◆ *Acceptance of Award on Behalf of CrossRef*

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I'm delighted to be at my very first Council of Science Editors meeting. I hope you will forgive me for a lack of humility in accepting this award on behalf of the individuals at CrossRef. I think I'm safe, you see, because as one of the newest members of the CrossRef staff, I had absolutely nothing to do with the success of CrossRef over the last 10 years.

Success it most certainly has achieved. Since the first organizational meeting at the Frankfurt Book Fair in 1999, 10 years ago this coming October, and its launch in June of the following year, CrossRef has grown from a collaboration of 33 publishers and 1,100 journals[1] to a strong membership organization with almost 700 voting members that represent more than 2,700 publishers and societies in sciences, in social sciences, in humanities, and in professional fields. Digital object identifiers (DOIs) for 20,000 journals and 75,000 books have been created.

But it isn't just the numbers that mark CrossRef's success. It is the simple fact that readers—be they researchers or consumers, students or faculty—now have a better experience when exploring the scholarly and professional literature. It is hard to imagine now, but 10 years ago, there was little reference linking from journal to journal. And what there was came at high administrative and technical costs. I know this all too well, because at the time I worked for an aggregator of secondary or abstracting and indexing databases, and my job was to persuade publishers to sign bilateral linking agreements that would allow us to link from our bibliographic records to the full text of articles at the publishers' Web sites. At the time, there were perhaps 4,000, perhaps 7,000 electronic journals—we didn't even know.

You all probably appreciate more than most that it takes publishers time to enter into these kinds of alliances. Those of you who are associated with societies routinely navigate complex political systems that do not lend themselves to quick decisions, especially in developing technology and business models. Ten years ago, publishers still spoke of cannibalization of their print revenues. Yes, they were putting their journals online, but they weren't 100% sure that they really wanted to optimize users' experiences once they got there.

Into this mix came CrossRef. The impact on scholars was immediate. The commute to the physical library for literature searches became largely unnecessary. For publishers who wanted to link, life was simpler. Now you needed to sign one contract with one set of rules, one set of obligations, and one metadata data-transfer format.

Perhaps it is an occupational hazard of consultants (and I was one for a number of years), but I find myself asking what the critical success factors have been for CrossRef. I ask this not to bore you with irrelevant history but to provide a case study that you may be able to apply to your own organizations.

So what makes CrossRef work?
- A vision for a better scholarly communication process.
- Sufficient initial funding and fiscal restraint.
- People—board, staff members, and committees.
- A culture of innovation and flexibility.
- Standards.
- Cooperation among some-time competitors.

Vision
The publishers behind CrossRef had an idea—a good idea. Now ideas are a dime a dozen, as I tell my husband every time he tells me that he had the original idea for the fax machine, the GPS, or some other piece of now-indispensable technology. How did CrossRef actually come into being rather than becoming another good idea that died on the vine?

People like Bernie Rous from the Association for Computing Machinery (ACM) were involved. Bernie is an old friend of mine. He was my first boss in scholarly publishing, before the ACM Digital Library was real. Bernie was a wonderful mentor, but more to the point, the man is both a visionary and a complete hound for technical details about how things work.

Bernie thought, in those days, that we should individually tag the components of our citations (author, title, journal title, volume, issue, page number) because someday we would or should be able to get citation statistics and information about cited-by relationships and incorporate links to related materials. I left ACM in 1994, long before CrossRef was thought of, so you can see how far ahead of the curve Bernie was. He has been active on the CrossRef board for the 10 years of CrossRef's existence.

But it wasn't just Bernie. It's people like Bernie in many, many publishing organizations who came together to see if they could actually make such a thing happen.

Funding and Fiscal Restraint
CrossRef's initial funding came from loans from eight of the founding publishers. Ed Pentz, our executive director, through good business decisions, has ably managed the finances, paying off loans not only on time but ahead of schedule. CrossRef remains fiscally stable even in the current difficult climate.

People
CrossRef has made an enormous contribution to scholarly communication because of the involvement of a dedicated board, committees like our Technical Working Group, and a small, yet phenomenal staff.

The founding board members included people like Eric Swanson from Wiley and Pieter Bolman from then Academic Press. Other founding publishers included
- The American Association for the Advancement of Science (the publisher of *Science*).
- The American Institute of Physics.

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- The Association for Computing Machinery.
- Blackwell Science.
- Elsevier Science.
- The Institute of Electrical and Electronics Engineers, Inc.
- Kluwer Academic Publishers (a Wolters Kluwer company).
- *Nature*.
- Oxford University Press.
- Springer-Verlag.

Even in looking over that list of names, you can see that the scholarly publishing landscape and who belongs to whom have changed over these 10 years. But CrossRef remains a viable organization.

Many of the founding members had been involved in a collaborative reference-linking prototype called DOI-X that was demonstrated for the first time at the Frankfurt Book Fair in 1999. It was at that demonstration that the large science–technology–medicine publishers saw the potential of the prototype and decided to form the Publishers International Linking Association, which does business as CrossRef.

The founding members were all primary publishers, but they were not all the same. Some were societies, some were commercial organizations. That diversity has expanded. Only primary publishers can be CrossRef members, but libraries, secondary publishers, online hosts, and other technology providers all have a role to play in the organization. Among publishers, the diversity has expanded to include the smallest single-journal organizations, nonscientific disciplines, and publications representing all business models—subscription, open access, completely free. And we have expanded beyond journal linking to include books and major reference works.

