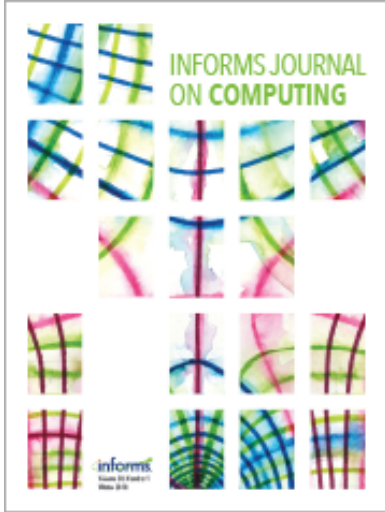




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COMMENTARY



The World Wide Web: It's the Customers

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The feature article by Bhargava and Krishnan does a wonderful job of outlining the current state of the Web and its future possibilities. The Web is an active and ever-changing place; providing a snapshot of the state of the art is not easy. In this commentary, I would like to concentrate on a group that the article does not cover in depth: the users of OR/MS. The number of users of OR/MS is vastly larger than the producers of OR/MS, and has been affected perhaps even more by the Web. I will concentrate on two types of users: those who do not know what OR/MS is but have found our community through the Web, and our students.

History

I created my first operations research oriented Web page in May 1994. My goal at the time was to have a page that had pointers to all online resources in OR/MS. I believe my first page had 30 pointers, the majority to FTP (File Transfer Protocol, a still-used method for transferring files without the Web's ease-of-use and interactivity) and gopher sites (a now archaic predecessor to the Web). Since then, Michael Trick's Operations Research Page (<http://mat.gsia.cmu.edu>) (MTORP) has grown to approximately 1,000 sites, and any hopes of completeness are long gone.

In the early part of 1995, INFORMS advertised for the founding editorship of INFORMS Online (IOL). The basic parts of IOL had been created by Jim Bean (then Vice President/Information Technology of INFORMS) and Mohan Sodhi from a gopher system set up in the previous year. On April 1, 1995, I became Editor of IOL, a position I currently hold.

INFORMS Online has experienced explosive growth in content. It currently contains more than 20,000 pages and uses a variety of search programs, utility scripts, and other programs to get information online quickly and accurately. Ten Associate Editors make this system work.

Explosion of Use

Perhaps more impressive than the explosion of content at IOL is the explosion of use of IOL. Before I discuss this growth, I need to say a few words about the information that is available from a Web server. Every time someone accesses a Web system, certain information can be stored about the access. This information includes which machine made the request, which file was asked for, the browser the person is using, and what was the immediately previous page accessed. For example, if I am looking at the Society page of MTORP and decide to go to IOL, IOL will find out my machine name (currently I do most of my browsing from a machine named cbi.gsia.cmu.edu), the page I wanted (IOL's [index.html](#)), the browser I am using (Netscape Communicator 4.05 for Windows 95), and the page I came from ([societies.html](#) on MTORP). IOL would not know my user name, nor would MTORP's server know that I had moved on to IOL.

Despite this rather basic level of information, it is possible to get a lot of information from the log files. Let's begin with some basic usage information. Figure 1 shows the weekly accesses of the main IOL page.

IOL is experiencing explosive growth in its use, from 200–300 accesses per week three years ago to 8,000–9,000 accesses currently. Furthermore, there is no sign of decrease in the rate of growth. IOL experiences two peaks per year at the time of INFORMS national meetings, but the base usage quickly surpasses the conference peaks.

This usage is particularly surprising when you consider that INFORMS has only approximately 13,000 members. Is it the case that every member of INFORMS accesses IOL once every two weeks? As I mentioned above, I cannot tell who are members when they access IOL because I have no user information. I do have machine information, and that can act as a useful, but not perfect, surrogate for user information. The key here is the relationship between machine names and users. When the first Web pages were put together, the relationship was clear: every machine corresponded to a user. In the beginning, the only machines that could access the Web were workstations, most of which sat on the desks of academic researchers. Each researcher used his or her machine to access the Web, so machines approximately equaled users. The situation today is much different. Many users coming from the same Internet Service Provider seem to come from the same physical machine (for instance, all American Online subscribers come from one of 116 proxy servers). Furthermore, many people access the Web through multiple machines. I use three different machines and two different ISPs to access the Web depending on where I am and which machine is handiest. Equating machines with users is a rough estimate at best.

Despite the inaccuracy of the estimate, there are still striking numbers embedded in the log files. In the period from April 5 through July 8, 1998 (94 days), approximately 125,000 different machines accessed IOL. This is a factor of 10 higher than the entire membership of INFORMS! Who are all these people, and why are they visiting IOL?

