

COMMENTARY



A New Horizon for OR/MS

ARTHUR M. GEOFFRION / *Decision Sciences, John E. Anderson Graduate School of Management, Box 951481, UCLA, Los Angeles, CA 90095-1481, Email: ageoffri@agsm.ucla.edu*

The Web creates important OR/MS opportunities, and the Bhargava-Krishnan feature article does an outstanding job of sketching some of them and of explaining the technicalities of how the Web can be used in the service of OR/MS. This commentary discusses briefly two points made in the article, and then calls attention to a new domain for OR/MS applications. This domain arises from a new and potentially large Web clientele for OR/MS that seems to have escaped notice to date: ordinary people. Satisfying this new clientele requires exactly the technologies explained by Bhargava and Krishnan. Doing so would pump new vigor into the field, directly benefit many people who use the Web, and help solve the long-standing public visibility problems of the field.

The Web as a Distributed Computer for Doing OR/MS

The Web may prove to be the most important marriage of communications and computation yet devised by man. The average Web-user is likely to be most conscious of the communications aspect. The authors make a point of emphasizing the other aspect, however, not so much because the Web vastly extends the computational power available to any user, but rather because of the advantages to be gained by distributed implementation of OR/MS applications. I want to add two more arguments for the importance of the Web as a distributed computer: it empowers dispersed practitioners and enables embedded applications.

A few years ago, just before the Web gained popularity, I surveyed the current status and major opportunities of OR/MS.^[2] Using the Web as a delivery medium for OR/MS applications contributes mightily to fully three of the five opportunities identified in that article, namely: ride the computer/communications revolution, support dispersed practitioners, and stress embedded applications.

The first requires no comment. The second fits because public Web access to OR/MS technology is very empower-

ing to OR/MS practitioners who are not in an organized OR/MS group and do not go to INFORMS meetings or read INFORMS journals, a population that may approach 90% of all OR/MS practitioners in the U.S. The third opportunity is exploited whenever an OR/MS application is made available through a Web server and/or Web-compatible client software, and is either offered or automatically invoked when it can be helpful. For example, a consumer visiting a large Web store might be offered wizard-style help based on a multiattribute choice model to help decide which of several competing products to buy. For another example, an optimization routine might be built into Web site operations software to optimize dynamically the choice of ads to be served from ad inventory each time a page is requested.

Suggestions for INFORMS

The authors suggest some ways in which INFORMS could help OR/MS more fully exploit the Web. The comments below reflect my recent experience as an officer of INFORMS.

The authors' suggestions for INFORMS are as follows (I take the liberty of embellishing them slightly):

1. to allow members to register their topical interests and request Email notification when pertinent information becomes available about such things as conference papers, job announcements, journal articles, professional news items, and special events;
2. to educate members via demonstration Web sites about Web technology useful for OR/MS;
3. to monitor developments in such technology and convey them to the membership;
4. to promote OR/MS interests to standards-setting organizations like the Internet Engineering Task Force and W3C by commenting on public drafts of new standards if not by direct involvement;
5. to provide a forum for discussing the design of the OR/MS-relevant custom markup languages that may soon be created under XML.

These are all good suggestions. Realistically, all but the first will fall entirely to volunteers rather than to INFORMS staff. To do it right, the first would need to be integrated with the new membership information system that likely will not be in place before late 1999, and would require extensive cooperation from the editors of INFORMS Online. The second may be a candidate for funding by the government, a foundation, or a vendor (or vendor consortium). The third and fifth could be undertaken by local meeting organizing committees or by a board-appointed task force. The fourth could be done by appointing external liaisons to pertinent organizations, under the new External Liaison Protocol adopted in 1997. Most of these activities could be coordinated by INFORMS' VP/Information Technology and certain subdivisions, namely the INFORMS Computing Society, the College on Information Systems, the Technical

Section on Telecommunications, and the Forum on Education.

