The Consequences for Internet-Mediated Research Collaborations of Broadening IPR Protections

Will Building 'Good Fences' Really Make 'Good Neighbors' in Science?

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ABSTRACT

Problematic issues are raised by the expressed intention of the European Commission to promote greater awareness on the part of scientists in the "European Research Area" about intellectual property rights and their uses in the context of "Internet intensive research collaborations." Promoting greater awareness and encouraging more systematic usage of IRP protections are logically distinct, but as policies for implementation – especially within the EC's Fifth Framework Programme – the former can too readily shade into the latter. Building "good fences" does not make for "good (more productive) neighbors" in science. Balance needs to be maintained between the "open science" mode of research, and private proprietary R&D, because at the macro-system level the functions that each is well-suited to serve are complementary. Recent policy initiatives, particularly by the EC in relation to the legal protection of property rights in database, pose a serious threat to the utility of collaboratively consttructed digital information infrastructures that provide "information spaces" for voyages of scientific discovery. The case for alternative policy approaches is argued in this paper, and several specific proposals are set out for further discussion.

Keywords: Intellectual property rights (IPRs), R&D, research collaboration, open science, digital databases, open source software production, science and tecnology policy.

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Will Building 'Good Fences' Really Make 'Good Neighbors' in Science? ♦

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Paul A. David

The American poet Robert Frost's ode to individualism celebrates the stone fences that distinguish the rural landscape of upland New England: "good fences make good neighbors." Perhaps it is so, where the resource involved is land, onto which the livestock from neighboring farms otherwise may wander to graze and thereby destroy the provender of the animals already pastured there. But is it so, too, when one scientist pores over the data gathered by another? Simple consideration of the "public goods" nature of information suggests that such is not the case.

Information is not like forage, depleted by use for consumption; data-sets are not subject to being "over-grazed" but, instead, are likely to be enriched and rendered more accurate, and more fully documented the more that researchers are allowed to comb through them. It is by means of wide and complete disclosure, and the skeptical efforts to replicate novel research findings, that scientific communities collectively build bodies of "reliable knowledge." There is good reason for caution in extending a system of resource allocation that can work well in the domain of conventional commodities, which are exhausted in the process of use and cannot be simultaneously enjoyed by many, into the realm of knowledge, information and scientific data. An overly literal application of the metaphor of "property" to knowledge, one that emphasizes the desirability of socially enforced rights to exclude trespassers and to alienate "commodities" by means of exchange, may lead towards perverse economic policies in the field of scientific and technological research.

1. Some problematic impacts of ICTs and IPRs upon the global science system

The foregoing view should not be shrugged off as an perversely unhelpful response to the EC STRATA-ETAN Programme's expressed interest in promoting greater awareness on the part of scientists in the "European Research Area" about intellectual property rights and their uses in the context of "Internet intensive collaborations." Who would seriously wish to argue against the intention of simply disseminating information and "raising awareness"? But, rather than proceeding to endorse devoting resources to such an effort, and moving with dispatch to the consideration of practical measures, it seems more sensible to ask first what social and economic purposes one hopes to serve by promoting *collaborative* scientific research in general, and Internet-based collaborations in particular. Having fixed those objectives in mind, it is logical to ask how the likelihood of their attainment would be affected by the introduction of measures which (whether by design or otherwise) would instruct researcher in how best to avail themselves of the existing the legal protections afforded for patents, copyrights, trade secrecy, and other means of appropriating the economic value derived from additions to the stock of knowledge.

