Networked journals – a shift of paradigm in scholarly communication

Tore Brattli
University library of Tromsø
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1. Introduction

The ongoing revolution

Digitalization of information together with the new opportunities to transmit documents directly from producers to consumers is about to cause a revolution in the information society, scholarly communication included. Many consider this the most important change since Gutenberg's invention of the movable type printing press in the mid-fifteen century, which made a revolution in written communication [Giles96].

The last decades we have seen a revolution on the metadata side. References are now organized in networked databases or other information services, in a way that makes it much easier for users to become aware of relevant information.

The next decades the time has come for the information itself. Especially journals are now being available on the Internet in large numbers. This will make it possible for users aware of articles, to fetch them in matter of seconds independent of where they are located, and print them out or read them on the screen. Users will have access to more information because it's available, more user-friendly and much faster than before. For authors the new technology makes it possible to "publish" their results available for all potential users without the help of publishers, libraries or other intermediaries.

A threat to institutions and functions

The new opportunities may become a threat to the traditional institutions handling journals and to important journal functions like quality control, archiving and academic credit. It's therefore a lot of work going on in the scientific community to secure these functions and in the institutions to redefine their tasks. This situation, which reduces the amount of work to be done and also changes it, has led to a "battle" between the participants where it seams like they try both to secure their position and to take over some of the others work tasks.

Many publishers, subscription-agents and other information providers are now trying to become both "digital libraries" and reference databases in addition to what they did before. Libraries/library organizations are trying to expand with "digital libraries", reference databases and agent services. In addition, they are joining in consortia to leverage bargaining power against the publishers/agents. Even groups of scientists have now begun to publish their own networked journals, without the help of publishers, agents or libraries.

The author and the reader - the two only important participants

The problems with this fighting is that the products introduced isn't necessarily what the users (i.e., the scientific community) wants or is best for scholarly communication. Many of the new services show signs of being temporarily. They are far from optimal, they change often and they don't fit into the routines in most libraries. Library users are often very traditional in the way they retrieve and use information and they would certainly not want to change the way they do this often. Orsdel98: "In the struggle to keep revenue streams intact, publishers and vendors are developing new strategies with agility and speed, forging innovative partnerships as they go. The result is a confusing array of choices and limitations that have librarians wondering if the electronic revolution is leading them where they wanted to go."

In a time of change like this, it's important to keep in mind the main goal of scholarly communication: that is to communicate high quality scientific results between scientists, both immediately and across centuries. The institutions involved in this communication, like publishers and libraries, are merely service providers that only have value as long as they effectively contribute to the main goal. When considering future solutions it's therefore naturally to look at what best suits the scientists, both as authors and as readers. In this paper, we will discuss some of these issues and the focus is on the formal communication through journal articles:

- In what way are networked journals fundamentally different from journals on paper?

- What new opportunities does these differences introduce?

- How can the new opportunities improve and make scholarly communication more efficient?

- How will this affect the institutions handling journals?

Our goal is to become better aware of what is coming and at the same time "make sure" that the revolution end up at the right track with products and solutions that best suit scholarly communication.

Definitions and use of concepts involved in this subject

The changing world of information has brought us many new concepts, some more appropriate than others. The problem is often that new concepts are connected to short-lasting technology instead of the actual function, which is presumably better. The reason is often to promote the new technology. An example of this is the concept CD-ROM databases, which denote the first reference-databases on the CD medium. After some time, they were put into jukeboxes out of sight for the users. Today many "CD-ROM databases" remains, even if they are stored on hard disks in the library or at the publisher, and accessed through the network. In addition, there are also different opinions about what to understand with even the most basic concepts.

We have therefore chosen to use the following concepts (when possible) instead of what may be the standard in this subject:

- Network instead of Internet or World Wide Web (WWW): The important is that something is connected and accessible, independent of location. Today everything is Internet and the WWW is actually a communication protocol.

- Networked instead of online: Everything is online today and the word has lost its meaning. Networked should normally also imply digital.

- Digital instead of electronic. Each word has its supporters, but the important here is the coding of the information and electronic is anyway an unfortunate choice.

- Networked journal instead of digital journal. For most people today, digital journals are only interesting as long as they are networked.

- Journals instead of full-text journals. All journals are by definition full-text. Non full-text journals are references.

- Full-text databases should be article databases.

In addition, we will define a journal is a steadily growing collection of articles, founded with the expectation of unlimited duration, managed by some kind of editorial and with the goal to disseminate new knowledge about the real world, often limited to one or more subjects [Osborn80]. We further define a scholarly journal as one that "*dedicates virtually all of its space to reporting research and scholarship or reviewing research and scholarship...*" [Giles96]

A networked (or digital/electronic) journal is a journal that has its content available through computer networks. We see no reason to make restrictions regarding availability on other media like paper or microfilm. Some even suggest that a networked journal must be fundamentally different from traditional journals i.e., that networked versions of paper journals would not be networked journals [Roes95]. We don't agree and stay to a broad definition. It's not wise to mix the change of media with the traditions in scholarly communication. Networked versions of paper journals will start realizing their potential when time is ready.

For the rest of this paper, some readers may be confused with way the concepts article and journal sometimes are mixed. As we will see later there is a possibility that future networked journals will appear more as specific article collections, focusing on the articles. The new opportunities for self-publishing also makes the difference indistinct. Both words will therefore be used, each where they suits best.

