Thinking in Electronic Terms

prepared for
Socioeconomic Dimensions of Electronic Publishing Workshop:
Meeting the Needs of the Engineering and Scientific Communities,
In Cooperation with IEEE's Advances in Digital Libraries '98
Santa Barbara, California, April 23-25, 1998

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Abstract—What will emerge as the dominant design(s) of the "information package" of the future? How do we resolve major obstacles to the creation and utilization of electronic documents? What concepts, terms, and design principles need to be defined to discuss these questions meaningfully and to start answering them? What do these new concepts, terms and design principles mean in editorial and publishing practice? Drawing on the experience of developing *Living Reviews in Relativity*, an innovative online journal for physics, this paper will discuss these latter questions. The paper will highlight some of the information needs *Living Reviews* fills and explain how the principles guiding its design attempt to meet those needs. These design principles are "synergy", "adaptability", and "utilizability" of information. In addition, the paper will discuss a basic assumption that, rather than having readers, *Living Reviews* has *users* for whom we are providing a research *tool*. Combining that perspective with the fact that we are offering (literature/research) review articles, and with the fact that we are working in an electronic environment which allows multiple forms of indexing and presentation, we have decided to treat our reference information as highly significant. The paper will discuss how we treat this information as significant, and the impact we expect this treatment to have.

I. INTRODUCTION

A. Starting Points

The main work of this meeting involves two importantly related tasks:

* discussing the identity and features of the scientific and technical information package of the future
* discussing ways to get to this package

In support of this work, we'd like to discuss *Living Reviews in Relativity*. *Living Reviews* is a solely online physics journal we have been developing at the Max Planck Institute for Gravitational Physics in Potsdam, Germany.

The journal went online in January 1998 (URL: www.livingreviews.org).

Living Reviews is, at least we like to think, an innovative project. The project is innovative in that, in building our journal, we have tried to create something solely for the World Wide Web, something solely electronic.

This starting point means that we have had the chance to think in new terms, terms not so influenced by a paper publishing model. It is that thinking in new terms that we would like to discuss today. We have had the chance to examine, with no background investment in the answer [1]: *What can a scholarly journal be in an electronic publishing environment?*

We would like to share some of the concepts, characteristics, and functionalities which we have come to in pursuing this question. In discussing what a journal can *be* in an electronic publishing environment, we hope to shed some light on the identity and features of the scientific and technical information package of the future.

Before we enter into a discussion of our work, we'd like to say that we're not advertising *Living Reviews in Relativity* as the "scientific and technical information package of the future." Rather, we involved with the project think *Living Reviews* is an interesting, helpful, and hopefully well-made **step down the road** to this package.

B. What is this Step? Some Aspects of the Journal Project

Living Reviews in Relativity is a physics journal which appears only on the WWW. The journal is a free resource to the scientific community. We publish articles for scientists working with relativity theory, that is, with the theory of gravity devised by Albert Einstein. Articles published in *Living Reviews in Relativity* are overviews of research conducted in a specialized area, for example, detection of gravitational radiation or the study of black holes.

In physics, articles offering a survey of current research in the field are called review articles. Review articles have a unique, and key place in relativity research. Since it is a key point in understanding the purpose our journal, we want to highlight the place of the review article in relativity research.

Research in relativity theory moves rapidly. In addition, the field is strongly affected by developments in other disciplines (such as astronomy, mathematics, high-energy physics, and computer science). *Due to the interdisciplinary*

and dynamic nature of the field, amassing a comprehensive, up-to-date, central bibliographic database of literature pertinent to relativity *has so far* proven intractable. Given this, relativity researchers *depend on review essays* that offer critical analyses of key literature and explain the significance of important research results. The review article, as something which offers analysis and synthesis of reports of new research in the field, is an important resource in relativity research. *The review article becomes the closest thing scientists working in relativity have to a centralized, specialized database of references relevant to their work.*

Articles offered in *Living Reviews in Relativity*:

- are invited pieces (Our Editorial Board invites authors.)
- are peer-refereed
- are kept current by their authors
- contain bibliographic references that are keyworded by their authors and put into an archive which is searchable online
- incorporate "multimedia" aspects, such as movies, (for example, simulations of the effect of gravitational waves on black holes), and color images
- incorporate links to other online information (These links are particularly important because they allow us to provide access to articles available in other online journals and in the Los Alamos Preprint Archive (URL: xxx.lanl.gov), a main, free source of much of the latest physics results and writing.)

