A Framework for Analyzing the Knowledge Commons

(Draft 12-2005)

Chapter for the forthcoming book *Understanding Knowledge as a Commons: From Theory to Practice* (The authors' names are reversed in the published version)

Charlotte Hess and Elinor Ostrom

Who hasn't heard of the six blind men of Indostan encircled around an elephant?[1] The six—one a political scientist, one a librarian, one an economist, one a law professor, one a computer scientist, and one an anthropologist—discover, based on their own investigations, that the object before them is a wall, spear, a snake, a tree, a fan, and a rope. The story fits well with the question that propelled this chapter: how can an interdisciplinary group of scholars best analyze a highly complex, rapidly evolving, elephantine resource such as ***knowledge***? Trying to get one's hands around knowledge as a *shared resource* is even more challenging when we factor in the economic, legal, technological, political, social and psychological components—each complex in their own right—that make up this global commons.

Studying Institutions

In this chapter we adapt a framework that has been used for over three decades as the main theoretical structure by many commons scholars from multiple disciplines. The Institutional Analysis and Development (IAD) framework is a diagnostic tool can be used to investigate any broad subject where humans repeatedly interact within rules and norms that guide their choice of strategies and behaviors. Most importantly, it can lead one out

of the path-dependency of existing patterns of practice when their accompanying ways of thinking have not yielded solutions (Oakerson 1978, 15).

The framework can be used to analyze static situations crafted by existing rules and relating to an unchanging physical world and relevant community. The framework can also be used to analyze dynamic situations where individuals develop new norms, new rules, new physical technologies. Studying these developmental processes are more challenging than studies of fixed structures, but are very important for the study of the knowledge commons given the fast rate of change related to the physical world, the rules that are crafted to cope with new situations, and the enlarged community of producers and users.

We define institutions as formal and informal rules that are understood and used by a community. Institutions, as we use the term here, are not automatically what is written in formal rules. They are the rules that establish the working "do's and don'ts" for the individuals in the situation that a scholar wishes to analyze and explain.

The IAD framework has been developed to facilitate the development of a comparative method of institutional analysis. Those who engage in institutional analysis seek to understand one of the most fundamental political and social questions: How do fallible humans come together, create communities and organizations, and make decisions and rules in order to sustain a resource or achieve a desired outcome? The framework is an analytical scaffolding that contains a universal set of intellectual building blocks. As a *framework* (and not a static *model* such as the Tragedy of the Commons or Prisoner's Dilemma which we discussed in chapter 1) the methodology is fluid and dynamic. In one way, it is a checklist of "those independent variables that a

researcher should keep in plain sight to explain individual and group behavior" (Gibson 2005). But the framework also structures the checklist into a causal schema while allowing great flexibility in the determination of exactly what factors should be included" (Ibid.). Its design allows for detailed analysis of specific resources and situations, while being general enough to apply to multiple types of inquiries (Oakerson 1992, 42).

Because the IAD obviates the need to invent a new framework for different research questions related to the study of human decision making in repetitive situations, it has been successfully applied in a wide variety of research projects. Examples of its application for diverse types of research questions are:

- To understand the role of institutions in influencing resource use in poor societies (Agrawal 1999);
- To make comparative studies on international higher education policies (Richardson 2004);
- To study how institutions influence behavior and outcomes in urban areas (see McGinnis 1999);
- To examine the evolution of banking reform in the U.S. (Polski 2003);
- To model operational decision-making in public organization (Heikkila and Isett 2004);
- To analyze governance and Aboriginal participation in forest management in Canada (Smith 2001);
- To tease out the perverse incentives facing donors and recipients in regard to international development assistance (Gibson et al. 2005); and

- To analyze the various action situations involved in the open source software commons, the Free/Libre and Open Source Software (FOSS) (see Schweik, chapter 10, this volume).

The IAD is particularly appropriate for analyses of various types of commons and common-pool resources. It has helped researchers see, for example, the need to factor in more than the trees when studying a forest. In order to understand why one forest is becoming deforested and another is thriving, researchers need to take into account not just the condition of the soil, the biodiversity of the flora, and the density of the tree growth. Equally important is the understanding of the user communities, the management systems, the various property rights involved, and the multiple levels of the rules-in-use (Gibson, McKean, and Ostrom 2000; Moran and Ostrom 2005). It would also lead researchers to take into consideration questions of multiple uses, conflict, equity, livelihood security, modes of production, and sustainability (see Berkes 1989, 11-13; National Research Council 2002).

This framework seems well-suited for analysis of resources where new technologies are developing at an extremely rapid pace. New information technologies have redefined knowledge communities, juggled the traditional world of information users and information providers; made obsolete many of the existing norms, rules, and laws; and have led to unpredicted outcomes. Institutional change is occurring at every level of the knowledge commons.

Designing institutions to enhance the production and use of any kind of commons, whether natural or human-made, is a challenge. Effective design requires successful collective action and self-governing behaviors; trust and reciprocity; and the continual

design and/or evolution of appropriate rules. We have learned that successful commons governance requires an active community and evolving rules that are well-understood and (Dietz, Ostrom, and Stern 2003). When a resource is large and complex, users may lack a common understanding of resource dynamics, users frequently have substantially diverse interests, and thus, the costs of sustaining large and diverse resources are much higher than when governing small and relatively homogeneous resources (E. Ostrom et al. 1999).

In the IAD framework, we posit three very broad clusters of variables that are basic underlying factors affecting institutional design and the patterns of interaction occurring within action arenas. The variables may also be considered at different scales of operation. Figure 1 delineates the local-regional-global scales. It is a suggestion of the "nestedness" of enterprises. Equally valid would be department-school-university or city-state-national-international arenas. The important point is that most the variables within the clusters will change at different scales.

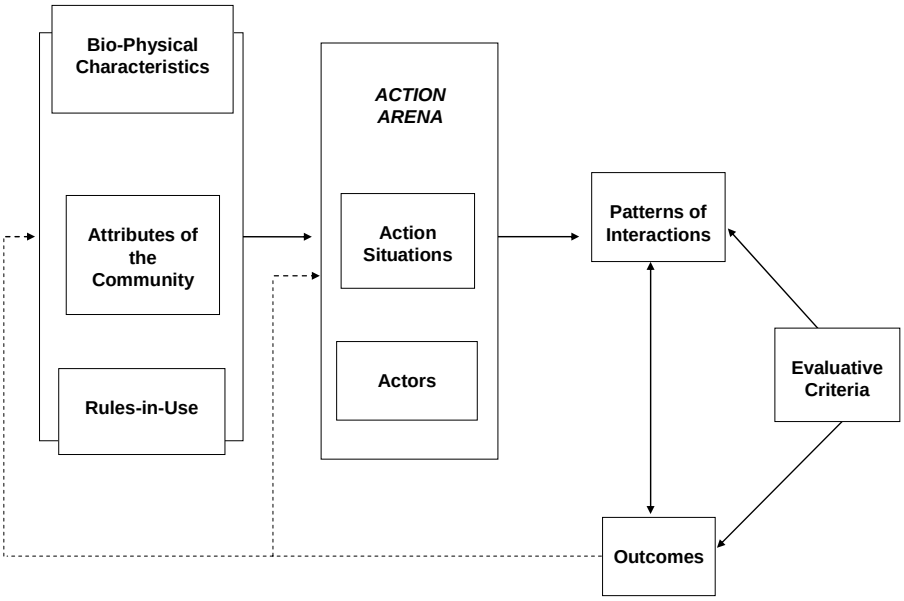

Figure 1. Institutional Analysis and Development Framework

There are three ways to enter the framework when studying a question: One can start in the middle with the Action Arena, at the right-hand side with the Outcomes, or at the left-hand side with the underlying factors (the Physical/Material characteristics, the attributes of the relevant Community, and the Rules-in-Use at several levels). Entering the analysis with the Physical/Technical and Institutional Characteristics is most appropriate when one is trying to understand the nature of the resource being shared, by looking at the physical, biological, and technical constraints and capacities of the resource, as well as the boundaries, size, communities of users and producers, and the relevant rules-in-use. The Action Arena consists of the Action Situation and the Participants (individuals or groups) involved. The Action Arena, often at the heart of the analysis, is particularly useful in analyzing specific problems or dilemmas in processes of institutional change. Within knowledge commons, it is an appropriate place to start when

trying to think through the challenges of creating a new form of a commons such as a new digital repository within an organization. Beginning with the Outcomes makes sense with questions such as why and how is information being enclosed? Why do authors not voluntarily contribute to a repository? We will begin by discussing the left-hand side of the framework.

