

***Revolution and Evolution in Scientific Communication: Moving from Restricted Dissemination of Publicly-Funded Knowledge to Open Knowledge Environments***<sup>1</sup>

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It is axiomatic that the rate of change in technological systems initially outpaces human capacity to adapt to the technological advances. This is particularly true for transformational technologies that displace their antecedents, including the associated organizational paradigms. Such a transformation is currently taking place as a result of the technological revolution brought about by the combination of digital information technologies and global communication networks. The pre-internet legacy business model for research journals that seeks to perpetuate restricted access to and use of publicly funded scientific information, however, is not taking advantage of the potential benefits of national and global open availability online. The print subscription model that has been transferred into the digitally networked environment is optimized for maximizing the income of the intermediaries that have captured the public-good knowledge of the academic community, rather than for promoting the value of that knowledge to the community that produces and uses it. Such a business model consequently is retarding the pace of scientific progress and socioeconomic development that otherwise could be achieved with approaches designed to be more responsive to public research and education needs. The question, therefore, is not whether open availability to publicly-funded research results on digital networks is better than access provided on terms that are economically, legally, and technologically restricted, but how open availability and re-use can be most effectively institutionalized and how quickly.

There already are multiple paths that are being taken to make this transition from restricted to open dissemination and use online, such as open access journal publishing, and institutional or thematic repositories. The evolutionary human systems are thus beginning to respond to the opportunities made possible by the revolutionary technologies embodied in global digital networks. A gradual, but highly significant and far-reaching restructuring of scientific communication in public research is thus taking place. However, most of these open-access mechanisms perpetuate the arms-length dissemination function of the public good knowledge, artificially segregating its dissemination from the production and reuse functions, and removing the knowledge from the direct control of the communities that produce and use it.

An alternative model proposed here is the author's vision of open knowledge environments (OKEs) for digitally networked scientific communication. OKEs would bring the scholarly communication function back into the universities, much like law journals are published in the United States today and run by student law reviews. But the OKEs would go well beyond the law journal model, integrating the disparate institutional open access developments in a holistic,

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<sup>1</sup> This précis is based in part on: Paul F. Uhler (2006). "The emerging role of open repositories for scientific literature as a fundamental component of the public research infrastructure." In *Open Access: Open Problems*. G. Sica (ed.). Polimetrica. Torino, Italy; and on Reichman, J.H., Tom Dedeurwaerdere, and Paul F. Uhler (forthcoming). *Designing the Microbial Research Commons: Strategies for Accessing, Managing, and Using Essential Public Knowledge Assets*. The views expressed here are those of the author and not necessarily those of the U.S. National Research Council.

thematic hub of interactive education and research. The production, dissemination, and use of public knowledge thus would be managed within the universities themselves, directly supporting the universities' mission and eliminating the artificial market created by the legacy intermediaries for these public goods.

The core concept of an OKE involves the development of interactive portals focused on knowledge production and on collaborative research and educational opportunities in specific thematic areas. Ideally, such OKEs would be developed around one or more thematically linked, open access journals and augmented by openly available reports, grey literature, and data. Various interactive functions (wikis, discussion forums, blogs, post-publication reviews, perhaps distributed computing or other computational science functions) would be added to stimulate discussion, contributions, and output related to specific topical areas.

The OKEs I envision could readily be hosted at single universities, or their components could be distributed among a consortium of universities having a strong interest in the relevant subject matter. The OKEs also could be based at other not-for-profit research centers or government agencies, although such hosting could diminish their direct educational value. In every case they would be multidisciplinary in character, not only bringing in the experts who have the domain subject-matter expertise, but also in-house computer engineers, information scientists, and librarians to help establish and manage the OKEs. Such a knowledge production and education project would not only involve senior faculty and experts in its development and application, but also would serve as a mechanism for teaching students at the university in the related departments and as a vehicle for involving them in the management of the OKE itself.

At the same time, the thematic OKEs could access and integrate information beyond the conventional disciplinary boundaries, making them tools especially well suited to interdisciplinary environments. Another compelling payoff of the OKEs that is not possible under the restrictive subscription-access model would be the possibility to use semantic web technologies that would dramatically increase the opportunities for automated knowledge generation, extraction, and integration. For instance, the open access journals in the OKE could encode references to certain research materials under a unified numbering system, using a consensual ontology, allowing researchers to search and integrate all available scientific information on a given topic. The OKE concept of course would build upon the advances in online peer production of knowledge and participative web 2.0 techniques.

Within such an open knowledge environment, the stove-piped, print-paradigm journal model would be transformed into a truly interactive networked mechanism for integrated knowledge production, dissemination, and use. As with the current journal system, OKEs would strive to maintain the highest quality standards of scholarly endeavor and promote the reputational benefits of the participants and of their universities. University presses, scientific societies, or even commercial publishers could in some cases provide a partial service function, supporting the publishing endeavor as consultants, but no longer capturing the academic public good knowledge outputs. Research funding organizations could establish grant programs to develop, test, and validate OKEs as proofs of concept, which would then evolve at universities and other public research institutions. Because OKEs would be integrated directly into the curricula or research functions of their host organizations, using on-site personnel and students, they would have low overhead costs to operate, while attracting grants and other positive externalities to the organizations, thereby providing financial sustainability while promoting the public-interest missions of those organizations.