2. The past, present and future of scholarly journals

The first journals

The publishing of scholarly journals began in the end of the 17th century. Several journals started up around the same time and Journal des Saçvans (1665) is supposed to be the first [Kronick76]. The reason why journals did appear is probably a combination of several factors and must be seen in light of the ongoing scientific revolution around the 17th century.

At that time scientific results were mainly communicated orally or through letters and books. Books were expensive and few could buy them. They also took long time to write and publish. Letters were faster but also more difficult to spread to a wider audience. There was a need for channel of communication that could spread information fast and widely.

In addition, new discoveries were often hidden or described in private jargon, obscure language and in a way that complicated or prevented reproduction. There was a need for a universal comprehensibility in science, which required better precision in language and willingness to share scientific methods. Scientists also had to be sure of their data and this required independent and critical confirmations of their discoveries. The growing volume of scientific information put heavy strains upon old institutions and practices. There was need for more structure and organization.

To manage this situation scientific societies were established, where scientists could meet to examine, discuss and criticize new results and old theories. To provide a common basis for these activities the societies began to publish scientific papers. The Royal Society's Philosophical Transactions (1665) was one of the first such professional scientific journals and it soon received both recognition and prestige [Encyclopaedia Britannica].

So out of the communication in the early societies emerged the scholarly journal with its functions and form as we know it today. Science historian John Ziman: "*It is extraordinary to consider that the general form of a scientific paper has changed less, in nearly 300 years, than any other class of literature except the bedroom farce.*" [Osburn84].

Journals today

The publishing of journals expanded greatly in the 19th century as new fields of inquiry opened up, and old ones divided further into specialties. The number of scientific journals has increased from approximately 800 around the year 1800 to 9000 around 1895 and 50.000 in 1950 [Osburn84]. Today, after more than 300 years with journals, it's estimated that the number of scholarly journals is more than 100.000.

Even if the number of journals increase, it doesn't necessarily mean that each scientist publish more. A survey in the period 1975-1995 [Tenopir98] from USA shows that the number of journals, articles and scientists increased respectively 62%, 85% and 117%. This means that the actually was a decrease of 25% in journals and 15% of articles per scientist. In spite of this, the number of pages published per scientist increased almost 70% and authorship per scientist from 1,0 to 2,1 per year. The explanation of this is more co-authors and longer articles. The number of articles read each year by scientists increased from 150 to 188 in the same period.

Journals are now the most important form of scholarly communication, especially in science and technology. It's the main archive of primary research information, basis for further research and source to academic credit for scientists.

Digital networked journals

Journals in digital form have been under development since 1976, but their non-experimental phase didn't begin until the 1990s (with a few exceptions). Real operational networked journals are essentially a phenomena of the 90s. The first peer review networked journal, The Online Journal of Current Clinical Trials, started in July 1992 [Harter98]. From that time, the number has exploded.

A survey in beginning of 1996 identified 115 peer-reviewed networked journals [Hitchcock96]. In January 1998, 30% (900, increase of 237 over last year) of the titles in Science Citation Index was available in an Internet version (24% of Social Science Citation Index and 10% of Arts & Humanities Citation Index) [Orsdel98]. "Founder of NEWJOUR[1] the e-list of new e-journals, estimates that there are now over 8000 refereed on-line journals" [Harnad98]. Most of the larger publishers now offer networked versions of their journals in addition to print. Only a very few of these earlier paper journals are offered in digital form only. More usual is it for newly started journals to appear in digital form only. D-lib magazine[2] and Psycoloquy[3] are examples of this. So we can definitely say that networked journals are coming and fast.

Of 2200 e-journals in the EBSCO database (256.000), about half comes free with print subscriptions and the rest cost between 10-20% extra [Orsdel98]. There is so far not much to save by subscribing to the networked versions only. How this will change is difficult to tell. Stephen Harnad, the founder of one of the first networked journals, believes that networked publishing should save 70% [Harnad98], and many agree with him. Most publishers on the other hand say no more than 10-30% [Bot98] [Tenopir98] [Varian97]. Networked journals may on the other hand considerable reduce work and space in libraries and in this way save a lot of library expenses [Varian97].

The issue of copyright is also an unresolved question. In the beginning, most publishers offered restrictive conditions regarding use, ownership and inter-library loan, but when libraries didn't agree to this, they had to relax them according to the standard for paper journals. As we will se later, there are strong indications that the conditions again will be restricted.

So do people use networked journals? The world changes so fast that it's difficult to find relevant surveys on this issue. The first impression was very little. However, that doesn't mean it will remain like that. Networked journals are to a very little extent integrated into library procedures, and for the scientists to change the way they retrieve information takes (long) time. However, the impression at least from our library is that the use has increased considerably since the beginning of the new millennium.

The future

Most experts in the area of journals now believe that networked journals in relatively short time will become the main medium for scholarly journals. Robert Bovenschulte from American Chemical Society's publications division [Wilkinson98]: "electronic journals are going to take over in the long run, no sooner than five years, but not longer than 10." Peter Boyce, senior associate in American Astronomical Society predicts 3 years. At the University library of Tromsø networked journals has already taken over. If networked journals will replace paper journals completely isn't a very interesting question in this connection.