I wanted to take a few minutes to talk about the people on the staff. Many of you know or know of Executive Director Ed Pentz, Director of Technology Chuck Koscher, and Director of Strategic Initiatives Geoff Bilder, who are very much in the public eye. I need to also mention my friend Amy Brand, who is here today and until her recent departure for Harvard University was responsible for the growth in membership and new products and services.

You may be surprised to learn that there are only 11 people on the CrossRef staff, so let me mention the people you may not be as familiar with but who contribute in innumerable ways to CrossRef's success: Susan Collins, Patricia Feeney, Lisa Hart, Tim Pickard, Jon Stark, and Anna Tolwinska.

One of our newest staff members is Kirsty Meddings. If I may be permitted a plug here, Kirsty will be moderating an excellent panel on plagiarism screening tomorrow, which I encourage you to attend.

It isn't an accident that these people are at CrossRef. CrossRef treats its employees well. The pay is competitive. The benefits are generous. The working environment is one of respect while allowing for disagreements and challenges.

We are a quasivirtual organization. We have two offices—one near Boston and one in Oxford, tethered by that wonder of internet technology, Skype. We have a policy of allowing, even encouraging, employees to work remotely a few days a week. People can choose their own technology—we're half Mac and half PC, and yet we still talk to each other.

These policies attract and retain talented people.

CrossRef hires good people but hasn't been afraid to fix hiring mistakes either. Excellent performance is expected.

And CrossRef has been smart about outsourcing work—to consultants, to technology vendors—rather than staffing up. This keeps the organization lean, efficient, and responsive. Two examples in the room are people from Atypon and Inera, both of which have been involved with CrossRef since the early days.

Culture

CrossRef also has a culture of innovation and flexibility. As early as 2002, CrossRef was exploring services beyond reference linking. CrossRef Search was its first foray into expanded services. For a variety of reasons, this service didn't hit the level of participation and success that we've seen with reference linking. I mention it only because if we are to have a culture of innovation, failures must also be an option.

CrossRef's business models have also evolved. One key reason for the successful uptake of reference linking is that there is no direct charge to the end user. Indeed, the service can be completely invisible to the researcher, who is reading an article, skims the references, clicks on a link, and goes to the relevant paper, probably without knowing what a DOI is at all. (Of course, we'd like to change that.)

In the early days, CrossRef charged publishers for depositing metadata and assigning a DOI (we still do) and for looking up DOIs. To encourage linking, CrossRef long ago discontinued the query fee.

Publishers pay on the basis of their relative size and the volume of material they publish (to be precise, the volume of material they deposit). A committee of members reviews the fee structure regularly to make sure that the fees reflect the principles of the organization, maintain fiscal responsibility, and provide market incentives to link to member content.

Standards

Clearly, standards are an important success factor. The key technological infrastructure that serves as the engine of reference linking is the DOI. The DOI is a current National Information Standards Organization standard and is working its way through the International Organization for Standardization process. CrossRef is one of 10 registration agencies (RAs) that can assign and maintain DOIs.

Reference linking is the "killer app" of DOIs, but it isn't their only use. Indeed, RAs are now beginning to use the DOI for new applications, like an actionable international standard book number (the ISBN-A).

CrossRef also relies on other standards, such as XML for DOI deposits and queries. Our OpenURL resolver allows researchers to be directed to the appropriate copy of content for their institutions. This interface has grown in popularity among researchers

and libraries in ways that were not originally envisioned, and CrossRef is devoting resources to ensuring its robustness.

Challenges for the Future

That's a lot. In the session I just attended, John Wilbanks, of the Creative Commons, drew an analogy between reference linking and tin cans connected with string. But we aren't finished. CrossRef is beginning a major system rewrite to ensure that our technology can keep pace with the growth in activity. We have launched new services, like cited-by linking, whereby publishers can show the content that is citing their own materials, and CrossRef Metadata Services, whereby organizations that want to display and link to publishers can receive bulk distribution of our metadata.

CrossRef's mission statement talks about trustworthy content, about cooperation, and about technology. Our newer initiatives build on the success of our cross-publisher collaboration with reference linking.

CrossCheck, which you can learn more about tomorrow, addresses important issues of publication ethics in a world in which copying without attribution is both easy and, increasingly, prevalent.

Further down the road, we are working on CrossMark, an initiative to "mark" the authoritative version of a work, which may also be able to carry metadata important to the publisher—things like funding sources or references to clinical-trial databases.

Contributor ID is a plan to extend the concept of unique identifiers from content to people. It may solve the problems of single sign-on, disambiguation, and name variations and enable analysis of sophisticated people relationships and mapping.

The Key Is Collaboration

Such organizations as CrossRef and the Council of Science Editors give us all important opportunities to collaborate—to transcend our own personal and organizational limitations to do what is best for the scholarly community at large. Collaboration isn't always easy. Competitors have their own agendas and priorities, as they should. A free and open marketplace for information is essential.

CrossRef provides an example for us of how cooperation despite differences can change our world for the better. And isn't that the reason most of us went into publishing to begin with?

Reference

1. Brand A. CrossRef turns one. D-Lib. 2001;7(5). [Internet.] [cited 29 May 2009.] Available from: www.dlib.org/dlib/may01/brand/05brand.html.

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