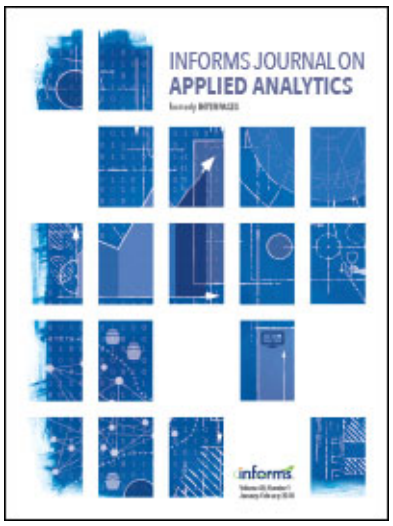

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Franz Edelman Award for Management Science Achievement

This 20th Anniversary Franz Edelman Award Competition for Achievement in Management Science Practice was truly a special event. We set a new record for the number of entries submitted, and the overall quality level was so high that we wound up with eight finalists. As many of you know, the Franz Edelman Award for Management Science Achievement is a joint undertaking of TIMS and the College on the Practice of Management Science (CPMS). The purpose of the competition is to call out and reward outstanding examples of our profession in practice. The prize is awarded for implemented work that has had significant, verifiable and preferably quantifiable impact—not for the paper submitted or for the presentation describing the work. That said, the presentations at the joint TIMS/ORSA meeting in Nashville on May 12, 1991 were at the high end of the quality scale by anyone's standard. The client organization that used each finalist's work receives a prize citation engraved on a presentation plaque. The authors of the work receive the cash awards, which total $15,000 this year.

The length of the list of the people involved in supporting the Edelman award competition and the stature of the people on that list attests to the quality of the effort that goes into the competition. Printing the entire list of names would turn this issue into a directory, so I won't do that, but I will give special acknowledgment to the coaches and judges.

CPMS provides a coach to work with each finalist during the few months between their selection as a finalist and the actual presentation. The high quality of the presentations and the videotapes of the presentations that CPMS offers for sale through the TIMS office in Providence reflects the efforts of these coaches. This year's coaching group was Tony Brigandi, Howard Finkelberg, Rajan Gadkari, Bill Hardgrave, John Ketelle, Frank Morrisano, Art Schneyman, and Tom Spencer.

The judges this year paid for the privilege of getting involved with all eight of these exemplary pieces of management science work by wrestling for many hours on Sunday evening with our obligation to select a grand prize winner from this group of eight winners—and they are all winners—who made it to finalist status. Joining me on the judging panel this year were Newt Garber, Steve Graves, Dave Hirshfeld, Fred Murphy, Peter Norden, Phil Taylor, and Elden Thomas.

Six of the finalist winners—and once again, they are all winners—have been designated as honorable mention finishers. I'd like to emphasize the honor by referring to them here as *very* honorable mention $500 prize winners:

GE Capital Corporation: William M. Makuch, Jeffrey L. Dodge, Joseph G. Ecker, Donna C. Granfors, and Gerald J. Hahn implemented optimization model

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work to improve delinquent consumer credit obligation collection efforts. Collections have improved by $37 million per year, and consumer relations have been enhanced by avoiding collection efforts that have now been shown to be unnecessary.

GTE Telephone Operations: Carolyn Jack, Sheng-Roan Kai, and Alexander Shulman implemented a PC-based interactive optimization system now being used by more than 300 telephone network planners throughout the United States. Savings of about $30 million per year are being achieved.

The Military Airlift Command: Michael R. Hilliard, Rajendra S. Solanki, Cheng Liu, Ingrid K. Busch, Glen Harrison, and Ronald D. Kraemer rapidly implemented a new airlift deployment analysis system under crises conditions to support all airlift activities associated with Operation Desert Shield and each of the phases that have followed. The success of this work is demonstrated by the fact that the Military Airlift Command achieved the most extensive airlift ever attempted in anything like the time frame involved.