How networked journal will be different from paper journals and which consequences this will have for authors, users and the institutions handling journals will be discussed later in this paper.

The question about whether the article will remain a practical unit or form for communicating scientific work is also interesting. Some say that the whole concept of an article will change, but there is no reason to believe that this will happen in a long time. The ongoing revolution is first of all a technological revolution that will change the way we publish, store and retrieve articles. The article itself is more dependent on how the scientific world is organized with tradition, recognition of authors and qualification. The new technology has opportunities that may change the concept of

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[1] http://gort.ucsd.edu/newjour

[2] http://www.dlib.org/

[3] http://www.cogsci.soton.ac.uk/psycoloquy/

an article, but changing a long lasting scientific tradition will take very long time (if at all), and is not within the scope of this paper.

3. The functions of journals and participants involved in traditional scholarly communication

After 300 years with scholarly journals, most scientists agree that they serve four chief functions: quality control, dissemination of information, archiving and academic credit [Rowland97]. There is also consensus that if networked journals is going to replace traditional journals, these functions must carry on as before. To ensure that the four functions actually occur today, there are a number of task that have to be done by a number of institutions.

Research and documentation

Research: The starting point for all scholarly communication is research. Of course, all modern research is highly dependent of previous scholarly communication, earlier research and so on, but some place we have to start.

Documentation: To make research useful it has to be documented. Otherwise it will soon be forgotten and in any case not available for others. To document research someone must write about it and in most cases, it's naturally that the scientists themselves do this job. Especially in research areas where time is an important factor, a journal article is the type of publication used. With articles, it's possible to publish even minor discoveries relatively fast.

Review and quality control

When the article leaves the author, it has to be checked and made ready for publishing.

Peer review: First the article must be reviewed to ensure that the work has sufficient quality and significance to be published (at least in that specific journal). The reviewing process must obvious be done by independent peers. Today this job is managed by the publisher who selects recognized scientists from different institutions.

Recognition of research and authors (prestige): Recognition of authors is connected to peer review and has to do with the level of quality (significance, originality...) which the journal sets for acceptance of articles. The higher quality the article has, the more prestige it receives. This is dependent of how the publisher (at least today) manage to get the best articles, make a good journal, sell many issues, have many (important) readers and receive many citations.

Date stamp of content: In addition, the journal works as a "time stamp" institution that connects scientific work, scientists and time. This makes it possible to decide in disputes concerning who was first. Normally this is the date the article first was received by the journal.

Language and layout: When the article is accepted, its language and presentation form must be corrected and updated to the journals standard. This requires both subject- and language specialists. At last, the layout must be upgraded, but this doesn't necessarily require topographic skills, since journals often use standardized layouts.

Distribution

When the article is accepted and corrected it must be grouped together with other similar articles and published.

Printing: The articles can now be printed as a journal issue and this is done by printing offices.

Dissemination: The issue now has to be sent out to all the libraries and individuals that subscribe to the journal. This is done by postal services.

Subscription services: Part in this distribution are institutions that coordinate subscriptions and do accounting. Especially libraries subscribe to many journals from many publishers. By purchasing in large numbers, agents simplify the task and make it cheaper by acting as a mediator. In this way a library only have to relate to a few publishers/agents, receive one bill and in addition pay less.

Organization

Local collections: In addition to some scientists private collections, it's mainly libraries that have local collections of the most relevant journals. Local collections make the journals available for users.

Awareness tools: In addition to journals, there are systems and people both locally and externally that organizes information about journals and articles. Abstracting and indexing services makes it possible to become aware of relevant articles without having to read all journals. This is of course especially important for journals not locally available.

Archiving: Traditionally it has been the libraries that archive journals for the future. Publishers do only store journals as long as they are commercially interesting and that is normally just a few years. The national libraries often have a special responsibility for its country's material.

Use

User education: Information search and retrieval is a subject in its own and requires education to make good results. This is an important task because the world is changing fast and because the trend is that the users do most searching themselves.

Services for articles not available locally: For articles not available locally, the users need services/institutions that can obtain the articles they want based on references.

Reference services: Subject experts that can help users find the information they need

Using articles in further research: The articles discovered and received may now be used as a basis for further research. The ring is connected.

As we will see later, not all of these tasks are necessarily needed with networked journals and some may be done much more efficient.

4. Computer networks and digital information - the basis for the revolution

The Internet revolution

The combination of the Internet, WWW and digital information is about to make a revolution in dissemination, awareness and retrieval of information. The most important reasons for this are the solid technical infrastructure, user-friendly and powerful information tools and many users.

The Internet is the large quantity of computers connected in a client/server environment using the TCP/IP[4] network protocol to transfer data. This infrastructure, which has evolved since 1970, has managed the enormous increase in users, computers and information surprisingly well and show no sign of weaknesses or limitations.

The information tools that really started the revolution are as a generic term called the World Wide Web. WWW was developed around 1990, and is a set of protocols which makes is possible to:

- Address all documents on the Internet (URL)

- Request for and transmit documents on the Internet (HTTP)

- Format and connect documents (HTML)

In addition, we have programs that can

- Display documents (Web-browsers)

- Make documents on computers available on the Internet (Web-servers)

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[4] Transport Control Protocol/Internet Protocol

In particular it was the Web-browser Mosaic from NCSA, with a graphical user interface, that speeded up the revolution and brought it out to the public. Mosaic arrived in the end of 1993 and was the last (important) piece of a big technological puzzle, which made it possible for the Internet and WWW to start realizing their potentials.

