solution method with other methods, the team found substantial cost reductions and were encouraged to extend their methods to the assignment of nonpilot (cabin) crew members. A senior official of Sabre confirms that several large airlines have been using Sabre's assignment methods as they have evolved over the past 20 years.

The U.S. Centers for Disease Control and Prevention (CDC) responds to serious situations where a potentially fatal disease is spreading rapidly (a pandemic) by quickly establishing emergency treatment facilities that handle large numbers of people. If the appropriate treatment is vaccination, as is true for many diseases, the key question is how best to organize and manage those vaccination facilities. By the innovative application of simulation and optimization, a team from the CDC and the Georgia Institute of Technology developed new analyses that provided several crucial improvements over past procedures. Among the potentially life-saving insights were: (1) to obtain better results, replace the earlier methods of only first-come, first-served (FCFS), or of only prioritizing such that some higher-priority people are processed ahead of lower-priority people, with the mixed method of first prioritizing, and then at a particular "switch time," changing over to FCFS; (2) receiving vaccination supplies without interruption is more valuable than with interruption, even if the cumulative supply with interruption is ultimately greater; (3) triage of arriving people can be counterproductive; (4) overall results depend greatly on efficient throughput. The CDC has adopted the team's methods and findings.

The Proctor & Gamble Company (P&G), in its line of powder detergents (Tide and others) for the North American market, was confronted with increasing pressure to reformulate frequently, traditional reformulation methods that were proving to be too slow, and rising cost consciousness. A team from P&G's Technical Centres in England and SAS Institute created mathematical-programming and statistical models that considered a whole portfolio of different powder-detergent products and quickly optimized their reformulations jointly in light of desired product properties, while making efficient use of available manufacturing facilities. Applying the models in North America resulted in faster reformulations, cost savings, and valuable simplifications within the associated reformulation and manufacturing processes. After learning from the first application, P&G is now refining the models to gain even greater benefit in the near future.

A team from the Johns Hopkins University School of Medicine and School of Public Health employed integer programming and simulation to improve the allocation of deceased-donated livers to needy transplant patients. In 1998, the U.S. Department of Health and Human Services declared that geographical location must not limit a candidate's access to a transplant. However, within the 58 liver-transplant service areas, grouped into 11 sharing regions (districts), strong opposition to changes in allocation emerged despite major differences among districts in transplant access. The Johns Hopkins team addressed opposition partly by carefully modeling each important aspect, including time delays associated with transplanting, cost of caring for transplant candidates and recipients, behavior of physicians in accepting or declining organ offers, and performance of organ procurement organizations. The models reorganized the service areas into a smaller number of sharing districts such that the disparities in availability between districts were greatly reduced. As a result, members of the controlling Liver Committee agreed

unanimously to redistrict as recommended by the models; even those members from transplant districts expecting to do fewer transplants after redistricting agreed. In April 2015, the model-based redistricting plans went out for required public comment.

We congratulate all the authors for their outstanding work. And we again thank our esteemed judges for their volunteer efforts, which made this competition possible. We look forward to another strong competition during the 2015 INFORMS Annual Meeting in Philadelphia, and to recognizing the winner at the Edelman Gala during next year's INFORMS Conference on Business Analytics and Operations Research in Orlando, Florida.

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Full presentation videos with slides are available on the INFORMS Video Learning Center (https://www.pathlms.com/informs) and as electronic companions to the *Interfaces* articles.