Resource Characteristics

For short-term analyses, the attributes of the physical and material world, of the community producing and using a resource, and of the rules-in-use affecting the decisions of participants are the *exogenous* factors in the analysis. Figure 2 highlights the left side of the framework illustrating these characteristics. At the time of analysis, one identifies the specific physical and institutional factors on the left-hand side of the framework. These factors then remain fixed throughout the analysis.[2] In this volume, regardless of the type or aspect of knowledge commons discussed, the exogenous physical characteristics are those of *distributed digital information.*

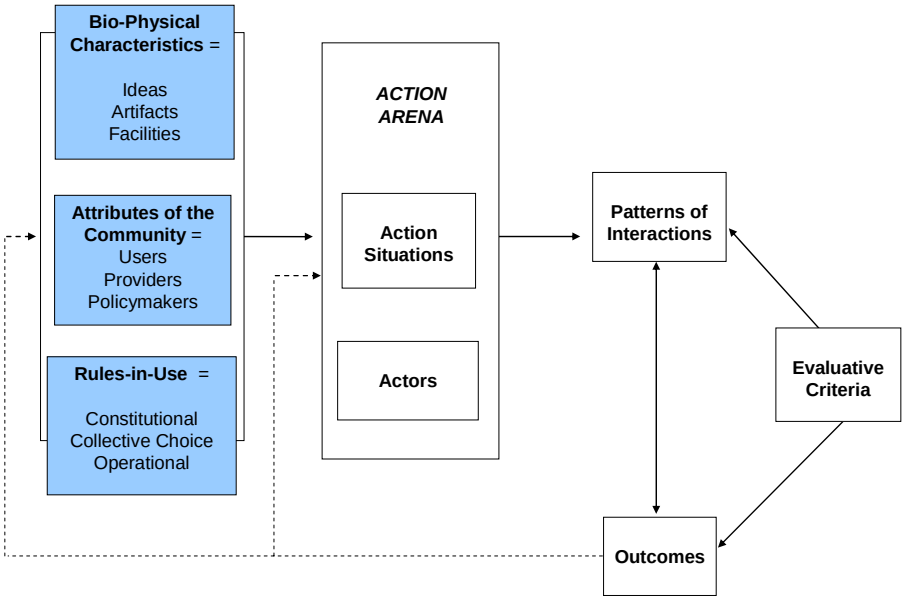

Figure 2. Biophysical, Community, and Institutional Characteristics Highlighted

Biophysical-Technical Characteristics

"Gallia est divisa in partes tres…"

When Julius Caesar began his *Commentaries on the Gallic Wars* around 58 BC he understood the importance of starting with the physical lay of the land in order to situate the conflict. Likewise, de Tocqueville opens his first volume of *Democracy in America* with a geographical description: "The Exterior Form of North America." The physical attributes of a resource always play an essential role in shaping the community and the decisions, rules, and policies. The physical nature and available technology determine the limitations and possibilities of a particular commons. These characteristics comprise such things as size, location, boundaries, capacity, and abundance of the resource. The technology determines the ability to harvest or appropriate the resource units.

Most of the “commons” characteristics of knowledge and information have developed from the effects of new technologies—i.e., physical nature of the resource. Before the digital era types of knowledge commons were limited to libraries and archives. Only when vast amounts of knowledge began to be digitally distributed (after the development of the World Wide Web in 1992) did it take on more and more characteristics of commons and commons dilemmas. Examples of the vast amount of changed characteristics (from paper to information technologies) include:

- more and more “standard” information born digital;
- more and more digital information distributed through the Internet;
- improved search engines, databases, and word processors, HTML, and other software;
- synchronous exchange of information possible; and
- access to digital information through personal computers.

The physical attributes of digital technologies may be well understood by technologists and librarians. They may not be so apparent, however, to policymakers, administrators and other who may be affecting the rules. As we will discuss, these physical changes led to complex web of rule changes as well as new user and producer communities.

The intense and sometimes sudden effect of new technologies can occur with all types of resources. With many natural resources, the physical characteristics can remain constant until the introduction of new technologies (one need only think of the impact of chainsaws on forest ecology or gigantic trawlers on fishery populations). New

technologies can introduce the likelihood of overharvesting, congestion, rivalry, and possibly even depletion—all severe commons dilemmas.

When investigating the physical conditions of a traditional natural-resource commons, scholars have found it helpful distinguishing between the *resource system* and *resource units.* In a fishery, the *resource system* (the facility) is the fishing grounds (Schlager 1994). The *resource units* are the fish. In groundwater, for instance, the groundwater basin the *resource system,* while the water quantities or amounts withdrawn are the *resource units* (Blomquist 1992). The complex nature of knowledge as a commons requires a *three*-fold distinction because it is made up of both nonhuman and human materials: *facilities, artifacts,* and *ideas* (Hess and Ostrom 2003).

Facilities store artifacts and make them available. Traditional facilities have been libraries and archives containing books, journals, papers, and other knowledge artifacts. These facilities had physical limits. The physical network infrastructure includes the optical fiber, copper wire switches, routers, host computers, and end-user workstations (Bernbom 2000). It also includes the amount of bandwidth, free space optics, and wireless systems. The new technologies that have made electronic, distributed information possible are also a part of the evolving physical conditions of the knowledge commons. The nature of many digital facilities today has the capacity for digital information to be non-rivalrous—at least over time.

Artifacts are discreet, observable, nameable representations of ideas, such as articles, research notes, books, databases, maps, computer files, and web pages. To use the term from copyright law, they are the "expressions" of the ideas. Here, too, whereas traditional knowledge artifacts (e.g., books and journals) are rivalrous, digital artifacts can often be

used concurrently by multiple users. Artifacts are the physical resource or *flow units* of a facility. In a knowledge commons they are the expressions of the ideas presented in a myriad number of formats, from the traditional paper, binding, microfilm, video, etc., to state-of-the-art computer graphics, text files, holograms, MIDI files, videos, searchable databases, and so forth.

Ideas are coherent thoughts, mental images, creative visions, and innovative information. Ideas are the intangible content and the *nonphysical flow units* contained in artifacts. There are certain idea-types such as mathematical formulae, scientific principles, grammar, names, words, numbers, and facts that are not "capturable" by copyright and are considered to be in the public domain (Samuelson 2003b, 151). But ideas in digital form do not have the same protections as they did in the pre-digital world (ibid., 164). The most notable characteristic of an idea is that it is a pure public good and, therefore nonrivalrous. One person's use of it does not subtract from another's.

In Donald Waters' exploration of preservation dilemmas in chapter 5, the physical characteristics of the resource—the decentralized, ever-changing nature of digital objects—are the heart of a social dilemma. Preservation in the digital context is much trickier in the digital world. All of the instances of enclosure discussed by Kranich have been brought on by the changed structure of the physicality of information. Suber underscores this connection when he writes that the "OA [open access] commons is non-rivalrous because it is digital, not because it is OA."

Attributes of the Community

Unlike a fishery or groundwater basin, it is much more difficult to grasp who is the entire community that is contributing to, using, and managing a knowledge commons. We can start by assessing who are the information *users*, information *providers*, and information managers or *policymakers*. The *users* are those appropriating digital information at any point in time. The *providers* are large diverse groups: those making the content available as well as those making the software, hardware and infrastructure available. The *policymakers* may be a voluntary and self-governing community of insiders, such as a library committee, or those leading the Open Archives Initiative,[3] the contributors to the FOSS movement discussed in Schweik's chapter, or the participants of the World Summit on the Information Society (WSIS)[4]. The provider and decision-making or policymaking communities are usually *nested*—that is, different groups functioning at various levels within this locally-provided, globally-appropriated commons (see Rules-in-Use section below).