On the Internet the WWW functions as a distributed information system where multimedia-information may be retrieved from different places and displayed without the users having to think about where it's coming from, how it's stored and in which formats. Information from different sources may easily and elegant be seamlessly integrated through hypermedia/hypertext. This also applies to document formats other than HTML (and protocols other than HTTP) by using modern Web-browsers with plug-ins or functionality to redirect downloaded files to other computer programs. For search and retrieval, WWW has options for powerful functionality like surfing, menus, predefined searches and search fields.

The WWW has made it possible for anyone to publish information available for the whole world and to retrieve information that others have put out, independent of location. This makes the WWW a powerful and user-friendly information system with unbelievable opportunities.

For a distributed information system, it's necessary with more than infrastructure and information tools. Spreading (of the system) and sufficient information is equally important. For the WWW, the situation was special, since most of the tools were non-commercially developed and could be freely downloaded. Together all this led to a spreading (and a standardization) in a speed and extent that the world earlier never have seen before. First in the universities where the Internet was "free" and the idealism were great to create and put out information available for others. Then in the rest of the society, when enough information was available for people to pay for it.

The situation today

Today the WWW/(Internet) is closely integrated with most computer software. It's the network backbone that makes it easy to send, download and present messages, files (in all formats) and software. It's also well integrated into most parts of society like education, mass media, trade and marketing.

Some of the problems with the change from paper based to digital medium has been issues like copyright and archiving, because digital information is so easy to copy and so easy to loose. But there is no turning back now and solutions will definitely arrive.

Many people also claim that the net is more or less just a low quality chaos where everything is free. Well this depends of how you look at things. Quality should be medium independent and today you have to pay for much of this information. The lack of organization is true, but much of the same information existed before also and then it was even more difficult to find anything. So in a way organization has actually improved! However, like before the Internet, you still need to know where to find organized high-quality information.

The important new with networked information

In addition to obvious advantages like user friendliness, increased speed and reduced cost, the important and fundamental new with networked information (in combination with information systems like the WWW) is location independence. This means that it doesn't matter where the publisher, the organizer, the retriever or the documents are located. Not even the documents have to be located at the same place (i.e., collected).

Everyone may organize

Everyone may organize documents (on different locations) into effective virtual collections. In fact traditional physical organization will "disappear" and virtual organization (database search, hierarchical subject indexes, lists, etc.) will become the only organization of networked documents. It has no meaning to browse through the actual physical memory of computers. The WWW also makes it easy, even for third parties, to make new information-services by integrating other information-services.

Everyone may publish

Everyone may publish information and effectively disseminate it to all or to well defined groups of users. Information may actively be spread by e-mail or more passive using search engines or subject-indexes.

Everyone may search and retrieve

Everyone may easily and effectively search for and retrieve relevant documents among all the documents available on the net.

No need for collections

With virtual collections and direct access to documents independent of their location, there is no need for collections or other kinds of intermediate storing (except from caching maybe) for documents to be (locally) available.

Journal articles share the same properties as Web-pages

Journal articles are very similar to "normal" Web-pages both when it comes to size, content and structure. They both consist of headings, text, images and references (links) to other articles/Web-pages. Most articles should therefore be possible to transform into Web-pages by encoding them in HTML. There are still some problems with mathematical typing, but this is likely to improve. It's also possible to use other formats like PDF, which now functions much the same way as HTML. Some encode articles as images, but this prevents or makes linking more difficult.

This means that journal articles may be digitized[5] in different ways and made available on the WWW/Internet. Digital networked journal articles also share the most important properties that Web-pages have like text, graphics and linking (references). Therefore the important new with WWW and Web-pages, also should apply to networked articles.

The WWW as a model for networked journals

Many people are wondering how the world of networked journals will function and look like in real when the revolution settles. This is of course difficult to predict, but we strongly believe that there already exists an excellent model: the World Wide Web. Because the WWW could evolve freely (without intervening from libraries), it soon reached an (so far) optimal model of how to store and organize information in networked environments. Examples are intermediate storing and collections, which is fundamentally different on the Internet. There is no need to collect Web-pages or to store them in a "library". Web-pages are stored on servers depending on who owns them (publishers, authors, institutions...) and users access them there. Reference databases like AltaVista (or Chemical Abstracts for articles) perform the task of organizing the Web-pages so it's possible to retrieve them. Subject indexes like YAHOO, local information specialists and the user may supply more specialized organization.

Differences between traditional and networked journals

If we assume that the concept of an article will remain, at least in the predictable future, the differences between traditional and networked journals are connected to the opportunities that computer networks and digital journals opens up. Together with computers, user-friendly software to transmit articles between computers and tools that can filter out relevant articles, networked journals may be handled and appear fundamentally different from traditional journals.

Instead of storing each journal in 500 scientific libraries worldwide, they can be stored at their respective publisher. There is no need for collections and the journals don't have to be close to the users. It's also possible for one single institution to organize journals and articles in a given subject and serve the rest of the world. The articles may contain different media types (image, film, sound, etc.) and links to other articles, commentary and additional information.