I encourage anyone interested in any of these possible activities to contact me at ageoffri@agsm.ucla.edu, whereupon I will do my best to coordinate their efforts on behalf of INFORMS.

Electronic Commerce and the New Horizon

Electronic commerce (E-commerce) is growing explosively, and creates numerous attractive opportunities for OR/MS applications. I will sketch some of these opportunities here, based in part on my recent experience developing and teaching a new course on E-commerce.

When we think about sources of demand for OR/MS, we traditionally think of decision makers, managers, and policy makers, because these are the people who have requested, paid for, and benefited from it in the past. The advent of the Web changes the traditional situation in one very important respect: there is now a new class of potential beneficiaries of OR/MS—the general Web-using public—that need not pay for it directly because now, for the first time, many organizations have the incentive to do so on the public's behalf. This leads to a new, potentially large, and distinctly nontraditional domain for OR/MS applications.

Who will pay for OR/MS applications aimed at serving the general public? The many thousands of business-to-consumer Web sites now locked in mortal combat for the attention of visitors. Many of these could profit from adding OR/MS technology for the benefit of their visitors, as explained below. With annual budgets running into the hundreds of thousands of dollars, and into the millions in some cases, there should be room to support additional OR/MS-based features when a convincing case can be made that they would be useful to a site's visitors.

To see how this could work, we need to take a closer look at the strategic design of business-to-consumer Web sites. Each site seeks to attract and serve a more or less specific type of visitor (I ignore the relatively few that try to attract everyone). Most are driven by some mixture of these four missions.

- *Sales*: To sell products or services on-line
- *Image-Building*: To enhance public awareness and provide information to consumers, investors, potential employees, the public at large, or some subset thereof
- *Customer Service*: To provide post-sales support to customers, either to reduce service costs or increase overall customer satisfaction
- *Advertising*: To offer content or services that will attract large numbers of visitors, and hence support substantial advertising revenues.

One can infer about seven other missions from today's E-commerce landscape, but present purposes do not require mentioning them here.

Because of the effects of network externalities,^[3] many believe that a successful Web site must achieve a dominant share of the Web traffic within its particular market, even if this share must be built at the expense of substantial early

financial losses. The winner eventually takes (almost) all, with losers fighting over the scraps.

With so much at stake, most business-to-consumer Web sites are exquisitely sensitive to opportunities for competitive advantage in satisfying their visitors. This presents a big opportunity for the OR/MS community if it can deliver new interactive, and preferably personalizable, enhancements that do actually help Web site visitors. Let me elaborate within the context of the four missions listed above.

Sales. Every potential customer who visits a Web site that offers products or services for sale must decide whether and what to buy. In many cases, these decisions could be supported by models that address multiattribute choice, product configuration decisions (where there are numerous options within a given product or product line), lease-or-buy decisions (for big-ticket items), and simulated or predicted product performance for individual customers (e.g., personalized Monte Carlo simulation of the performance of a homeowners insurance policy). Perhaps the most fundamentally important applications in this context are the first mentioned, which fall under the rubric of Multiple Criteria Decision Making; more specifically, choice is from a finite, known set of multiattribute alternatives with deterministic choice outcomes. This is a well-developed area with many available methods.

Image-Building. The kind of OR/MS applications suitable to this mission depends on the target group. Potential consumers could benefit from the same kinds of applications as the Sales mission, even though no sales may be consummated at such a site. Potential investors could benefit from financial, forecasting, and planning models that focus on the sponsoring organization. Potential employees could benefit from simple but actuarially personalized models of health and retirement plan choices. The public at large could benefit from any kind of high-level (not too detailed) OR/MS application relating to the public welfare. For example, a health care business might sponsor a quantitative analysis of a public health-impacting bond on the next ballot, a utility company might sponsor strategic models of urban transportation systems or emergency medical systems in the metro areas it serves, a pharmaceutical firm might sponsor legislative policy models for air quality management or health care systems, and a law firm might sponsor criminal justice or law enforcement models. Besides showing civic-mindedness and impressing visitors, such applications could actually be useful to activists, volunteers, and public-service organizations.