That articles will be kept up-to-date by their authors is a particularly unique feature of *Living Reviews in Relativity*. Review articles, and indeed information about what is happening in a given research area, are often only as helpful as they are current. This is particularly the case in a dynamic, quickly developing field like relativity. When authors agree to write for *Living Reviews*, they also agree to update an article as its subject develops. This potential continuing relationship between an author, his or her coverage of a topic, and the journal is something unique to electronic publishing. (We will discuss this point more later in this paper.)

In developing *Living Reviews*, we have tried to put together a solid, good idea, one that is practicable. Part of the practicality of *Living Reviews* is trying to maintain minimal publication costs. One of the ways we are trying to minimize publication costs is by creating article processing and journal maintenance tools which are semi-automated. After editorial work is complete, the preparation of an article, and its references, for placement in the journal is handled mostly through Perl scripts. We are building Java-based tools which provide an efficient interface to these scripts. In addition, maintenance of the site will be automated through these Java-based tools. (A typical maintenance task is, for example, validation of all links to external information sources made in articles.)

C. Users

An overarching concept in our work, one that greatly affected us starting out, and one that is a natural outgrowth of thinking in solely e-terms, is that we have always thought of ourselves *not* as having readers, but as having users. The main impact of this concept has been that we have considered the journal, throughout its development, a potential **research tool**, something which could *utilized*, actively, and in a variety of ways, by working scientists.

We mentioned above our key development question of: **What can a journal** *be* **in an electronic publishing environment?** In considering ourselves as having users, and in considering the electronic journal as a research tool, we naturally came to a partial answer to this question: In an electronic publishing environment, a journal can become a multi-faceted, dynamic information resource, a tool, utilized by researchers.

"Multi-faceted, dynamic information resource." The phrase has a nice ring to it. But not to remain on the level of word play, we'd like to get into what this phrase means. That is, we'd like to offer some thoughts on: What does such a thing look like? More aptly put, we would like to discuss "What characteristics can an electronic journal – as an online information resource, as an online research tool – have?" This question is part and parcel of one of the questions key to this workshop: *What is the scientific and technical information package of the future?*

II. CHARACTERISTICS OF THE E-JOURNAL AS A RESEARCH TOOL

Important to note when looking at this question is that we need to think about the characteristics of online information resources on two levels. We need to think about characteristics related to the nature, and thus to the quality, of the information presented in the electronic resource [2]. We also need to think about characteristics related to the organization, features and layout of a resource. Of course, needs or potentials regarding ensuring the nature and quality of information affect a journal's organization, features, and layout. And journal organization, features, and layout can affect the nature and the quality of the information presented. So maybe instead of levels, we are better to think of them as interlocking rings

Drawing examples from *Living Reviews in Relativity*'s design and concept, we want to outline and explain 3 main characteristics of the electronic journal as an online research tool. The interlocking themes of nature and quality of information and of organization, layout, features are embedded in each of these characteristics.

A. Synergy of Information

It goes without saying that there is an ever-increasing plethora of information available through electronic means and print. Electronic journals can bring order to the potential chaos which results from having so much information readily available. E-journals can do this by linking together various methods of scholarly communication in one, peer refereed, forum. E-journals, as research tools, can make the plethora of information available to scholars more accessible. This can be achieved by the way an e-journal integrates other electronic information.

In developing *Living Reviews*, we spent a lot of time considering how an e-journal can integrate other electronic and print information available to scientists. This led us to the following questions: W*hat identity and role can an e-journal have in this particular area of scholarship? What relationship can the e-journal have to other print and electronic resources?*

Living Reviews in Relativity publishes overviews of what is happening in relativity. As we designed the journal, we knew that we did not want *Living Reviews* to replicate existing publishing efforts. Logistically, putting together a new, electronic publication which would directly compete with already well-established print journals made little sense. These established journals provide a valuable service and meet an existing need by publishing original research and, in many cases, by effectively using the WWW to deliver their articles. Additionally, we did not want to compete with existing electronic resources, such as the Los Alamos Preprint Archive. This archive, as well as many other physics WWW based information sources, are generally well organized, efficient, and provide the relativity community with valuable and much used resources.

We wanted to create something which would add to the value of these existing resources. We wanted to provide something which would be a *new service* to the relativity community. Concentrating on *synergy* as a design principle, thinking about the *identity and role* the e-journal could assume, and considering its *relationship to other print and electronic information sources,* we saw that the greatest potential service to the scientific community would be in providing a publication which would build on, and integrate, rather than replicate, the system of print and electronic resources already available to physics researchers. We also saw a way to meet relativists' need for a central place from which to approach the literature relevant to their field.

B. How is the information in Living Reviews *synergistic?*

In discussing current research in a field, review articles naturally point to the important references in that field's literature. We have encouraged our authors to expand this activity to also incorporate references to appropriate online materials. In *Living Reviews*, a reference to another paper is often directly linked to the electronic, Los Alamos version of the paper. Authors also reference, and then provide links, to

articles in online journals, to online simulations, to the web pages of various groups, and to other resources.