The community may be involved with various aspects of governance, regulation, enforcement, educating other community members or the public, as well as other types of activities. Whether the values of a community are shared or divided, substantially affects the strategies adopted within action arenas and the resulting patterns of interactions. For example, the university community—even when divided by discipline—used to be fairly unified in their primary quest for the creation and production of new knowledge. Today, there are conflicting values within the academy that has close ties to corporate sponsorship and where the processes of education are increasingly commodified (Argyres and Liebeskind 1998; Vaidhyanathan 2002; Bollier 2001). The values of the community are more complex, and possibly conflicting. In an earlier and slower world, the

community using any of the components of the knowledge commons usually shared common values related to the creation of new knowledge, teaching students the knowledge they would need in order to be productive members of a community, a society, and an economy, and providing general information necessary for the sustenance of a democratic society. If these values erode or change dramatically, the resulting physical conditions and action arenas are also strongly affected.

Traditional commons analysis has demonstrated that small, homogenous groups are more likely able to sustain a commons (Cardenas 2003; NRC 2002). If a community of providers and decision makers are unified as to the purpose and goals of the information resource or knowledge commons at hand, then the community can be said to be *homogenous*. Homogeneity can be quite important in the ultimate robustness of a commons. One of the surprising developments of global digital commons, such as the Open Source movement, is the high degree of cooperation and coordination that has been achieved by apparently disparate individuals, many of whom never have face-to-face contact.

Defining a digital knowledge community would be particularly fruitful in analyzing a complex commons since certain members or groups of members may not be readily apparent with all the different types and levels of users, providers, and policymakers. In Levine's chapter, the *community* is the central focus of the discussion. In his *associational commons,* the community is itself the resource. This is also the case with the Open Access commons that Suber and others discuss in this volume. These types of resources are similar to traditional village commons except that the shared space is virtual and/or intellectual rather than physical.

Rules-in-Use

Rules are shared normative understandings about what a participant in a position must, must not, or may do in a particular action situation, backed by at least a minimal sanctioning ability for noncompliance (Crawford and Ostrom 2005). When these normative instructions are merely written in administrative procedures, legislation, or a contract and not known by the participants or enforced by them or others, they are considered rules-in-form. Rules-in-use are generally known and enforced and generate opportunities and constraints for those interacting. These rules can be analyzed at three levels: *operational, collective choice*, and *constitutional.*

Multiple Levels of Rule-Making

At the *operational* level, individuals are interacting with each other and the relevant physical/material world making day-to-day decisions. For an organization's digital repository,[5] operational rules would affect *who* may submit *what*, as well as how to submit. The second level is the *collective choice* (or policy) level of analysis where individuals interact to make the rules of an operational level. For a library, most collective-choice rules relate to the responsibilities of the library administration for making policy decisions. The *constitutional* level of analysis includes the rules that define who must, may, or must not participate in making collective choices. For a University library, the constitutional rules would exist in the general charter for the University and the broad division of responsibility within the University.

Rules matter at every level in that they "rule-in" some behaviors and "rule-out" others. When one wants to understand why some patterns of interactions and outcomes occur rather than others, one looks at the rules-in-use at these multiple levels for a key part of the explanation. Rules, however, rarely so constrain behavior that they are the sole structure factor affecting who participates, what their incentives are, what interactions ensue, and what outcomes are obtained.[6]

Too often, in environments with rapid technological change, the current rules-in-use are out-of-sync with the capabilities of the technologies. New rules or laws can be made based on lack of adequate information, awareness, or understanding of the true nature of the issues. Often the rules are hard to "see," as with protocols, standards, and computer code. Even more challenging is the occurrence of "technological inversion," where the capabilities of technology contradict traditional missions, values, or even constitutional rights.

Pre-1998 copyright law made clear exceptions in "fair use" for educational purposes. It is not clear whether the decision makers who passed the 1998 Digital Millennium Copyright Act (DMCA) were uninformed or blinded to the extent of the wide ramifications of this, possibly inadvertent, rule change. With the DMCA, licensed software that restricts the number of copies does not contain the flexible facility to make exceptions for fair use. This is an example of usage constrained by the resource's physical nature as well a newer rule (DMCA) contradicting an earlier rule (Fair Use). Circumnavigating the software, even for the sake of fair use, is against the law. None of the statements by witnesses to the Congress expressed the opinion that fair use exemption should be eliminated. Nevertheless, the DMCA has paved the way for increasing Digital

Rights Management.[7] Legal and library scholars are beginning to examine the enforcement of the "new rules" of DRM as a type of private governance (Samuelson 2003a; Madison 2000; 2003; Mendelson 2003).

In an era of rapid change, participants will move from operational situations into collective-choice situations—sometimes without self-conscious awareness that they have switched arenas. While members of the technology team for a local Digital Repository are engaged in discussing the ongoing customization of the software, for example, a member of a team may casually reflect that one of the ways they have been doing things in the past was not working very well. The staff member may say—"Why don't we change our routine and do X next time rather than Y?" Sometimes X is simply a jointly agreed upon strategy within a given set of rules. But other times, X is a new rule that may be adopted by the team without ever self-consciously recognizing that they have just made a new rule for themselves! Thus, most governance systems that have a strong link to an operational-level situation move dynamically over time across levels as changes in the physical environment and in the community produce outcomes that participants find less desirable than other outcomes they perceive to be feasible with a change from Y to X way of operating.

Intellectual Property Rights as Rules

Intellectual property rights are national and international formal rules as well as informal rules-in-use (see Ghosh, chapter 8, p. 5). Most authors and researchers are acquainted with the elementary rights and duties of copyright and patents, although both have become complex and surrounded by controversy within the digital arena. New information technologies allow the capture of information far beyond what the original drafters of these legislations ever imagined (Litman 2001; Samuelson 2003). In order to provide an alternative to the brittle confines of copyright law, a group of legal scholars developed the Creative Commons[8] in 2002. This service uses "private rights to create public goods . . . a single goal unites Creative Commons' current and future projects: to build a layer of reasonable, flexible copyright in the face of increasingly restrictive default rules." This collective action initiative is a case of changing operational rules in order to adapt to evolving technologies and new forms of restrictions. Millions of individual and corporate authors, musicians, and artists worldwide have already adapted to using this licensing system.

In general, property rights define actions that individuals may take in relation to other individuals regarding some "thing." If one individual has a right, someone else has a commensurate duty to observe that right. Developed from the earlier classification of Schlager and Ostrom (1992), we identify seven major types of property rights that are most relevant to use in regard to the digital knowledge commons.[9] These are defined as access, contribution, extraction, detraction, management/participation, exclusion, and alienation.

Access	The right to enter a defined physical area and enjoy nonsubtractive benefits.
Contribution	The right to contribute to the content.
Extraction	The right to obtain resource units or products of a resource system.
Removal	The right to remove one's artifacts from the resource.
Management/ Participation	The right to regulate internal use patterns and transform the resource by making improvements.
Exclusion	The right to determine who will have access, contribution, extraction, and removal rights and how those rights may be transferred.
Alienation	The right to sell or lease management and exclusion rights.

The rights outlined above may be useful in rule setting for an organization's digital repository. Understanding that property rights—whether intellectual or real—are bundles of rights is extremely important. There are many forests, for instance, that are governmental property but where a community has the right to manage, harvest, and sell the forest products but does not have the right to sell the land. It was this bundling of rights that the Creative Commons developers adapted with their six core licenses.[10] The understanding of the "bundle of rights" within property rights is steadily growing because of the increased online visibility of the Self-Archiving Initiative and the Creative Commons. Many authors, however, are still not aware that they can retain copyright while making their works available through open access (Harnad 2001; Hess 2005).