♦ This essay was developed from the notes for a presentation by the author at the European Commission (DG-Research) STRATA-ETAN Workshop on "IPR ASPECTS OF INTERNET COLLABORATIONS," held in Brussels, 22-23 January 2001. It reflects at many points the lively and illuminating discussions that took place in the Workshop meetings, which were organized on the initiative of Fred Marcus of the DG-Research staff, and which the author co-chaired with Dominique Foray. The extraordinarily intense and prolonged exchanges of email among the participants during the post-Workshop phase of drafting the report, also has left its marks upon this text. [*IPR Aspects of Internet Collaborations*, is forthcoming in May 2001 as EC/Community Research Working Paper, EUR 19456.] Without implying necessary agreement on their part with the personal views expressed here, it is a pleasure to acknowledge the following individuals' contributions to those proceedings: Graham Cameron, Bastian De Laat, Anne De Moor, Ove Granstrand, Bronwyn Hall, Elad Harison, Michail Marinos, Ulf Petrusson, Anselm Kamperman Sanders, Vincent Ryckaert, W. Edward Steinmueller.

The larger set of issues just broached must not only frame, but guide the consideration of practical policy actions in this area. I therefore think it is particularly relevant to preface such discussion by referring to the concluding statement of an earlier international workshop that sought explicitly to address the incipient conflicts between the expanding technological opportunities and the rising institutional impediments affecting international scientific collaborations. The "orienting" statement to which I refer was issued by the participants in the International Workshop on the Global Science System in Transition, convened at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, 23-25 May 1997.[1]

Noting that opportunities for formally and informally organized research collaborations are being greatly widened by the spectacular advances in digital technologies (including computer-mediated telecommunications), they also found reasons for concern about the impact upon open science of the environment of intensifying international competition for markets in R&D-intensive products. Several passages in the Laxenburg Statement elaborate this tension, and therefore bear quotation here at some length:

> "[P]ublic officials responsible for science and technology policy have succumbed to pressures to treat governmental funding of civil fundamental research, along with national institutional infrastructures supporting science training and information dissemination, as instruments that should be deployed primarily for the purpose of securing immediately foreseeable economic advantages for their nation's business firms, workers and consumers. In the new rhetoric of "international competitiveness through innovation," paradoxically, the possibility that basic science will yield unforeseen benefits that can accrue equally to other peoples is no longer presented as a virtue, but instead has become as a potent political argument against such increasing expenditures for such research.
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> "The conjunction of these developments is worrisome, in our view, not least because the kinds of cooperative initiatives that they most imperil include precisely those that appear to be required to enable the world's peoples to address rationally many collective problems -- such as global climate change, the multiplication and spread of antibiotic-resistant pathogens, environmental degradation and the cascading collapse of local ecological systems -- all of which are potentially of critical importance for the welfare of coming generations…."
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> "We call also for attention to be paid especially to monitoring and assessing threats to the present and future vitality of "open science" as a mode of producing reliable knowledge, particularly through international collaborations. Preservation of that vitality requires increased vigilance in preventing the creation of impediments to information access as by-products of the drive on the part of private business interests and public agencies to render new knowledge more readily harnessed for commercial exploitation and international competitive advantage.
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> "Prospects of inducing increased private funding for research (to supplement curtailed public expenditures) have combined with the ongoing commercialization of new information technologies, thereby lending more powerful impetus to proposed changes and elaboration of legal protections for intellectual property in science and technology. Although the establishment of international patent and copyright conventions has had undoubted beneficial effects in reinforcing private incentives for the generation of productivity-improving and quality-enhancing technological innovations, some serious burdens may be imposed upon science by inadequately considered measures intended to further strengthen and extend the intellectual property systems established in the advanced industrial economies. Widespread patenting of research materials and computational algorithms, and copyrighting of scientific databases without due provisions for "fair use," are instances of recent legal innovations that have the potential to create crippling barriers to the free exchange of new scientific findings, and to impede ready access by the world's research communities to the archives of scientific knowledge upon which the cumulative advance of scientific discovery and invention necessarily relies."

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[1] *The Laxenburg Statement on the Global Science System*, Final Authorized Version: 10 October 1997. For the full text, and the list of (29) participants, including physical and social scientists, and science and technology policy experts, see www.globsci.aps.org,. Paul David, Dominique Foray, and W. Edward Steinmueller (all participants in the 22-23 January 20001 STRATA-ETAN Workshop) formed the organizing committee for the 1997 Laxenburg Workshop.