Prudential Securities Incorporated: Yosi Ben-Dov, Lakhbir S. Hayre, and Vincent Pica implemented a family of models using probability, statistics, and Monte Carlo simulation techniques to evaluate and optimize groupings of mortgages assembled for packaging as mortgage backed securities. On the strength of these models, Prudential's mortgage backed securities business has grown in four years from three percent of a $1 billion market to 12 percent of a $14 billion market, a 40-fold increase to $1.6 billion for Prudential.

The United States Postal Service: Michael E. Cebry, Anura H. deSilva, and Fred J. DiLisio used mathematical modeling to redirect the automation program aimed at improving the cost structure of their 760,000 employee organization. Extrapolation of the results achieved to date shows total annual savings of 1,000,000 work years of mail carrier labor, which will allow the US Postal Service to maintain its status as the lowest unit cost postal service among developed countries worldwide and to continue to control postage rate increases in the United States to lower than inflation growth rates.

Yellow Freight System, Inc.: John W. Braklow, William W. Graham, Stephen M. Hassler, Ken E. Peck, and Warren B. Powell implemented an interactive optimization planning tool that combines networking algorithms and advanced optimization concepts to assist in the ongoing network design needed to support the direct service they provide for less-than-truckload shipment to and from more than 24,000 cities nationwide. Direct cost savings of $4.8 million per year are attributable to one aspect of the model, and another $10 million per year is delivered by major facility projects planned and evaluated using the work.

The judges designated a second place, $2,000 prize winner this year:

The Columbus-America Discovery Group: Lawrence D. Stone made innovative use of classical search theory and a collection of supporting models in the successful hunt for the *SS Central America.* About 130 years after the mail steamer sank in a hurricane some 200 miles off the Virginia coast in one and one-half miles of

water, the group was formed specifically to conduct a multidisciplinary research project to find and recover the remains. The shipwreck had taken gold bars and coins worth an estimated $1 billion to the ocean floor. The group did locate the wreck using this work after many search efforts by other groups had failed.

Finally, our grand, $10,000 prize winner for this 20th Anniversary Edelman Award is American Airlines Decision Technologies: Barry C. Smith, John F. Leimkuhler, and Ross M. Darrow for implementing a series of statistical and mathematical models to "sell the right seats to the right customers at the right prices." This work has added a vital new dimension to the value American Airlines is realizing from the data collected by their SABRE system. All told, this yield management work has generated more than $1.4 billion in revenue for American Airlines during the last three years.

We hope you agree, even based on these teaser descriptions, that this special issue covers a precious collection of eight of the best examples of implemented management science work to have surfaced in quite some time. They are winners all and worthy of our very special attention.

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This is my fourth year participating in the Franz Edelman Award for Management Science Achievement, and I am again pleased to serve as the editor of the special issue containing the papers from this year's competition. This past year was the most competitive of the competitions with which I have been involved. There were eight finalists. The diversity and range of applications are again truly remarkable. As one of the judges, I can attest that it was very difficult to sort out the finalists. After having sat through the full day of presentations by the finalists and facing the prospect of having to choose a winner, my first reaction was that our profession was the winner to have such a strong set of entries. I only wished that the presentations could have been witnessed by more of the management science community. Indeed, I think it is a shame that we can not fill up a ballroom to listen to these outstanding examples of management science practice. One consolation is this volume of the papers, as well as the tapes of the presentations available from the TIMS office. I encourage you to read these papers, share them with your colleagues, and teach them in your classrooms.

To the extent that there was a common theme this year, it was that nearly all of the entries represented a long-term effort that has resulted in an institutionalized application of management science. This year's winner from American Airlines is a good example of this. Yield management for an airline is the dynamic control and management of reservations inventory in order to increase company profitability. Yield management includes issues of how much to overbook a flight, as well as setting the number of seats available for each fare category. Furthermore, these issues are dynamic and often require daily examination and update for each scheduled flight over the next year. Indeed, American Air-

lines has up to 50,000 fare changes daily, and its daily yield management entails up to 250 million decisions. Yield management is also complicated by the hub-spoke networks employed by all major airlines; a particular flight segment into a hub airport (Dallas/Fort Worth) may serve 30 markets due to possible connections, and yield management decisions need to reflect the different revenue implications from selling a seat that can ultimately serve different markets. Researchers from American Airlines have been working on these questions since the late '60s, and have developed and implemented a series of yield management systems, utilizing a wide range of management science techniques. Today, American Airlines is regarded as having the best yield management system in the industry. American Airlines estimates that yield management has increased revenue by $1.4 billion over the last three years and should continue to contribute $500 million per year into the future.