Customer Service. It might seem that OR/MS applications in support of purchase decisions (see above) are not relevant here, but there are exceptions. Many products imply the regular purchase of consumables; for example, autos use gas and tires, cameras use film, and VCRs use rented video tapes. The customer service mission for these products would be advanced by purchase-advisory models for such consumables. Other products create a demand for complementary goods or services. For example, buying a camera may create a demand for additional lenses, a computer for a modem or scanner, and a stereo system for recorded media. Again, models that assist purchase decisions could be help-

ful. Probably the highest-impact OR/MS applications for a customer service Web site, however, are those tailored to the purchased product itself or to the needs of the kinds of people who make such purchases. For example, a modem manufacturer might offer selection models that help owners pick the best Internet service provider or long distance carrier based on their particular needs, a bank might offer a variety of quantitative tools for personal investment decisions, and a sporting goods manufacturer might sponsor a variant of the diet model aimed at nutritional planning for athletes.

Advertising. Think of any OR/MS application that could benefit someone outside of work, and it is a candidate for addition to an advertising-supported Web site that seeks to attract that particular type of person: A price forecasting model hooked to a price history database for some type of collectable (coins, stamps, etc.)? Offer it to a site that caters to that particular collectable; An acoustics model that permits optimizing the location of speakers in a room as a function of room design and listener location? Offer it to a site for audiophiles; An optimal training plan model for an individual sport or an optimal strategy model for a team sport? Offer it to a suitable sport-centric Web site. Armed with a list of hobbies and leisure activities and a good imagination, one can match many known OR/MS methods and applications to potential beneficiaries who, for the first time, can access them easily once they are on the Web.

This completes my discussion of the new horizon: business-to-consumer E-commerce on the Internet as a fertile new source of OR/MS applications directly serving the general public. There are more familiar horizons as well, including business-to-consumer E-commerce applications of more conventional type in which the organization or Web site itself is the beneficiary (the dynamic ad choice application mentioned earlier falls in this category).

There is also *business-to-business* E-commerce on the Internet and private TCP/IP networks, which at present is much more mature than business-to-consumer E-commerce.^[1] Many of the Web site missions found in the latter sector,

such as sales and customer service, also operate in this sector and offer similar OR/MS opportunities.

Additional OR/MS applications are arising on *intranets*, nonpublic TCP/IP networks accessible only within a single organization, and on *extranets*, nonpublic TCP/IP-connected intranets accessible only by small groups of closely cooperating organizations. An example of an application on an intranet would be a simulation designed by a central OR/MS group for use at several branch facilities. An example of an extranet application would be an inventory and production control system designed for use by supply chain partners.

Taken together, these network venues add up to vast opportunities for networked OR/MS applications using the technologies explained by Bhargava and Krishnan. Intranets and, to a lesser extent, extranets are destined to host many OR/MS applications during the next few years, initially of familiar types converted from existing applications, and then of fresh types. The Internet will also host a growing number of applications, with the potential for rapid growth if the new horizon described here captures the imagination of the OR/MS community.

If the community does respond and applications of the type sketched do proliferate, then for the first time ordinary folks in nonwork roles will experience personally the benefits of OR/MS. Not only would this be a valuable social good, but also it could go a long way toward solving the recognition and visibility problems that have plagued the field for decades.

References

1. U.S. DEPT. OF COMMERCE, 1998. *The Emerging Digital Economy*, Secretariat on Electronic Commerce, Washington, DC.
2. A. GEOFFRION, 1992. Forces, Trends, and Opportunities in Management Science and Operations Research, *Operations Research* 40(3), 423–445.
3. C. SHAPIRO and H. VARIAN, 1998. *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, Boston.