By offering review articles, we have created in *Living Reviews* a forum in which contemporary research and information sources are set in an evaluative context. By offering electronic overviews of the field, we provide not only current coverage of the field, but also **evaluation and organization** of print and electronic information sources. We can link anything online to a *Living Reviews* article. So, in many cases, we also provide active entrance points into information resources.

Concentrating on *synergy of information* as a design concept, we have been able to situate *Living Reviews* as a key part of a complex information system which includes both print and electronic resources. The journal has a central role in this system. This role is multi-faceted. It is organizational, evaluative, and educational. Authors are able to select, explain, and link (in both hyper- and conceptual senses) the most important research and resources in the field.

If an e-journal is to assume this organizational, evaluative, and educational role, if the e-journal is to become an active, central hub in what we might call an integrated, interdisciplinary scientific information system, we need ways to ensure that the e-journal's content is of high quality. In *Living Reviews*, we try to ensure this in at least 3 ways:

- Authors/articles are invited by our international Editorial Board.
- Therefore, a qualified expert is doing the selecting, explaining, and linking of research and resources.
- The articles, (and the result of the author's efforts), are refereed by at least 2 peers.

C. Adaptability of Information

Overviews of research, particularly in a dynamic, fast-changing, interdisciplinary field like relativity, have the most value when they are current. And links to online resources are only helpful if the links are up-to-date. Fortunately, in an electronic publication authors can "easily" augment, or modify, their articles to keep them helpful, growing, and current.

What does "easily" really mean here? Well, it means that, once an author has moved through the important stage of deciding what to write, the actual modification of an electronic text takes little time. Placing a new or a modified text on a web server is not a time-intensive process. In this sense, keeping information current can be "easy".

Of course, I have to note that this potential mutability and evolution of information is problematic. Information living on the WWW is in some cases transitory. This brings up serious questions regarding how to go about archiving information, and about how to ensure the consistency of that information.

D. How is the information in Living Reviews *adaptable?*

Our journal went online this past January. Already we have updates of 2 articles planned. In both cases, authors have come to us and asked to update. The authors desire to update comes from 2 sources. They feel that they are not using our format as well they could be. They also feel that certain recent developments in the field, developments which have happened in only the last 2 months, are important to convey to journal users.

Authors write their articles in LaTeX, part of the TeX processing system commonly used in science. In producing *Living Reviews,* we take an author's LaTeX source, proof it, and then convert it, through a series of Perl scripts, to our WWW presentation format. For updating their articles, authors edit the most recent LaTeX, *"Living Reviews* proofed" version of their document. In the case of the 2 planned updates, authors will be changing their original texts significantly and adding wholly new information. Because of this, their updates will be considered new articles from an editorial perspective. These updated articles will therefore go through the peer-referee process again.

Living Reviews is published in yearly volumes, and within each volume, we assign each article its own publication number. The publication number is unique and is built as follows: YEAR#-name. So, for example, 1998-1rovelli, 1998-2anninos, 1998-3reula, etc., etc. The publication number becomes part of the article's URL.

Articles which have been updated in a significant way (for example, in the 2 cases noted above, where the articles will go through the refereeing process again), will be assigned new publication numbers. For archival purposes, we will keep all versions of articles available. However we will distinguish updated versions from their originals. We will note in our index which publication number is the most current version and make this version the main access point to our coverage of the given topic.

E. Utilizability of Information

Why use the almost-word *"utilizability"?* Why not something less grammatically challenging, like "usefulness" or "utility"? We thought about "usefulness", but it seemed to connote something being of "practical use, serviceable, helpful." We thought about "utility", but it seemed a more general and abstract term with respect to commodities and services. Neither of these terms seemed dynamic enough to capture an important characteristic of the e-journal as a research tool.

"Utilize" moved us in the right direction by calling to mind just that – movement, activity, employment, of a resource. In invoking the term *utilizability,* we want to call attention to the fact that, in an electronic publishing environment, documents become like databases. They contain a variety of information which can be prepared, stored, presented, searched, and utilized in multiple ways. When we set *utilizability of information* as a design goal, it helped us to remember the fact that, when a document is prepared, stored, and presented electronically, the potentials for integrating, categorizing and offering the data it contains are greatly enriched. The job of the electronic resource developer is to think about how to make the variety data within a document, and within a document collection as a whole, accessible and meaningful.

F. How is the information in Living Reviews *utilizable?*

There is one main example we would like to bring up here. It revolves around how we have chosen to process references connected with *Living Reviews* articles. We feel that any reference cited in *Living Reviews* has gone through 3 tiers of quality assurance:

- Authors are invited experts.
- Authors select the most important references.
- Peers referee the article.