Second prize in this year's competition was awarded to the Columbia-America Discovery Group for their application of management science, namely search theory, to their successful effort to find the *Central America*. Hunting for sunken treasure has a certain universal allure to it, combining risk with the potential for instant riches. To think that management science could help find a treasure is particularly alluring to those of us engaged in less glamorous and less profitable applications of management science. The *Central America* went down in a hurricane in 1857 off the coast of South Carolina and took with it three tons of gold. For over 130 years, efforts to find the ship have been unsuccessful. The Columbia-America Discovery Group, using classical search theory, created a search plan that incorporated historical accounts of the storm and shipwreck, mathematical models of drift due to ocean currents and winds, and estimates of the accuracy of the navigational instruments of the period. The search plan was first used to convince investors that their investment had a reasonable chance of finding the *Central America*. The eventual discovery of the *Central America* required the full execution of the search plan. The story of the discovery is intriguing and, I believe, will become a management science classic.

The secondary mortgage market is a market created for issuing and trading securities built from portfolios of mortgages, primarily single-family mortgages. This market continues to grow rapidly and is now comparable in size to the corporate bond market. In the past five years, Prudential Securities has gone from a marginal player in the secondary mortgage market to one of the top three firms; the volume of collaterized mortgage obligations issued by Prudential Securities has grown by a factor of 10 over this period. A key component in this success story is the application of management science models and methods. In particular, the financial strategies group at Prudential Securities has developed a full range of models to predict the prepayment of mortgages, to estimate the value of mortgage-backed securities and adjustable-rate mortgages under various interest-rate scenarios, and to structure optimal fixed-income portfolios of mortgage-backed securities. The methods utilized include Monte Carlo simulation, nonlinear

regression, probabilistic analyses, and mathematical programming.

GTE is the largest local telephone company in the US and invests $300 million annually on improving, upgrading, and expanding the facilities that connect GTE customers to their local central offices (local exchanges). With the advent of new switching and transmission technologies, such as fiber optic cables, the multi-year planning for these investments has become exceedingly complex. A typical problem might have a 10-year planning horizon and a network with 60 nodes and can be formulated as a nonlinear, integer mathematical program with 25,000 binary decision variables. To help network planners, GTE Laboratories developed a PC-based decision-support tool, NETCAP. NETCAP allows the planner to obtain near-optimal solutions to the planning problem, and it also provides a planning environment in which the planner can do what-ifs and can evaluate alternative plans. Nearly 200 network planners are using NETCAP, and GTE attributes to it cost savings in network construction costs in excess of $30 million per year.

The retail financial services (RFS) component of GE Capital (a subsidiary of General Electric) is the largest provider of private label consumer credit in the world. Delinquent balances (that is, credit accounts that are behind in making monthly payments) average about $1 billion at RFS; RFS expends over $150 million annually to collect this debt yet still had to write-off approximately $500 million of bad debt in 1990. RFS brought in management scientists from GE's corporate research and development to examine and improve their collection strategies. The result was the development and implementation of a user-friendly computer system, called PAYMENT, for discovering, evaluating, and comparing collection strategies. PAYMENT is designed to permit RFS to propose and experiment with collection strategies and then to determine the most resource-efficient strategy based on actual collection histories. PAYMENT has changed the way GE Capital implements delinquent consumer credit collections and has conservatively resulted in reducing losses by $37 million.

The enormity of the daily tasks performed by the United States Postal Service (USPS) is truly awesome: 500 million pieces of mail, in all shapes and forms, delivered daily to 100 million locations at the lowest unit costs in the world. How do they do it? The USPS relies on the largest civilian work force in the nation, along with the most advanced technology and systems for sorting, processing, and moving the mail. It also relies on management science as evidenced by its widespread deployment of META (model for evaluating technology alternatives) for capacity planning and evaluation of technology investments. META has been a critical tool in the development of the postal service's corporate automation plan, a plan to invest $12 billion on automation technology with expected annual labor savings of $4 billion. The implementation of the corporate automation plan should allow the postal service to continue to fulfill its commitment to meet the nation's needs for the full range of mail collection and delivery services at the least unit costs.