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[5] Most new articles are originally in digital form

On the other hand, networked journals may be treated almost similar to traditional journals. A library could purchase digital versions of paper journals from publishers and store them in local databases. Virtual collections can be made available for the users by linking the OPAC to the local networked journals. This may be a perfectly working solution even if it's limited and quite inefficient.

Copyright, payment and preservation of important journal functions

Important journal functions like quality control, academic credit and archiving has actually little to do with the digital coding or networked communication. If they are threatened it should be no problem to protect these functions and it definitely will be done. "Details" like copyright, access control, licensing, will be solved and adjusted to something optimal in between what the participants are willing to give and take.

New opportunities with networked journals

- Authors and publishers may easily serve all potential users directly.

- Users may search for and retrieve the desired articles directly and immediately independent of where they are located.

- Everyone may organize journals/articles into effective virtual collections.

- Linking and media types (image, film, sound, etc.).

Transformations of fundamental traditional practices

The consequences of these new opportunities are that networked journals may change and they may also be handled different from traditional journals.

Networked journals doesn't require intermediate storing or physical collections

With the Internet, producers of information can serve the consumers directly. Both scientists, publishers and libraries (or other mediators) may now serve all the users directly. Journals don't have to be stored intermediately or locally to be available when needed. Another consequence is that journals don't have to be physically collected (maybe except for them you own or have the copyright to). With networks, it doesn't matter where the information is located and it doesn't have to be at the same place. The physical collections may be replaced by logical collections (e.g. reference databases, bibliographies and so on)

Transition from journals to article-databases

Today's journal issues are to a large extent just a wrapping of articles. To speed up publishing, networked journals may publish articles as soon as they are ready. A journal will then be the same as a specific collection of articles. It's likely that the concept of a journal will remain for a long time as article-databases, but the concept of volume and issue will probably disappear [Roes95], [Giles96], [Wilkinson98] and [Hitchcock96].

Transition from subscription to pay-per-view and access to everything

With networked journals and articles, the users in principle will have immediate access to "everything". The earlier significant difference between having and not having will decrease and reduced to a question about money. Some journals will probably be available through subscription, the rest through pay-per-view using effective payment-protocols or mediators (like Telenor for telephone). Pay-per-view is the standard everywhere else where it's possible to measure use of products, like electricity or the telephone. The system is also more fair, especially for small institutions and companies. You pay for what you get.

An interesting consequence of access to everything is that the library-catalog will be superfluous. Another is that the scientific "World Wide Web", where it's possible to "surf" from article to article, finally may be a reality!

5. New opportunities, practical solutions and consequences for today's mediators

Which tasks will survive and who are going to do them?

The revolution in information technology has given new opportunities for the participants in the information chain. Significant parts of scholarly communication may now be done more efficient and other parts different from before. This is likely to have consequences for the participants involved.

Traditionally it has been the scientist writing articles, the publishers publishing them and the libraries making them available for the users. In addition, we have agents that manage the libraries journal subscriptions with different publishers and reference databases that organize information about articles.

With networked journals, it's not obvious which tasks that still will be needed and who are going to do them. This has led to a situation where it seems like the participants are trying to secure themselves by "biting of more than they can chew" or having skills for. Some e.g., agents, are now trying to run both reference databases and libraries, when all they did before was manage subscriptions and writing bills.

- For authors, it's now possible to serve every user directly, leaving out publishers, agents and libraries. With Internet search engine technology, they can even collaborate about reference databases.

- For publishers it's also possible to serve the users directly, leaving out agents, and libraries.

- Many mediators (agents) are now trying to become both libraries and reference databases

- Libraries are talking about publishing local material, leaving out publishers and agents. The libraries are even a threat to themselves with the making of large cooperations to save expenses when negotiating with publishers.

This situation has led to a battle where the outcome is hard to predict. As mention earlier, the problems with this fighting is that the products introduced isn't necessarily what the users (i.e., the scientific community) wants or is best for scholarly communication.

There are at least two reasons why we should engage our selves in the future of scholarly communication. The obvious is to be prepared for what's most likely to come, but most important is that we can rethink every task from author to reader and hopefully end up with the best possible solution according to some main goal. The main purpose of scholarly journals is to communicate science from scientist to scientist. When considering future solutions for scholarly communication, it's therefore naturally to focus especially on optimal solutions for these two groups: the author and the reader.

The important questions are: which functions are still needed, who should do them and how.

The authors

Traditionally

Authors have traditionally published their articles in journals with as much prestige as possible. Often this has been commercial journals with peer review run by publishers. This system recognize authors by having journals that filters articles according to quality (significance, originality...) and at the same time documents whom did what at which time. In addition, articles in high prestige journals are often more read and receives more citations, which again increases the prestige for the author. Prestige is the important journal function for authors, because it's so closely connected to promotion in academic institutions and as a measure of productivity between institutions. The drawback with this system has been too much dependence on publishers, expensive journals and relatively slow publishing.

With networked journals

Because prestige is an important part of the academic world, it's no reason to believe that this will change with networked journals. Authors need prestige, so the question will be how to make high prestige networked journals and who can do it. Research [Harter98] show that networked journals so far has little impact on use and citations and too many draw the conclusion that networked journals has no future in scholarly communication. The problem may be that networked journals are defined too narrowly, as something new, special and fundamentally different from the traditional paper journals. These journals are often just started (on a new medium) and naturally have low prestige. There will of course be high prestige networked journals in the future. Most of them will probably be networked versions of today's traditional paper journals run by commercial publishers and scientific societies.