For the purpose of analysis, it is important to remember that all knowledge and all technologies are human artifacts, with agreements and rules, and strongly tied to the rules of language itself.[11] Thus, knowledge has an important cultural component as well as intellectual, economic, and political functions. As such, it is a "flow resource" that must

be passed from one individual to another to have any public value**.** The rules connected with knowledge, epistemic communities, and information technologies must continually be adapted as those technologies and communities change and grow. Rules need to be flexible and adaptable order to create effective institutional design and ensure resource sustainability.[12]

The Action Arena

Action arenas are comprised of participants making decisions within a situation affected by the physical, community, and institutional characteristics that will then result in varying patterns of interactions and outcomes (E. Ostrom 2005, chap. 2).

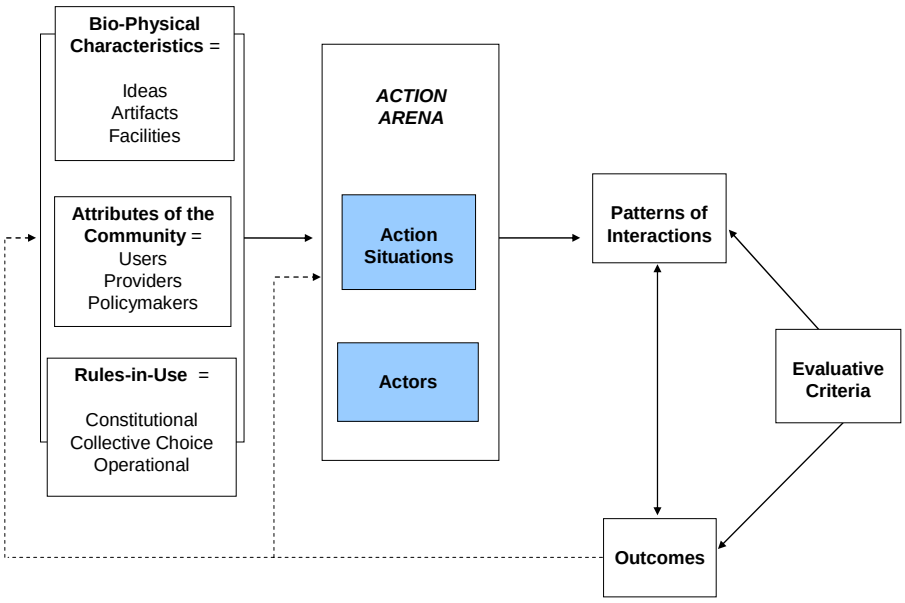

Figure 3. Action Arena Highlighted in IAD

Action arenas can occur throughout all levels of rule and decision making including the operational choice, the collective choice level, and the constitutional choice levels discussed above. They can also occur at the local, regional, or global levels. Importantly, the action arena is at the heart of any analysis involving *institutional change.*

In our discussion we will apply the IAD framework specifically to the diverse arenas involved in developing digital repositories for research materials. The relevant actions could thus be trying to get faculty and departments to voluntarily submit their artifacts to the university repository, agreeing on the format and metadata standards for an international online global archive such as the microbiological commons, or deciding on the policies of who can access which collections held in the facility, as well as many others.

Action Situation: Building a Digital Repository

The action situation focuses on with how people cooperate or do not cooperate with each other in various circumstances. The analysis needs to identify the specific participants and the roles they play within the situation. It will look at what actions have been taken, can be taken or will be taken and how these actions affect outcomes. How much control does each participant have and how much information do they have about the situation? Are all the actors equally informed? Are decisions being made to address short-term dilemmas or are long-term solutions being sought? Are varying types of outcomes possible? What are the costs and benefits?

In the example of building a university digital repository the levels of actions and decisions will be polycentric—that is, there will be decentralized, alternative areas of authority and rule and decision making. Say the intended action is to build a digital repository and populate it with faculty research products—both published and unpublished. There will be actions and decisions made by library committees and subcommittees and by the library administration. At the same time, there will be actions taken by faculty groups and committees, and multiple actions and decisions made by computer technology committees and groups.

In analyzing situations, one is particularly concerned with understanding the *incentives* facing diverse participants. With an institutional repository, many incentives exist for faculty to want to submit their research. Most immediate is the high visibility, usage and citation impact that free, online articles receive. It has been estimated that the citation rate of an article's cited in other journals increases dramatically when the cited article is freely accessible online (Brody and Harnad 2004).[xiii] This *visibility/impact incentive* pertains to organizations as well as to individual authors (Savenije 2004; Crow 2002). Well-populated and widely used university repositories, for instance, can reflect a university's quality and can "demonstrate the scientific, societal, and economic relevance of its research activities, thus increasing the institution's visibility, status, and public value" (Crow 2002). Higher citation counts also lead to more research funding for the author and organization as well as career/salary benefits for the authors (Smith and Eysenck 2002; Harnad et al. 2003).

Valuable scholarly and scientific information that can be harvested through its metadata will greatly facilitate the global knowledge exchange and further the time-worn

tradition of open science. It is no surprise, therefore, that even greater incentives exist in developing countries for the construction of digital repositories. Online accessibility gives voice, visibility and impact to authors of important research who are often passed by in the western scientific journals.[xiv] At the same time open access gives developing country researchers greater access to the global scientific literature (Kirsop 2004), thereby informing and strengthening their research.[xv].

The initial planning process requires strong leadership, great amounts of energy, and time *from individuals* or a small group. The impetus for MIT's D-Space repository software development (http://dspace.org/index.html) grew from discussions between the director of the libraries and faculty members.[xvi] The director then became the driving force of the initiative. Kansas University's Provost, David Shulenburger encourages librarians to be those individuals, educating their university presidents and chief academic officers, as well as the faculty, about the current trends in scholarly publishing and the potential of open access. Most important, faculty need to "get the message."[xvii] On the other hand, one of the strongest voices in the international self-archiving and institutional repository movement is Stevan Harnad, a professor of Cognitive Science at Southampton University.

In order for the incentives to be effective, the participating community—the faculty and researchers—need to be educated about them. Harnad (2003b) writes that "It is becoming apparent that our main challenge is not creating university repositories, but creating policies and incentives for filling them.[xviii]" Many faculty are not yet familiar with the capabilities of global cross-archive metadata harvesting.[xix] Since experience is already showing that creating a university repository and encouraging faculty to fill it is

not enough, it may be that some kind of formal requirement would be the best method of filling such repositories (Swan and Needham 2005, 34). It may take much longer than hoped to build successful repositories where faculty participate routinely and willingly. The requirements for such institutional change may be much more complex than we imagine, while social capital and trust are built, and while the process of participating is simplified. Faculty from different disciplines will take varying amounts of time to assimilate the new and gravitate from the old ways of publishing.

A major impetus that may move many institutions from reluctance to action is the growing support for the Berlin Declaration.[xx] The 2003 Declaration encouraged support for the principles of Open Access.[xxi] The 2005 Berlin 3 meeting in Southampton, UK, moved the initiative from one of passive support to actual implementation of the principles by recommending that institutions should (1) *require* that their researchers self-archive all of their published articles and (2) as *encourage and support* publishing in OA journals as much as possible. Several institutions have adapted policies that now require self-archiving of non-OA journal articles and encourage and support publishing in suitable OA journals where possible. The University of Southampton has been the overwhelming leader in the Open Archives movement. Its School of Electronics and Computer Science, developed a very clear, systematic and relentless mission in the mid-1990s to promote self-archiving. It prevailed in creating Cogprints in 1997, Eprints Open Source Software in 2000, Citebase in 2001, the Archive Registry, the Policy Registry, the Journal Policy Directory, and it provided the model policy for both the Berlin Declaration and the UK Recommendation.[xxii] And, indeed, it may be universities like Southampton that will ultimately lead the way for the rest of the world. Referring to the slow rise of

repositories and the difficulties of compliance in the U.S., Indiana University Professor and Dean Blaise Cronin suggests that it may take the success of repositories from smaller countries with centralized educational systems, where policies are uniform and participation is required, to demonstrate the overwhelming value of a successful, well-populated repository (Cronin 2005).