The invasion of Kuwait by Iraq in Au-

gust 1990 precipitated a rapid and strong response from a coalition of nations led by the United States. The military operations, first Desert Shield followed by Desert Storm, required the largest airlift in history: as of July 1991, 20,000 missions had first delivered over 800,000 passengers and 650,000 tons of cargo to the Persian Gulf and then subsequently returned the passengers and cargo to their home bases. The scheduling of these missions was performed by the Military Airlift Command (MAC). Within a few weeks of the start of Desert Shield it became clear that the automated systems in place at MAC were inadequate for the task at hand, and were jeopardizing the operation. A request was made to accelerate the implementation of the airlift deployment analysis system (ADANS), which was under development at the time by Oak Ridge National Laboratory. The ADANS development staff worked around the clock with flow planners from MAC and by October 23, 1990 ADANS was fully implemented as the scheduling system for MAC implementation. The subsequent success of the airlift and Desert Storm are now history as Iraq was driven out of Kuwait.

The past decade has been a very challenging and competitive time for the motor carrier industry as it has adapted to deregulation and to increasing demands for service from shippers. For instance, of the 20 leading less-than-truckload (LTL) carriers in 1979, only six remain in business today. One of the survivors is the last finalist, Yellow Freight System, which now handles over 15 million shipments annually through a network of 630 terminals. Key to Yellow Freight's success has been a large-scale interactive optimization system, SYSNET, which was developed to optimize the routing of shipments. SYSNET has evolved into a comprehensive planning system that is used in all aspects of the business. SYSNET has allowed Yellow Freight to discover and implement new operating strategies. In particular, Yellow Freight has converted from decentralized operating strategies, which suffered from being myopic, to a centralized operating strategy which permits Yellow Freight to coordinate flows system-wide. Annual cost savings are conservatively estimated at over $7 million; of more importance, Yellow Freight has been able both to reduce transit times and to improve service reliability to its customers.

All of the finalists deserve congratulations for their excellent work, and my thanks for their contributions to this issue. To all the volunteers who continue to make this competition a successful event, I extend my thanks and appreciation for their participation, inputs, and help. Finally, I need again to thank Mary Haight, not just for her contributions that turn the assorted manuscripts into a polished volume, but also for her patience with me.

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For a field like MS/OR to prosper we must continue to hone our technical skills and to draw from other disciplines to broaden our horizons. This Edelman competition demonstrates our ability to develop in both of these directions.

This issue contains several papers that

are important for their contribution to the technical strength of our field and for their novelty of application. In this category I place the papers by Stone on the search for the *SS Central America;* Braklow, Graham, Hassler, Peck, and Powell on the use of optimization in the movement of less-than-truckload shipments at Yellow Freight; Hilliard, Liu, Busch, Harrison, Kraemer, and Solanki on scheduling the Desert Storm airlift; and Cebry, deSilva, and DiLisio on postal automation.

The remaining papers combine MS/OR techniques with the tools of other disciplines. The yield management system at American Airlines, described by Smith, Leimkuhler, and Darrow, weds management science and economics with a big impact on the bottom line. The article by Ben-Dov, Hayre, and Pica on mortgage-valuation models at Prudential Securities is an example of how understanding markets can create an edge in a very competitive market. As described by Jack, Kai, and Shulman, GTE made the human being the focus of its decision support system for telephone system planning. GE's key consideration in its approach to consumer credit management was the effect on customers. Makuch, Dodge, Ecker, Granfors, and Hahn successfully integrated human considerations with quantitative analysis.

The participants in this competition have demonstrated the important benefits that come from using analytical approaches of MS/OR. Indeed, I suspect that the benefits from this competition alone have paid for all expenditures on MS/OR developments since the inception of the field. They also have demonstrated the ability to reach out to other disciplines to enhance the quality of their work. This ability to draw on this other knowledge is a healthy reminder of our early days as in interdisciplinary field.

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