2. Keeping "information spaces" freely navigable for "voyages of discovery"

It is vitally important to approach the analysis of IPR policies, like that of other issues affecting scientific and technological research communities, within a unified dynamical systems framework. One may usefully point out that there are many kinds of research projects, distributed along the continuum stretching from the purely exploratory to the applications-oriented and mission-driven. Some collaborations are one-time, short-term coalitions of "partners" who are able to reconcile their conflicting goals sufficiently to take advantage of the complementarities among their respective capabilities. Others, from the very nature of their objectives, entail an extended and open-ended process of data collection and analysis that must be conducted cooperatively by numerous, widely distributed participants. Different groups engaging in the generation of different sorts of information will undoubtedly need to work out specific combinations of intellectual property rights ownership and contracting arrangements. Keeping track of the general features of these organisational solutions, and finding ways to distribute such information for use by others without mandating particular solutions, are tasks that public agencies should take – especially when they are in a position to impose some reporting requirements upon the participants in publicly subsidized collaborations. In this way the EC could contribute to the reduction of the transactions costs of research collaborations even beyond the sphere of the research projects it helps to underwrite.

But, if creating taxonomies of collaborative forms, and typologies of participants serve to underscore the point that universal governance and distribution rules are not likely to fit the needs of most of the collaborations that can be conducted with electronic network support, putting things in separate boxes also carries dangers. The variety of collaborative enterprises in science are not independent in their effects, nor self-sufficient in their informational and knowledge requirements. Because the knowledge produced by a given research collaboration typically becomes an input into other, subsequent research, this dynamic interdependence is characterized by strong positive feedback. The good news is that enhancements in collaboration technologies, by raising research productivity, have the potential to raise the productivity of other collaborations. But the dark side of the situation is that there will be productivity reducing feedback also from new impediments to collaboration. This is where the introduction of new IPR devices, and changes in the ethos of scientific researchers who are encouraged to view what they discover first-and-foremost as possible bases for immediate "wealth creation" can prove perversely destructive – eventually, if not in the short run.

A concrete illustration of the creative power of collaborations built to exploit enhanced digital technologies is provided by the vast, multi-dimensional "information space" that has been built up over the course of many years by the research community whose activities are coordinated today by the European Bioinformatics Institute (EBI). This "virtual library" is a dynamic collective research tool rather than a simple repository of information. The ordinary conceptualization of "a database" is too static, and, in a sense too pre-structured, to comprehend the potential for discoveries that has been created by this collective construct. Yet, as Graham Cameron, the EBI's Director, told the Workshop (in his statement to the opening session, on 22nd January), this information space began to be formed long before the research communities involved gave any consideration to intellectual property right restrictions on the use of the information contents that were being linked for subsequent retrieval and analysis. The implication was clear that it would be far more difficult in today's environment to create this particular research tool.

When considering the benefits to society of enabling the appropriation of the value of this facility (and ones like it in other research fields) for users who seek to exploit it in conducting commercially oriented research -- say, in developing new genetic diagnostic kits, or new drug therapies -- the question to be asked is what effect doing so will have on the probability of valuable discoveries both in the near term and over the longer run. Seeking to apply the rights granted by the EC's Directive for the Legal Protection of Databases (March 11, 1996), and to partition and restructure the "information space" so as to readily extract licensing fees from users, would have the predictable effect of curtailing searches that were not thought to have a high expectation of quickly finding something with high "applications value." In other words, the probabilities of unexpected discoveries would be further reduced by the economically restricted utilization of the facility. Targeted searches may be quite affordable, but wholesale extraction of the data-spaces' contents to permit exploratory search activities is especially likely to be curtailed.