However, for authors the new technology also opens up other alternatives to publishers. They may publish their articles without using commercial publishers, it can be done faster and it with interesting opportunities like discussion and open review.

Self publishing

For significant articles that for some reasons doesn't reach or get accepted by a journal, authors (or hosting institutions) may now publish them without the help of publishers. With the new information technology it's quite simple to create effective (unrefereed) systems for self-publishing. Authors could for example send in [Ginsparg96] or report their articles to special propose scientific search engines that index them and make retrieval possible. To ensure authenticity, i.e. connect the article's content, author and time published, it's possible to use cryptographic techniques for authentication. An independent institution could be responsible for this task and it could be done more or less automatic.

The problem with self-publishing is that we mainly have to rely on the integrity of the author(s) when it comes to the quality of the results presented. Also the border between formal and informal publishing may be weakened and the question of prestige must to a larger extent be handed over to judging committees in connection with promotion.

Esoteric publishing

A more organized form of self-publishing is described by Stevan Harnad, where scientists in very specialized areas may publish their own peer reviewed journals. This mode of "esoteric" [Harnad97] publishing may be an interesting alternative in areas where there doesn't exist any journals or where the journals are very expensive (because of few readers).

Additional material, response and discussions

Networked journals also offer new opportunities for authors to present additional material (more detailed data, software, etc.) related to the article, links to references/citations [Wilkinson98] and to receive response from readers. Because space is limited in journals, years of research is often presented in 10 pages, leaving out much interesting. This can easily be included in networked journals. The same applies to comments from readers that can be attach to the articles and function as a form of open peer review [Harnad].

Authors don't want to be publishers!

There is no reason to believe that scientists want to become publishers, but if they have to, they now have the opportunities. It will become more difficult for publishers to claim unacceptable terms and prices, but prestige will still rule. On the other hand, publishing must cost and having professors doing the job doesn't necessarily make it cheaper. The issue of quality also indicates that publishing should be done by independent institutions like publishers or scientific societies.

What is sure is that authors will continue to publish their articles in the journals that gives the highest prestige and it doesn't seem very likely that their institutions will try to change that. Only if authors or research institutions can produce high prestige scholarly journals or change their criteria for promotion, this may change.

On the other hand, there may be more difficult to get publishers to publish articles with little commercial interest, because transition to pay-per-view. Articles will be published more dependent of their sale potential i.e., like books. More and differentiated use of page fee is also possible.

The consequence of all this is that the relation between the author and the publisher will become healthier, especially regarding to copyright, preprinting and price. Despite that, there will probably be more publishing outside the traditional publishers.

For the authors of scientific articles it's reason to believe that the transition to networked journals will be an advantage.

The publishers

Even if networked journals opens up new opportunities for authors to publish themselves, it's still reason to believe that independent publishers (and scientific societies) are the best institutions to do publishing. They know publishing, they can ensure high quality, and they may after all be best suited to perform (or manage) independent peer review. Nevertheless, there will now be more competition on issues like copyright/licensing, price, speed and most important the production of high-prestige journals. Traditional commercial publishers and scientific societies may be the best here.

Some probable changes for publishers:

- The publishers will become digital libraries that distribute its journals directly to the users. However, as today we can not expect publishers to archive journals/articles longer than they are commercial interesting, so archiving must be taken care of independently.

- More sale of single articles (pay per view) and price-differentiation between groups of users dependent of size. When journals are not collected locally there are no reason to pay for more than what is used. Better pay-protocols should make this feasible.

- With more pay per view, publishers might be more interested in collecting the commercial salable articles. Other articles may be more dependent on page fee. Of course, this might introduce a problem between the commercial interesting versus high quality research.

- Time is an important factor in scholarly communication and today's delay of up to a year or more is not acceptable. An idea here for publishers is to start their own preprint-servers and publish articles in "beta-versions" immediately after they are accepted. In this way the articles are early available and may compete with other preprint-services which often represent a problem in relation to copyright. The publisher can sell them as usual and when the final version is ready, it could be sent to the owners of the beta-version free of charge. Similar preprint-servers are now offered by Elsevier[6].

- Transformation from journals to article collections

- New media types, links to additional material, response to and discussion around articles.

- More flexibility in number of articles and their length. Some even say quality by introducing editorial rating [Varian97].

- More restricted copyright, especially for libraries.

We believe that traditional publishers will continue to play an important role, also after the transition to networked journals.

Abstracting and indexing services

Traditionally

While libraries often have limited themselves to organizing their journals, abstracting and indexing services have played a very important role in the task of organizing the articles. They have produced or collected references to articles limited to subjects or in general, indexed them and made them available in reference books or databases.

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[6] http://www.elsevier.com/

With networked journals (and networked reference-databases)

Reference-databases will definitely continue to play an important role in the task of organizing articles. With more and more articles, the need for high quality indexing and abstracting services will increase. The great change for these services is that the references will be integrated with the journals with direct links to networked articles. This will fundamentally increase the user-friendliness and reference-databases will become virtual libraries. Otherwise, access and pricing issues will develop in the same direction as for networked journals.