We can analyze the referring page information to get a handle on this. Ignoring internal references (one IOL page

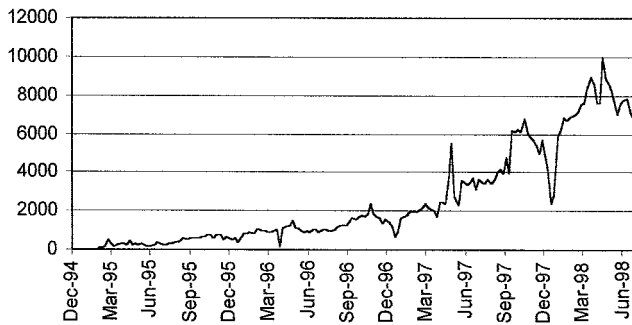


Figure 1. Weekly IOL home page accesses.

referring to another), the top nine referring sites are all search engines. A search engine is a Web site that specializes in pointing people to sites of interest. This can be done automatically (like at Lycos (<http://www.lycos.com>)) or by human design (like at Yahoo! (<http://www.yahoo.com>)). Lycos sent people to IOL pages 31,190 times in that 94-day period; Yahoo sent them 28,577 times. In contrast, the first nonsearch engine (and first OR/MS site) was MTORP, with just 2,801 references (although over 94 days, that still means about 30 people per day come in from MTORP).

Still closer analysis reveals that these people are, in 99% of the cases, not sent to IOL because they have a direct interest in OR/MS (which would be shown by searching on terms like Operations Research or Management Science). Rather, these people have an interest in something we do (and that interest is reflected in journal or conference pages). For instance, about 10 people a day find IOL because they did a search on Supply Chain Management using one of the search engines. Other hits seem more idiosyncratic. One of our most popular pages (hit 894 times in 94 days) is the page corresponding to a presentation Arnold Barnett gave at the Washington INFORMS meeting in 1996. The title of his talk was "The Affirmative Action Debate," and is found in a variety of searches. Given the wide variety of pages we have, particularly in the conference area where every session at a conference has a page of its own, it is not surprising that an IOL page can appear for almost every search phrase.

These are Our Customers

This brings me to my main point: the Web has made it much easier for those interested in what we do to find us, even if they have never heard of OR/MS. The Web is bringing our customers to us, and they come even before they know that they are customers. I do not know of any other cost-effective method we have to bring hundreds of thousands of responses to find out what we do.

Furthermore, this is a remarkable international group. In that 94-day period, users visited us from 116 different countries, ranging from giants such as the US, Canada, and Germany, to Papua New Guinea and Liechtenstein. Again, no other campaign INFORMS can put together can reach such a variety and depth of customers that the Web can.

Educational Aspects

The second group I would like to look at is our students. I have been using the Web as an adjunct to my courses since shortly after I discovered the Web, and I believe that the use of the Web has made me a more effective teacher.

I teach primarily MBA students in a business school that takes operations research very seriously. We have a one-semester required course in quantitative methods/operations research in addition to a semester of probability and statistics, and a semester of operations management.

The most obvious use of the Web is as an adjunct to teaching. For all my courses, I have a basic Web setup that consists of online notes, assignments, and a discussion area. Depending on the course, I may also set up a chat area. As Bhargava and Krishnan point out, there are a number of ways of hosting discussions and chats on the Web, including Java applets and more advanced features. I use a series of CGI scripts available at Matt's Scripts Archive (<http://worldwidemart.com/scripts>). These free scripts require some setup (and as Bhargava and Krishnan point out, significant server computational power), but can be used by any browser and are reasonably robust. The translation of course notes is more problematical, because operations research notes, by their nature, tend to be quite mathematical. I use a typesetting language called LaTeX, and use a free translator called latex2html (<http://www-dsdl.llnl.gov/files/programs/unix/latex2html/manual/>). The results can be seen at (for instance) <http://mat.gsia.cmu.edu/mstc>, where I have archived a course I taught in 1996.

Having course materials online has been a tremendous help and has made teaching much more pleasurable. However, the biggest effect on teaching for me has been in supplementary material for students.

Like all faculty in business schools, I am constantly faced with the question of relevance. How does what I teach in the classroom provide value to our MBA students? I find MBA students to be very hardworking and creative, but only once convinced of the usefulness of the topic. When they feel a topic is not useful, classes can degrade very, very quickly. For me, the best aspect of the Web is the ability to point to projects that used OR/MS. The online version of *OR/MS Today* (<http://lionhrtpub.com/ORMS.shtml>) consistently provides examples of the importance of OR/MS in the real world. There is no better way to make MBAs work hard than to tell them about, say, The Sabre Group's storied past in operations research (particularly in flight scheduling and revenue management) followed by pointing them to Sabre's Web pages describing their activities in more detail. The final kicker is to remind them that the company is interviewing on campus. Suddenly linear programming looks a lot more interesting!

Implications for Professional Societies

In keeping with the tone of Bhargava and Krishnan to provide helpful advice to professional societies on their roles in the Web, let me conclude with some advice and suggestions.

1. Many people first find out about OR/MS through Web pages. Professional societies have a responsibility to en-

sure that they find useful information, ideally by ensuring that they see Society pages.

2. Society pages aimed only at members and their needs will only meet part of the goal; there must be services and information for the novice also.
3. Societies must recognize that the Web recognizes no national boundaries, and that the customers the society Web

pages attract come with a wide variety of resources, skills, and interests, and the pages need to be flexible in providing relevant information for all.

4. Societies should ensure that the best examples of the work of their members are easily available online to inspire students and provide guidance for those in the field.