The University of Kansas was the first American university to sign the principles. Its endorsement was drafted by the University Faculty Senate and was backed by the University Provost, who is an enthusiastic supporter of open access. The endorsement is not a requirement, but faculty are strongly urged to deposit their publications into the university's repository by the provost and the council.[xxiii] Three months after the endorsement the university's IR, KU ScholarWorks"[xxiv] has around 500 records which indicates a low compliance rate. Other institutions with new OA requirement policies are Minho University in Portugal, 12 Dutch universities, and the Max Planck Society with its 78 institutes. Over time, it will become more evident which actions strategies are most effective for implementing and populating repositories.

In this volume, Kranich, Levine, Schweik, and Lougee all discuss action arenas within different knowledge commons. The measure of success will be how people behave in response to those actions and how those responses determine the outcomes.

Patterns of Interaction

The exogenous characteristics, the incentives, the actions, and the other actors all contribute to the patterns of interactions. In a commons, how the actors interact strongly

affects the success or failure of the resource. As figure 4 illustrates, the patterns of interaction are intricately linked to the action situations.

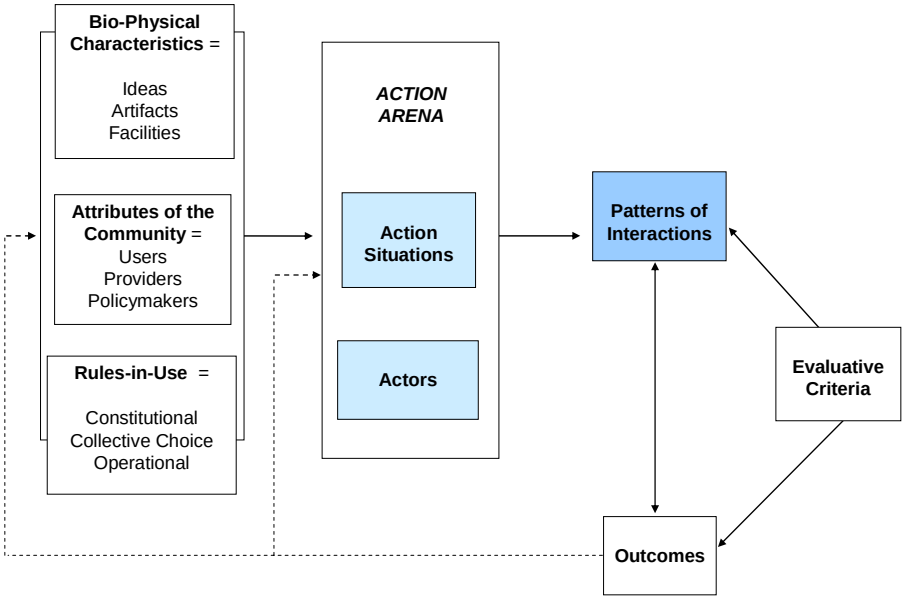

Figure 4. Patterns of Interaction Following the Action Situation

Developing a university repository is a commons activity. It requires multiple layers of collective action and coordination. It also requires a common language and shared information and expertise. One can free ride on that production process by not depositing materials that need to be in the repository. But the free riding can only occur with those members of the local knowledge commons—the faculty and researchers who are expected to contribute to the repository.

We discussed the multiple incentives that should motivate actors to participate. Various aspects of free riding and misuse have to do with noncompliance with the rules related to the development of a university repository. A perverse outcome on the use side of the public good aspect of a university repository is *underuse*. While scholars who have

focused primarily on natural resource commons will be amused to see a problem of underuse, it is an inefficient use of resources to make a major investment in a university repository that is not used and the knowledge in it not made available to those who need it. Others outside that community who browse, search, read, download, or print out documents in the repository are *not* free riding. In fact, they enhance the quality of the resource by using it.

Are the participants able to gain sufficient information about the structure of the situation, the opportunities they and other participants face, and the costs of diverse action, that they develop increasing trust that the situation helps to generate productive outcomes and in the expected behavior of others? Patterns of interaction can be strongly conflictual especially when there is hyperchange in the community of users, and their values and goals. In addition to conflict, interactions may be simply unfocused and unthinking—a part of a growing "culture of carelessness" (Baron 2000) where quick-fix solutions take the place of collaborative analytical processes. In the university community, patterns of interaction may be influenced by hierarchies, lack of respect, and distrust that often accompanies the "tribalism" of disciplines (Becher and Trowler 2001; see Thorin 2003, 13, who discusses the "complexity embedded in the disciplines").

We have focused so far on university or organizational repositories. Our own experience lies in the construction of an epistemic repository—the Digital Library of the Commons (DLC).[xxv] As of December 2005, there are 1035 full-text papers, dissertations, and published articles in the repository. Epistemic repositories could be obstacles to institutional or university repositories. Work on the DLC began in 2000 when there were few repositories at all. It encourages submissions by colleagues in developing countries

where repositories are not yet established.[xxvi] And it gives visibility to a widely interdisciplinary area of study that is often not recognized by local departments and universities. As we discussed, there are many incentives but participation is lagging. We have made numerous attempts to educate the community through demonstrations, presentations, and articles (see Hess 2005). Most of the documents contained in the repository have been submitted by the DLC staff and conference chairs after receiving author permissions from local, regional and international conference. This is a viable strategy to get authors to participate, with librarians, information technologies, and researchers working collaboratively in the provision of new knowledge.

Outcomes

In the environmental commons research, the analytical process often begins with the outcomes, especially negative outcomes, such as "why is there continual drought in the African Sahel?" or "why are the cod fisheries close to depletion?" Analysis can also be motivated by confusing and conflicting outcomes, such as "why is one forest depleted while another ten miles away is thriving?" Sometimes the outcomes in the knowledge commons seem crystal clear, as with the disappearance of footnote or citation URLs that Waters discusses or the loss of important information through mandatory filters that Kranich talks about in chapter 4.

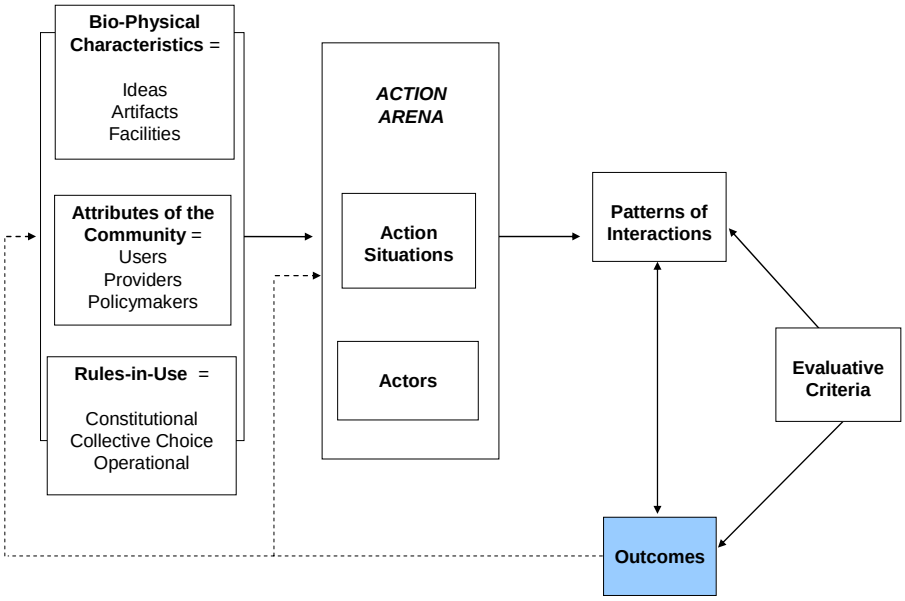

Figure 5. Outcomes in the IAD

Most of the outcomes that have been written about in the newly emerging knowledge commons literature are either types enclosures of information that used to be open or the creation of new digital commons that provide better access to information.[xxvii] Writers tend to point to outcomes that they like or dislike but few have gone into in-depth analysis. Thus far we (all of us!) have mainly been at the "look what is happing!" stage. In the midst of the relentless hyperchange it can seem like a full-time job just keeping up with what is happening in the realm of digital knowledge commons.