The adverse influences of the consequent "lost discoveries" also are likely to ripple outwards. This is so because the development of new and more powerful search devices, and techniques of pattern recognition,

statistical analysis, and so forth, are more likely to figure among the discoveries that would be made collectively through the exploratory use of facility by a larger number of searchers. Therefore, some cost of extracting economic rents from this construct today will most likely come in the form of smaller benefits (and the sacrifice of reduced applications-oriented research costs) in the future. In addition, one should consider the possibly serious inhibiting effect of setting up a "model" of IPR exploitation of such structures upon the construction of some new, presently unimagined information tools that would require the assembly (and licensing) of myriad information components from many, diverse sources.

3. From 'open science' to open source software, and "peer-to-peer" organisation

The foregoing may be construed as a confrontation between the European region's quest for greater international competitiveness through technological innovation, on the one side, with the global open science community's need to avoid being fettered by the strengthening of IPR on the other side. As matters presently stand this representation of the situation, and of the need to strike a balance between the opposing claims, is a reasonable basis for policy discussions. Yet, in a longer run context, it may turn out to be a misleading caricature of the IPR issues that currently are emerging in the world of business; among at least some leading innovators concerned with the future trajectory of e-commerce, there is growing recognition that the conventional regime of proprietary controls over the use of information by industry may be a hinderance to exploitation of new profit opportunities being created by digital, networked technology.

Within the domain of Internet based media industries, a new landscape of what are referred to as 'peer to peer' (P2P) services has emerged, featuring shared storage, shared information and shared processing. The new P2P applications devolve significant autonomy and control to independent nodes in the network; they capitalize on under-utilized network-connected computing resources at the edge of the network; they operate as transparent end-to-end services across an Internet of uneven and temporary connections. One vision of the future is that the greater effectiveness of this comparatively unstructured and self-organized mode of producing and delivering new information to individual users will become the basis for new and competitive commercial services; that these will challenge the incumbency of traditional business forms in information-intensive production and distribution activities.

Not surprisingly, therefore, spokespersons for P2P business applications have been worried by the threat that proprietary standards strategies on the part of platform vendors would create barriers to collaborative computing, in just the same way that scientists engaged in distributed Internet projects worry about IPR-created barriers to the flow of information, and the diminishing future prospects for easy voyages of exploration in "information space." Here is Esther Dyson's formulation of the threat to P2P, and a possible means of avoiding it:[2]

> "The growth of P2P services will be retarded if this world fragments into warring proprietary platforms, forcing users to make unpalatable choices and killing synergistic network effects. Some existing proposed standards fit naturally into P2P models, including simple object access protocol (SOAP) and universal discovery description and integration (UDDI)…. At some point it will make sense to have at least *de facto* standards for common P2P elements. Standards bodies [which under ANSI rules preclude adoption of proprietary specifications that are not freely licensed] provide a place for industry participants to gather, compare notes, identify shared challenges and find common ground."

At the recent Economic World Forum meeting in Davos, Switerzland, Richard Li, executive Chairman of Pacific Century CyberWorks, is reported to have voiced essentially the same worries:[3] "his biggest concern about the development of broadband technology was the conservatism of many content providers who were determined to retain copyright protection and unwilling to consider creative new business models.'That element is probably the missing slice -- for the time being'."

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[2] Quoted from *Release 1.0, Esther Dyson's Monthly Report*, vol. 10, no.2 (22 November 2000), p. 8. Available from http://release1.edventure.com.

[3] "Industry Leaders See a New Era in the Tech Revolution," *International Herald Tribune*, 30 January 2001, pp. 1,16.

Significantly enough, the emerging P2P approach to network-based computing and computer-mediated telecommunications services, and the demonstrated capacity of that non-hierarchical form of machine organization to mobilize distributed intelligence for the rapid solution of new problems, has strong elements of homomorphism with the historical functioning of "invisible colleges" in the open science domain.[4] What has changed, of course, is the qualitative effects of the technological capacity to link "distributed intelligent resources" in a host of differentiated sub-communities at negligible cost; and to thus provide spectacularly rapid capabilities of searching the "information spaces" thereby created. What hitherto was the peculiar organizational facility for discovery and invention that the commercially unpressured pace of open scholarly inquiry afforded practitioners of "open science" may become a much more widely relevant mode of generating innovative information-goods that customers are willing to pay for.