Thus, when working with a *Living Reviews* article, users know that they have access to current, quality bibliographic items. As information resource planners, we realized that the bibliographic items contained in *Living Reviews* articles were key information, information of high value to our users. This insight in tow, our question became: What could we, as developers, *do* with this information? How could we make it meaningfully accessible to our users?

We made a decision to have authors keyword each reference cited in their articles. References cited in *Living Reviews* are collected into what we call the *Living Reviews Reference Archive*. This archive contains all references cited in the journal. The archive is searchable online by a number of criteria: Author, Keyword, Title, Journal, Year, and Published Format. Search results can be viewed on the screen (in one's Web browser), or they can be mailed to the user directly. Search results can be mailed in a variety of formats: Plain text, BibTeX, or HTML [3]. Any URLS listed in our *Reference Archive* are active links in the HTML report form. Regarding URLS, we should also note that we have given special consideration to citing these as completely as possible. Citations to electronic information include the following information: Author (or responsible party), Title, Information Type (article in an online journal or an HTML document, for example), date information was published, date URL was cited, and of course the URL itself.

We also keep track of which articles have cited which references in the *Archive*. Users can view this information as well. With Perl scripts to automatically process this information, it takes little additional time and effort (on the part of authors and on the part of the Editorial Staff) to make the *Reference Archive* available to users. The *Archive* is a wonderful complement to an e-journal containing review articles, a complement that actually becomes an important part of **utilizing** *Living Reviews* to work in relativity.

III. SUMMING UP *AND* SOME BIG PICTURE KEY POINTS FOR THE FUTURE

Electronic publishing provides the ability to present information in multiple ways. This functionality means that an electronic publisher can extend the activities of the traditional print journal by developing an integrated information system which can be used as a research tool. With careful planning, we have been implementing a number of basic features needed to make *Living Reviews* a valuable resource to the international relativity community.

Among the important points about the journal are:

- The journal contains a constantly current set of reviews, updated by their authors.
- Articles supply links into the print and electronic resources most valuable in following the field. These references are annotated and evaluated in the articles, and links to electronic resources are made active.
- We provide multiple presentations of all references cited in journal articles. All references cited in journal articles are keyworded and are searchable online. Reports from these searches are available in a variety of useful formats.
- The journal bears no page or subscription charges. By maintaining the journal, the Max-Planck-Institute for Gravitational Physics provides a service to the worldwide relativity research community, but it also creates an information service for its own scientific staff. *Living Reviews* furthers the Institute's goals of advancing research, stimulating international collaboration, and disseminating scientific results.
- The tools and model we are developing for producing the journal are things that we would like to share with others interested in developing effective and efficient, low cost, non-commercial scholarly publishing.
- Authors, referees, and others with whom we have shared the idea have been enthusiastic and supportive. People are interested in developing and in being part of things like *Living Reviews*.

We cannot look at "publications" as isolated pieces. Journals (print and online), email lists, books, databases, web sites – all the places scholars gather, work out, and communicate their ideas – are collections of information. Taken as a group and integrated into an electronic environment, these various forms of communication can become a scholarly information system. Because of the potential inherent in the multiple ways that electronic information can be collated, processed, and presented, the integration of varied forms of scholarly communication into scholarly information systems can become the central core for the "scientific and technical information package of the future".

We need more and more ways to recognize and integrate the various ways researchers communicate into scholarly information systems. Libraries and librarians have a natural role here. But so does the e-journal as an online research tool. The e-journal can provide links, discussion, and integration of other information resources as ways to understand a given field. Building on the tradition of print journals, the e-journal can be a forum where scholars themselves are involved in articulating their information needs, and in writing, editing, and refereeing articles which evaluate resources important to understanding their respective fields. The development of low cost, efficiently produced and easily maintained e-journal publishing models and tools can help scholars develop their own information systems.

IV. NOTES

[1] By background investment, we mean that we had no archive of print articles associated with our journal to be converted for presentation on the web, and we had no subscription model based on having saleable print versions of the articles. This meant that we could define how the publication and articles would be prepared and presented thinking only in online terms.

[2] A great starting point for learning about information quality on the WWW is: T. Matthew Ciolek and Irena M. Goltz, *Information Quality WWW Virtual Library: The Internet Guide to Construction of Quality Online Resources,* (15 February 1998), [Online HTML Document]: cited on 23 March 1998, URL: www.ciolek.com/WWWVL-InfoQuality.html.

[3] BibTeX is a bibliographic database system used by those working in science. It is used in conjunction with LaTeX, TeX, etc.