Within the broad spectrum of the knowledge commons there are a myriad number of competing outcomes—some of which are considered negative, while others are seen as positive (see table 1). The conflicting outcomes reflect a highly complex resource where new technologies have increased capabilities to "harvest" information as a commodity. There are now multiple uses by expanded communities for the same resource—not just

scholarship, but entrepreneurship, competition, and financial gain. Because the outcomes are often the result of numerable actions, it is helpful to keep an interdisciplinary frame of mind. The *desired* outcome may be the dissemination and preservation of the scholarly record, but contributing factors in the outcome formula are new computer technologies, financial constraints, university corporatization, declining numbers of tenured faculty, lack of information, and new intellectual property rights legislation.

Table 1. Potential Positive or Negative Outcomes in Various Knowledge Commons

NEGATIVE OUTCOMES	POSITIVE OUTCOMES
Proprietary scientific databases (enclosure)	**Open access research libraries** (access)
Digital divide and information inequity (inequity)	**Global use, provision and production** (equity)
Lack of standards across collections (degradation)	**Standards and interoperability of digital information** (diversity & rich commons)
Conflict and lack of cooperation	**Cooperation and reciprocity** (social capital)
Lack of quality control (pollution)	**Quality control of content** (richness)
Overpatenting and anticommons (enclosure)	**Open science** (enhanced access/ communication)
Noncompliance (weak resource)	**Compliance and participation** (well-populated repositories)
Withdrawal of information (instability, degradation, depletion)	**Preservation of information** (access)
Spam (pollution)	**Scholarly blogs** (enhanced quality information & communication)

Seeing outcomes in their context and as a progression of events may better help us see solutions. At the Workshop on Scholarly Communication as a Commons (the forerunner of this volume described in the Preface of this volume), Clifford Lynch, pointed out that it is difficult to know how we are doing in this uncharted territory of globally distributed information. Indeed, it is possible that the outcomes, such as under-populated digital repositories, are the results of an old path. One might even surmise from using the IAD framework, if the physical characteristics have substantially changed, it is reasonable that the institutional characteristics, the actions, and the patterns of behaviors will have to change—to *adapt*—in order to have successful and sustainable outcomes.

It is possible that successful outcomes in the knowledge commons may be most apparent in the developing world. It is too soon to know. At a pan-African information communication conference in 2004,[xxviii] many African participants were planning actions that would lead to further-reaching outcomes than their western/northern counterparts. They wanted to use university open-access repositories to communicate with indigenous communities, to inform government officials and policymakers on best practices and lessons learned from scientific research, and, ultimately as a way to help alleviate poverty and build sustainable economic development!

Evaluative Criteria

The Evaluative Criteria allows us to assess outcomes that are being achieved as well as the likely set of outcomes that could be achieved under alternative actions or institutional arrangements. Evaluative criteria are applied to both the outcomes and the interactions

among participants that leads to outcomes. While there are many potential evaluative criteria, some of the most frequently used criteria are (1) increasing scientific knowledge, (2) sustainability and preservation, (3) participation standards; (4) economic efficiency, (5) equity through fiscal equivalence, and (6) redistributional equity.

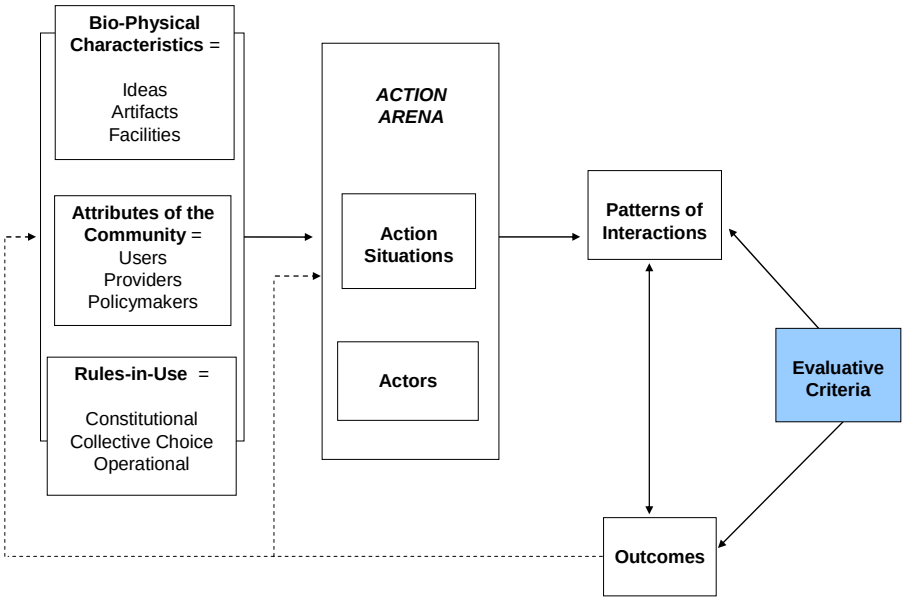

Figure 6. Evaluative Criteria

Increasing Scientific Knowledge

One of the core evaluations made of scientific research is whether it leads to an increase in the knowledge that has been recorded and made available to other scholars, students, and the public at large. The evaluation of increasing scientific knowledge can be based on the amount of high quality information available; the quality and usefulness of the common pool; the local and global usage of the information; and the percentage of free, open access information versus closed, proprietary information. One can also evaluate the markup language, metadata, and format standards that facilitate or restrain

interoperability. One of the hotly debated questions at this time is about the sustainability of the integrity of the scholarly record with the advance of institutional repositories, especially if it results in the demise of academic presses (Anscombe 2005).

Sustainability and Preservation

Sustainable systems are those that meet current needs of many individuals involved in producing, deciding and using a commons (e.g., students, faculty, researchers, librarians, administrators, citizens, public officials) without compromising the ability of future generations also to meet their needs. Unfortunately, because change is part of the human and physical condition, resources can never be sustained "once and for always." Sustainability is an ongoing process that requires monitoring and frequent re-evaluation. Thus, when evaluating the sustainability of a system, one needs to examine the processes involving interactions among participants and whether they increase the physical, social, and human capital involved or slowly erode that capital. In regard to ecological systems, sustainability has usually meant the maintenance of the capacity of an ecological system to support social and economic systems over time (Berkes, Colding, and Folke 2003, 2). When applied to a knowledge commons, one is asking whether these systems can survive themselves over time as well as supporting ecological, social, and economic systems through increased access to relevant information. Are the preservation strategies economically feasible? Such strategic plans will need to factor in changing actors and participants, adaptive software systems, and constantly evolving rules. The process of sustaining the knowledge commons will be a continual juggling act of the requirements

of sudden and demanding new technologies with the steadfastness of long-term commitments. Perhaps the successful plan for sustainability is in the balance.

Participation

As we have pointed out, participation—that is, submission of research artifacts to an institution's repository—is essential to the quality of the whole. It is clear that the incentives and rules must change for authors to participate actively in the open and public provision of knowledge. The challenges for institutional change for a successful digital repository are daunting. Scholars are not used to thinking of themselves as archivists. Yet, the self-archiving aspect of repository requires just that. It may be that participation is successful when the amount of information in a repository has reached a critical mass, so that the norm will be to get one's documents into the system as soon as possible after production or publication. Librarians and technologists can help the system reach a critical mass by scanning and archiving retrospective documents of value. This is what MIT's DSpace repository did recently when the libraries digitized over 10,000 theses and dissertations and put them into the system. In a sense, they participated as information providers by being "proxy submitters."

Economic Efficiency

Economic efficiency is determined by the magnitude of the change in the flow of net benefits or costs associated with an allocation or reallocation of resources. The concept of efficiency plays a central role in studies estimating the benefits and costs or rates of return to investments, which are often used to determine the economic feasibility or desirability of public policies. When considering alternative institutional arrangements, therefore, it is crucial to consider how revisions in the rules affecting participants will alter behavior and, hence, the allocation of resources. Many studies have already shown the economic efficiency of open access publishing, but finding the appropriate rules for sharing the new costs of this form of publication is still under development.

Achieving economic efficiency in path-dependent libraries is a delicate task. In most academic libraries, the "digital library programs" are separate from the traditional departments in the library, such as the subject areas, acquisitions, and cataloging. This made sense 10-15 years ago but today most all information resources are "born digital." How to integrate and make these two library systems efficient is a major concern.