The transformation that appears to be bringing the world of P2P network-based commerce and the world of "invisible colleges" of academic inquiry into closer alignment with regard to their working modalities is an intriguing development, and one that is potentially promising for the future synergetic interactions between those two spheres of human endeavor. It stands in much greater need of concerted public policy support than the present impetus being given to the negotiation of university-industry collaborative research agreements whose IPR provisions accede to the monopoly-protecting strategies familiar to conventional R&D-intensive businesses in the chemical, pharmaceutical and electro-mechanical engineering industries.

My point in drawing attention to the parallels between the organization of open-science communities, and the information-intensive strategies emerging in the domain of cyber-commerce is simply this: European policy-makers, by pressing research groups to think about the practicalities of conventionally securing and "managing" proprietary rights to the use of new knowledge, may turn out to be trying to ride the wave of the past at the expense of building the wave of the future. In actuality, if such efforts to create "wealth from knowledge through IPR" succeeded, the result might be to have rendered more difficult European industry's eventual development of novel kinds of computer-network intensive service organizations, and the other new lines of business they would generate.

Rather than seeing "open science" communities as asserting claims that stand in the way of the exploration and exploitation of profitable business opportunities built on exclusive ownership and control of digital content, their characteristic mode of disclosure and data-sharing might well be regarded as a precursor and paradigm of future economic activities that will fully exploit the potentialities opened by the Internet. In other words, the ethos and mode of organization that has been associated historically with publicly supported scientific work groups (at least since the 17th century), now could be coming into its own as the basis for new forms of *commercial* activity feasible in the Digital Age. This certainly is what some observers of the open source software movement now suggest.[5] What European policy-making ought to consider carefully, therefore, is how to avoid promoting an entrenchment of durable IPR protections that could fatally obstruct that evolution.

4. Recommendations: Using IPR to make "good neighbors" in science

What sort of intellectual property arrangements will make for "good fences" in the "information spaces" where collaborative research enterprises are most likely to thrive? The policy position that I have advanced on previous occasions, and wish to propose here is one that has been shaped by my detailed economic analysis of the likely impacts of new legal initiatives in Europe – particularly, the EC's 1996 Database Directive, and the provision of legal reinforcements for the application by IPR-owners of digital "self help" technologies such as watermarking and encryption.[6] My conclusion is that these institutional innovations

[4] See P.A. David, "Communication norms and the collective cognitive performance of "Invisible Colleges'," in *Creation and Transfer of Knowledge: Institutions and Incentives*, Eds. G. B. Navaretti et al., New York and Berlin: Physical Verlag, 1997; P.A. David, D. Foray and W. E. Steinmueller, "The research network and the 'new economics of science'," *in The Organization of Innovative Activities in Europe*, eds., A. Garmbardella and F. Malerba, Cambridge: Cambridge University Press, 1999.

[5] See, e.g., "The Organization and Viability of Open Source Software: A Proposal to the National Science Foundation," P. A. David (Principal Investigator), Stanford Institute for Economic Policy Research, January 22, 2001.

[6] For further discussion, see P. A. David, "A Tragedy of the Public Knowledge 'Commons'? Global Science, Intellectual Property and the Digital Technology Boomerang," Department of Economics Working

exemplify the wrong direction in which to be moving. In the domain of scientific and technological information, the "best fences" are likely to be "low and penetrable."

IPR regimes when implemented in that manner can serve a socially valuable informational purpose, by helping potential collaboration members locate and access various sources of scientific and technological knowledge, and it would be desireable to improve the patent and copyright registration systems towards that end. There are some well known circumstances where significant patent protection is warranted by the high fixed costs that public regulatory policies impose upon the private developers of innovative commodities that are readily "reverse engineered" and cheaply copied -- e.g., the extensive field testing requirements for pharmaceutical products and medical devices. But, these represent the exception rather than the rule, and the end products themselves typically do not have the essential 'public goods' properties associated with information-good and information-tools.