Computer based reference databases have moved from online searching to single user CD-ROM to local network CD-ROM. Now it seems like the trend is returning back to online searching again, but now with the users performing the searching. With fast networks, user-friendly network search programs (WWW/Java) there are no good reasons for libraries to keep local copies of reference databases unless they want to do something with the data e.g., tailor-made presentations for their users. If AltaVista with its full-text cataloging of 100 million Web-pages can manage to serve the whole world in just a second, this should be possible for reference databases too.

The pricing policy will also change. With new simple and secure payment-protocols, it will be easier to differentiate between customers, making it feasible to serve everything from single users to large institutions at a fair price for each. Both the single-user marked and the small institutions marked have great potentials. So far it have been quite unfair that small institutions must pay the same as the large ones. Mediators (agents) may also here play an important role.

For the traditional producers of reference-databases there will be competition from both library-organizations (like OCLC), agents and with the new technology, also from user-produced databases or search engines. With the increasing amount of articles available, high quality indexing, user-friendly intelligent search interfaces that produces high precision and recall, flexible search options and last but not least the right content, will be important. The traditional producers should have all the opportunities for continuing their work also with networked journals.

Agents and other mediators

Traditionally subscription agents have acted as intermediates between the publishers of journals and the reference databases on one side and the libraries or the users on the other side. This mediation has been especially useful for libraries because they have been let of much of the work with subscription management in addition to receiving cheaper journals.

Many "experts" are concerned regarding the future of agents, but we strongly believe that there is a need for agents with networked journals. The reason for this is:

- There will be many journals and reference databases

- There will be many publishers

- There will be many institutions and users

The agents will do, as they always have done, coordinate access between different products and different users, perform access control, monitor use and write invoice. The agent will work as the trusted mediator between publishers and users (or institutions) in a way that makes it possible for every user to access every article, journal or reference database and receive one single bill. With networked journals and articles, the users will have immediate access to everything. All the user (or his institution) need is an agreement with the agent, the publisher or is willing to pay-per-view.

On the other hand, there is no reason why agents or other intermediates should keep collections of journals, run reference databases as some are now trying to do, or do archiving as some has suggested. Journal packages like ProQuest Direct or information services like SwetsNet doesn't quite fit in to the world of networked journals and the agents don't necessarily have the expertise to manage them. This also applies to some of the products from library organizations like OCLC and Pica.

Libraries

There are many indications that libraries will experience the most negative consequences of the transition to networked journals. The reason is that several of the most important functions in

libraries are based on having collections of journals locally available. As we already have discussed, this is not necessary with networked journals. In fact, it's quite inefficient. But there are also other problems approaching:

End of the open library?

Traditionally[7] most libraries have been open to everyone who wants to visit and use them. In a digital networked environment, the libraries on one hand will be more open (accessible) to their primary (registered) users, but on the other hand more or less closed to all others because of copyright regulations. Copyright is difficult to combine with open networked libraries. Especially for public libraries this may have major implications. Who will buy a journal if you can easily "borrow" it from a networked library. So the libraries future problems are more than the technology threatening to make them superfluous, it may also be illegal to keep them open.

The same will apply to inter-library loan. At first most publishers tried to be restrictive, but when libraries didn't agree, they had to accept the traditional interpretation of "fair use". In the future when libraries are "addicted" to networked journals, it will probably become restrictive again. It's difficult to loan digital material and inter-library loan has no meaning in a digital networked environment.

Collections

Today libraries must deal with issues like:

- Acquisition of networked journals (Price, Single journals or in packages, Consortia agreements, Lease or own)

- Cataloging networked journals

- The life of networked journals together with traditional journals

However, in very few years collections will be reduced to not more than old journals, local materials and library specialties. We will have a shift from collections to licensing. Access to "everything", journal packages and national agreements will also reduces the process of selection and administration in each local library.

Archiving

With networked journals, it's possible and probably better to separate the functions of collections and archiving. The collections (in use) will in most cases be located to the publishers or producers of articles. One solution is that the archive function is taken care of by the national library in each country, especially its country's material. Even if the national library archives "everything", only the material that is not commercial interesting could be made available for the public.

Locally each library will archive no more than local materials or specialties for that library. With networks, it has little meaning that for example small Norwegian libraries should archive foreign journals for the future.

Organizing information, user education and guidance

Even with high quality networked reference databases it's reason to believe that the need for local organization will remain. This is an important function of today's libraries and it will also be needed in the future. Users or groups of users have different needs and this requires tailor-made organization, which is difficult to produce externally. The need for local organization is one of the reasons why it's important for users to be able to make direct links (bookmarks) to both journals and articles. Some journal packages and publishers don't allow this today. Parts of local organization may also disappear. With access to everything, the library-catalog is in danger of being superfluous.

User education/guidance is likely to be an important function in future "libraries" because the amount of information is increasing exponential and the users now have to do most of their searching themselves.

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[7] At least the last 100 years

However, to do both this tasks it's essential to be close to the scientists. If not, any subject specialists may do this job. Over the last decade in many countries, we have seen a centralization of libraries. Expensive technology has led librarians to believe that fewer larger libraries are more cost effective than many small. This is true, but there is a problem connected with this "doctrine". The use is declining with increased distance to the library. With networked journals, this trend will grow even stronger. The solution must be to decentralize libraries. The users want information specialists nearby. Therefor the talk about future libraries as information centers is not a good idea. There is no center for information. Networked information is distributed, but the local information specialists must be close to the users.