Equity through Fiscal Equivalence

There are two principal means to assess equity: (1) on the basis of the equality between individuals' contributions to an effort and the benefits they derive and (2) on the basis of differential abilities to pay. The concept of equity that underlies an exchange economy holds that those who benefit from a service should bear the burden of financing that service. Perceptions of fiscal equivalence or a lack thereof can affect the willingness of individuals to contribute toward the development and maintenance of resource systems.

One of the perplexing issues related to the publication of journals in the digital age is how to "tap" the beneficiaries of the provision of a journal to pay for the cost of publication including managing the flow of documents, choosing referees, refereeing, editing, and publication itself. The costs used to be borne by a mixture of academic disciplinary associations drawing on their membership fees, subscriptions by members of disciplines and by Libraries, by Universities who benefited from the prestige of having a well-respected journal housed at their University, by publishing houses, and by advertisers in the journal. As more journals are "going-on-line" and not relying on publishers, a substantial proportion of the costs are being shifted to the authors of accepted articles. Trying to work out an equitable assignment of the costs to the various beneficiaries is a process that is challenging given that there are few ways of determining the relative size of the benefit flow.

Redistributional Equity

Policies that redistribute resources to poorer individuals are of considerable importance. Thus, although efficiency would dictate that scarce resources be used where they produce the greatest net benefit, equity goals may temper this objective, resulting in the provision of facilities that benefit particularly needy groups. This is an example of a type of the digital divide that is becoming more frequent. International scientific collaboration is steadily increasing, but the information divide between the haves and have-nots is also increasing. Should universities from developed countries take a more active role in providing access services with partners in developing countries?[xxix] On the other hand, redistributional objectives tend to conflict with the goal of achieving fiscal equivalence,

and tough decisions as to which aspect of equity needs priority must be made. Should an on-line journal charge authors from developing countries a lower "publication" fee in order to enhance redistributional objects, but then who pays for the increased efforts to provide information to scholars in developing countries?

Requirements of Adaptive Governance in a Complex System

Researchers who have focused on the governance[xxx] of natural resources have struggled with the question of why some self-governing systems have survived for many years (some as long as 1,000 years), while others collapse within a few years, or even after a long and successful era. There is no simple answer. One of the core problems that has been documented is that rapid change in the environment and in the community is always a major challenge for any governance system. Over time, scholars have come to a general level of agreement that there are several requirements that somehow need to be met for a governance system to be adaptive and robust over time. These are: providing information, dealing with conflict, inducing rule compliance, providing infrastructure, and being prepared for change (see Dietz, Ostrom, and Stern 2003). A wide diversity of specific ways of meeting these requirements have been observed. Let us briefly discuss each of these requirements.

Providing Information (Reflexivity of Knowledge—Basic to All Systems

All effective governance systems at multiple levels depend on good, trustworthy information about stocks, flows, and processes within the entities being governed, as well as about the relevant external environment. This information must be matched with the

level of aggregation that individuals are using to make decisions. All too often, large flows of data are aggregated. Decisions are, however, frequently made by much smaller units where there is substantial variance from the average reported in the aggregated data. Information must also be fit with decision makers' needs in terms of timing, content, and form of presentation. Informational systems that simultaneously meet high scientific standards and serve ongoing needs of decision makers and users are particularly useful. Information must not overload the capacity of users to assimilate it. Finding ways to measure and monitor the outcomes generated for a University repository that has substantial impact outside the university is an informational challenge for any governance system.

Dealing with Conflict

Sharp differences in power and in values across interested parties make conflict inherent in all choices of any importance. Conflict resolution can be as important a motivation for designing institutions as is the concern with building and maintaining a resource itself. People bring varying perspectives, interests, and fundamental philosophies to problems of the scholarly commons. Conflicts among perspectives and views, if they do not escalate to the point of dysfunction, can spark new understandings and better ways of accomplishing outcomes. The core problem is designing conflict resolution mechanisms that enable participants to air differences and to achieve resolutions that they consider legitimate, fair, and scientifically sound.

Inducing Rule Compliance

As we have learned, effective governance also requires that whatever rules are adopted that they are generally followed, with reasonable standards for tolerating small variations that always occur due to errors, forgetfulness, and urgent problems. It is generally most effective to impose modest sanctions on first offenders, and gradually increase the severity of sanctions for those who do not learn from their first or second encounter (E. Ostrom 1990). The challenge in designing a new governance system is how to use informal strategies for achieving compliance at the beginning that rely on participants' commitment to a new enterprise and the rules they have designed and subtle social sanctions. When a more formal system is developed, those who are the monitors and those who impose sanctions must be seen as effective and legitimate by participants or rule evasion will overwhelm the governance system.

Providing Infrastructure

Infrastructure includes physical and institutional structures and technology. Thus, the infrastructure affects how a commons can be utilized, the extent to which waste can be reduced in resource use, and the degree to which the physical conditions of a resource and the behavior of users can be effectively monitored. Indeed, the ability to choose institutional arrangements depends in part on infrastructure—largely in regard to ways of storing and communicating information. Infrastructure also affects the links between local commons and regional and global systems.

Consider (Hyper)Change the Norm

Institutions must be designed to allow for adaptation because some current understanding is likely to be wrong, the required scale of organization can shift, and biophysical and social systems change. Fixed rules are likely to fail because they place too much confidence in the current state of knowledge, while systems that guard against the low probability, high consequence possibilities and allow for change may be suboptimal in the short run but prove wiser in the long run. This is a principal lesson of adaptive management research.

Conclusion

The purpose of this chapter has been to clearly guide one through the various components of the IAD framework. It has been a tested tool for analyzing traditional commons dilemmas, for understanding inexplicable outcomes, and for facilitating new institutional design. We expect that the framework will evolve to better fit with the unique attributes of the production and use of a knowledge commons. Over time, it will be possible to extract design principles for robust, long-enduring knowledge commons. After more efforts succeed and others fail we will be able to better understand what makes various knowledge commons work and how we can better work toward robust and sustainable resources.

Notes

[1] Referring to the poem of John Godfrey Sax (1816-1887), "The Blind Men and the Elephant:" "It was six men of Indostan/To learning much inclined/Who went to see the Elephant/(Though all of them were blind). . . ." At: http://www.wordfocus.com/word-act-blindmen.html

[2] For longer-term analyses, feedback from the outcomes of interactions tends to change these "temporarily" exogenous variables. And, when one is analyzing a rapidly evolving system with changes occurring at multiple levels relatively rapidly, these feedback loops are very important.

[3] See http://www.openarchives.org/community/index.html and http://www.openarchives.org/organization/index.html

[4] See http://www.itu.int/wsis/documents/doc_multi.asp?lang=en&id=2266|2267

[5] Usually referred to as an "institutional repository." We will refer to this kind of organizational archive as a "digital repository" to avoid confusion with our discussion of "institutions" and "institutional analysis."

[6] For more on rules, see Commons, 1968; Bromley, 1989; Agrawal, 1994; Crawford and E. Ostrom, 2005.

[7] See http://www.eff.org/IP/DRM/fair_use_and_drm.php and http://www.eff.org/IP/DMCA/20030102_dmca_unintended_consequences.html
Also, Cohen, Julie, "Call It the Digital Millennium *Censorship* Act: Unfair Use," *The New Republic Online*, May 23, 2000 http://www.law.georgetown.edu/faculty/jec/unfairuse.html

[8] See http://creativecommons.org/

[9] In Schlager and Ostrom (1992), the term used for *extraction* is *withdrawal*

[10] "Offering your work under a Creative Commons license does not mean giving up your copyright. It means offering some of your rights to any member of the public but only on certain conditions." http://creativecommons.org/about/licenses

[11] Vincent Ostrom has repeatedly emphasized the artifactual nature of knowledge and institutions:

> Every development—street sweeping, production of fertilizers, irrigation works, the development of new seed stocks—a component to it that is concerned with how the activities of people are organized in relation to one another." (Vincent Ostrom, Organization, working paper, Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, Indiana, 1969, on file with authors)

[12] There are numerous works on the nature and application of rules by commons scholars. See Agrawal, 1994; Poteet and Welch, 2004; Ostrom, 2005; Young, 1996; and search "rules" at http://dlc.dlib.indiana.edu/cpr/index.php

[xiii] See http://opcit.eprints.org/oacitation-biblio.html for a comprehensive list of visibility/usage/impact studies.