Thus, the important broad principle to be established is a simple one: whatever are the legal rights that societies construct regarding "intellectual property," whether under international patent and copyright regimes or by *sui generis* protections (inadvisable as these may be, on other grounds), the licensing terms available to "owners" should never be allowed to create inefficient artificial impediments to the intensive utilization of the contents of virtual archives and information tools. As I have suggested, this principle may be just as important for the future of new commercial ventures based upon computer-mediated telecommunications as it is for the health of fundamental, exploratory inquiries organized under the auspices of non-profit institutions.

It also should be more widely recognized that such a principle is not necessarily deterimental to profitable enterprise in information-goods markets. Indeed, the best way for business to exploit the potential monopoly power conveyed by legal protections for "intellectual property" is not always that of trying to extract the maximum consumer surplus from each individual user. Even traditional "content owners" of information goods such as books, video-recordings, CD's, software programs, and the like may be able to reap greater profits by licensing the free sharing of information goods among groups of users that are closely integrated socially, and whose collective willingness to pay exceeds the sum of their separate revealed demands for the commodity in question.[7]

In the view of most economists, the "first best" allocation system in situations where goods are produced with high fixed costs but far lower marginal costs, is to apply what is known as the "Ramsey pricing" rule. This fits the case of information products such as scientific publication and data, where the first-copy costs are very great in relationship to the negligible unit costs of copies. Ramsey pricing in essence amounts to price discrimination between users whose demands are inelastic and those users for whom the quantity purchased is extremely price-sensitive. The former class of buyers therefore will bear high prices without curtailing the quantity purchased of the goods in question, and hence not suffer great reductions in consumption utility on that account, whereas the low prices offered to those in the second category will spare them the burden of economic welfare reducing cutbacks in their use of the good.

The case might then be made for treating scholars and public sector, university-based researchers as having highly elastic information and data demands. Such a characterization would follow from considering that this category of knowledge-workers is employed on projects that have fixed budget allocations from public (or non-profit) entities, organizations that are expected to promote the interests of society at large. Since there is strong complementarity between their data and information requirements, on the one hand, and on the other resources they use in their research, the effects of raising the real price of this input are tantamount to sharply reducing the quantity of useful work that such projects can accomplish so long as their budgets remain fixed. Obviously, there is no workable economic or political mechanism that would serve to "index" the nominal

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Paper 00-16, Stanford University, October 2000 [available from http://www-econ.stanford.edu/faculty/wpapers/index.html.]

[7] See further discussion in David, "A Tragedy of the Public Knowledge 'Commons'? (2000: pp. 19ff), referring to Yannis Bakos, Erik Brynjolfsson and Douglas Lichtman, "Shared information goods," University of Chicago Law and Economics Working Paper No. 67 (2nd Series), February, 1999, and other papers.

value of public research budgets on the prices of commercially provided data. Even were such mechanisms to be found, commitment to implement them on the part of the rich societies would most likely result in pricing the use of scientific information and data beyond the reach of many poorer societies.

The general thrust of the policy advocated here is thus quite simple: statutes that would establish legal ownership rights for compilers of scientific and technological databases also should include provisions mandating compulsory licensing of scientific database contents at marginal costs (of data extraction and distribution) to accredited individuals and research institutions. The implication is that the fixed costs should be covered by lump sum "subscription" charges, which would be waived in the case of researchers engaged in constructing and maintaining these databases under the auspices of publicly supported projects.

A further, logically consistent, albeit still bolder recommendation would have the same provisions apply more broadly. They could be extended to all the users of such data and information resources who agreed to distribute the data they generated on the same basis as that on which they had been able to access the data used in creating it. That universal application of the so-called "Copyleft" principle leaves open the possibility to commercial ventures of licensing and directly marketing ancillary and complementary goods and services, as the means of recouping the fixed costs of their contribution to the "information infrastructures" that they would participate with publicly sponsored researchers in helping to create.