Other tasks/new tasks?

Libraries may become publishers of important but not commercial interesting material or start digitizing old paper-based material [Treloar99]

The users

For the (privileged) users, the transition to networked journals will improve the access to information considerably. Important issues like speed of publishing, awareness, availability, retrieval, user friendliness and other benefits will improve.

Logical organization and awareness tools

For many users the most important source for becoming aware of relevant articles are not the journals themselves, but rather references to articles. The organization of references is therefore of great importance to scientists.

Traditionally users have become aware of relevant articles by:

- Browsing reference lists in similar articles and books (both paper and digital).

- Searching abstracting and indexing services like reference databases and alert services (both paper and digital) and collections of reference-databases like Dialog[8].

- Searching OPACs or other journal-lists for relevant journals in the local library or available on the Internet.

- Receiving hints from colleges.

- Browsing/reading journals (both paper and digital).

With networked journals, the process of finding relevant references will probably not change that much. The metadata-revolution is well underway and we should have a good impression of what the future will look like. There is no reason to believe that the process of collecting articles will (or should) change fundamentally with networked journals or technology. However, it may finally be possible to realize "article surfing" i.e., surfing from article to article linked together (both ways) in the scientific World Wide Web.

The search systems will hopefully increase their recall and precision, be more automatic, intelligent, intuitive user friendly and offering more options (e.g. full-text-searching).

A consequence of the new technology is the possibility for scientists to collaborate about joint networked reference databases covering articles related to research projects or single subjects. In this way, all the private databases around will increase their value and decrease the updating effort for each scientist.

Physical organization and availability

For a long time, journals will be a mixed environment including networked journal, paper journals and other media like CD-ROM and microfilm.

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[8] http://www.dialog.com/

Traditionally the physical organization of journals has been taken care of by libraries. The journals have been placed in shelves alphabetically or by subject and there are often shelves for the recently received journals. For articles not available, libraries may perform interlibrary loan.

With networked journals, there is no need for physical organization (at least designed for the users). There is no need to put the journals in a specific order or even to collect them together. Physical organization will be replaced by logical organization i.e., reference databases or bibliographies so the essential question is therefore availability. Reference databases may become important interfaces to the future virtual libraries.

Digital references linked to networked articles: Digital article-references in books, articles, reference databases, alert-services, e-mail or otherwise must be linked to networked articles if they exist. It's therefore important that information providers doesn't restrict the possibilities to make links to their journals or articles, as some of them do today. For all practical instances this also imply that it's best with only one copy of each document at fixed locations.

Access to all networked articles (and reference sources): With all reference linked to networked articles there must of course also be access to all networked articles. A possible model may be our telephone companies, where it's possible to phone everywhere and receive only one bill. For a university this imply open access for all users to some articles, open access to more expensive articles for a limited group of users and access to all other articles through an article "switchboard". In addition each user may have an "article account", which limits the total use. Because articles may cost a lot of money, users must accept to get some kind of local approval each time or as an account. Payment models may be subscription, user initiated pay-per-view or library initiated pay-per-view. Access control may be through IP-address (stationary) / password (mobile), mediators or "VISA"-cards. The same system can be used for access to reference sources. In the beginning library catalogs (OPACs) may be linked to networked journals, but as said earlier, with access of ALL networked articles the traditional OPAC has no meaning and may disappear.

Easy handling of non-digital references: It's also important for users to have systems that can handle non-digital references. There should exist a catalog that covers paper-journals available in or through the local library and a network-based ordering system for such articles.

User interface

Ideal it should be possible to search for both articles and journals in the same database using one single standardized user interface. In reality, we know that it so far has not been possible to collect everything, even references and even in one single subject, in one database. It has also shown difficult to standardize search interfaces, references and layout of journals and articles. The reason why does obviously not relate to technology. Do today's journals and books to look the same?

It's therefore likely to believe that it also in the future will be differences in the presentation of information. In a period of revolution like we now are going through, it may also be an advantage with differences because too much standardization prevents advances. Possible solutions are to standardize the structure of the information (e.g. SGML, Z39.50). This makes it possible for a user to search different databases at the same time and to present information the way he/she prefers.

Comments and discussions

Networked journals gives new opportunities for both authors and users to add information, comments, and reviews and to discuss issues relating to the articles. This is actually very interesting and may add value for both authors and users.

6. Summary

The transition to networked journals is well under way and we have already passed the point of no return. There is no turning back now. Networked journals are fundamental different from traditional paper journals in several ways. One of them is that they are location independent. That means that it doesn't matter where they are stored or organized and they don't need to be collected to be locally available. Together with efficient payment protocols or mediation services, this makes it possible for users to have access to every article directly from digital references in databases, articles and bibliographies.

This may become a threat to institutions handling journals, especially journal libraries. The new information technology has also made it possible for authors to publish articles without the help from publishers, agents and libraries. Hopefully this will lead to a healthier marked, because there now are more alternatives. If one "player" doesn't do his job its possible to leave him out.

However, the important issue will still be how to make high-prestige and high quality journals and we believe that the traditional journals run by traditional publishers will play a central role here. The new media doesn't change that.

What's left then is archiving for which there must be established new routines. Our suggestion is that the national libraries have a special responsibility for its country's material.

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