[xiv] A 1995 survey revealed that the main index of scientific journals, the *Science Citation Index*, indexes 3,300 journals of the 70,000 that are published worldwide. Less than 2% of the journals are from developing countries (with 80% of the world's population). The author writes that the "near invisibility of less developed nations may reflect the economics and biases of science publishing as much as the actual quality of Third World

Research." (Gibbs, 1995). The authors could find no evidence that these numbers have improved over the last ten years.

[xv] While rates of cited references vary among disciplines, multiple studies have demonstrated the overwhelming advantage for authors in the natural sciences who make their research artifacts freely available online by self-archiving their non-OA journal articles on the web. Citation counts are compared for articles within the same issue of the same non-OA journal that are or are not made OA by their authors through self-archiving (Lawrence, 2001; Harnad and Brody 2004a; Brody et al., 2004; Hitchcock et al. 2003; Murali et al. 2004). Some other impact studies show that citation rates for OA journals actually have fairly similar patterns to non-OA journals, but that the citations of OA journal articles appear earlier than for hardcopy articles (Testa and McVeigh 2004; Pringle 2004). See The Open Citation Project at http://opcit.eprints.org/oacitation-biblio.html#harnad-brody04a for a comprehensive, frequently updated bibliography of open access visibility studies.

[xvi] See "MIT's DSpace Experience: A Case Study." http://www.dspace.org/implement/case-study.pdf

[xvii] "Key to any success was defining the problem confronting us. It is not 'the library problem' or 'the Provost's problem,' but 'the scholarly communication problem'" (Shulenburger, 1999).

[xviii] One well-known study found that 49% of faculty have self-archived at least one article in some way but out of the 51% who have not, 71% were unaware of the option (Swan and Brown, 2005). Even more significant was the finding that 81% stated that they would comply willingly with self-archiving *if their institutions required them to;* 14%

more would comply reluctantly, and only 5% say they would not comply (Ibid.). With 92% of journals having already given authors self-archiving their green light, but with authors self-archiving only 15% of their articles.

[xix] OAIster harvests data from 6,073,500 records **from** 572 institutions. See http://oaister.umdl.umich.edu/o/oaister/

[xx] See: http://www.zim.mpg.de/openaccess-berlin/berlindeclaration.html

[xxi] OA means "immediate, permanent, free online access to the full text of all refereed research journal articles" (Harnad 2005).

[xxii] http://www.ecs.soton.ac.uk/~harnad/Temp/UKSTC.htm

[xxiii] The endorsement is online at: http://www.provost.ku.edu/policy/scholarly_information/scholarly_resolution.htm

[xxiv] https://kuscholarworks.ku.edu/dspace/

[xxv] At http://dlc.dlib.indiana.edu The DLC went online in 2001.

[xxvi] The DLC staff will digitize hard copy texts and images, convert them to PDF files, assign the metdata, and submit them for those who do not want to go to the trouble or who do not have the digital capability.

[xxvii] Examples of knowledge commons that have been analyzed are *congestion and overuse* on the Internet caused, for instance, by peak demand and not enough bandwidth(Gupta, Stahl, and Whinston, 1995; Hess, 1995; Huberman and Lukose, 1997; Bernbom, 2000); *free riding* (Adar and Huberman, 2000); *conflict* (Carnevale and Probst, 1997); *deception* (Grazioli, 2004); *withdrawal* (such as the removal of presidential papers from the public domain pursuant to Executive Order #13233) (Evans and Bogus, 2004); *enclosure* (Boyle, 2003); *inequity and the digital divide* (Greco and Floridi, 2004); and

other forms of degradation. Others have focused on positive interactions and outcomes, such as *cooperation* (Weber, 2004; Kollock and Smith, 1995); *institution building* (Dinwoodie, 2004); *collective action* (Rheingold, 2002; Mele, 2003; and *self-organization* (Noonan, 1998).

[xxviii] See *Proceedings of the Conference "Universities: Taking a Leading Role in ICT-Enabled Human Development*, held at Makerere University, Uganda, Sept 5-8, 2004 (forthcoming).

[xxix] This is the notion of "common but differentiated responsibilities" frequently applied in international law and promoted in the in the World Summit on Sustainable Development, Johannesburg, August 2002. See: http://www.cisdl.org/pdf/brief_common.pdf.

[xxx] Governance has to do with humans trying to find ways of making decisions that reduce the level of unwanted outcomes and increase the level of desirable outcomes (E. Ostrom, 1998).

References

URLs accessed 12-2-05

Adar, Eytan, and Bernardo A. Huberman 2000. "Free Riding on Gnutella." *First Monday* 5(10).

Agrawal, Arun. 1999. *Greener Pastures. Politics, Markets, and Community among a Migrant Pastoral People*. Durham: Duke University Press.

Agrawal, Arun. 1994. "Rules, Rule Making and Rule Breaking: Examining the Fit between Rule Systems and Resource Use." In *Rules, Games, and Common-Pool Resources*. E. Ostrom, R. Gardner, and J. M. Walker, eds. Ann Arbor: University of Michigan Press.

Anscombe, Nadya. 2005. "Repositories: Archive Programmes Gain Momentum." Research Information 19 (Oct/Nov) http://www.researchinformation.info/rioctnov05repositories.html

Argyres, N. S., and J. P. Liebeskind 1998. "Privatizing the Intellectual Commons: Universities and the Commercialization of Biotechnology." *Journal of Economic Behavior and Organization* 35(4):427-454.

Altarelli, Guido. 2005."Continuing CERN Action on Open Access." CERN Scientific Information Policy Board. http://doc.cern.ch/archive/electronic/cern/preprints/open/open-2005-006.pdf

Baron, Cheryll A. 2000. "High Tech's Missionaries of Sloppiness." *Salon.com* (December 6). http://dir.salon.com/tech/feature/2000/12/06/bad_computers/index.html

Baron, Robert A. 2002. "Reconstructing the Public Domain: Metaphor as Polemic in the Intellectual Property Wars." Presented at the VRA-ARLIS NINCH Copyright Town Meeting, The Changing Research and Collections Environment: The Information Commons Today," St. Louis, MO, March 23, 2002. http://www.studiolo.org/IP/VRA-TM-StLouis-PublicDomain.htm#Ch004

Barrett, D. 1998. *The Paradox Process.* New York: AMACOM.

Becher, Tony, and Paul Trowler. 2001. *Academic Tribes and Territories: Intellectual Enquiry and the Culture of Disciplines*. 2nd ed. Philadelphia, PA: Open University Press. http://mcgraw-hill.co.uk/openup/chapters/0335206271.pdf

Benkler, Yochai. 1998. "The Commons as a Neglected Factor of Information Policy, Remarks at the Telecommunications Policy Research Conference (Sept. 1998)." http://www.law.nyu.edu/benklery/commons.pdf

Benkler, Yochai. 2003. "The Political Economy of the Commons." *Upgrade: The European Journal for the Informatics Professional* IV/3 (June): 6-10. http://www.upgrade-cepis.org/issues/2003/3/up4-3Benkler.pdf

Berkes, Fikret, ed. 1989. *Common Property Resources: Ecology and Community-Based Sustainable Development*. London: Belhaven.

Berkes, Fikret, Johan Colding, and Carl Folke. 2003. *Navigating Social-Ecological Systems. Building Resilience for Complexity and Change.*

Bernbom, Gerald. 2000. "Analyzing the Internet as a Common Pool Resource: The Problem of Network Congestion." Presented at the Eighth Conference of the

International Association for the Study of Common Property, Bloomington, Indiana, USA, May 31-June 4, 2000. http://dlc.dlib.indiana.edu/documents/dir0/00/00/02/18/index.html

Bollier, David. 2002. "The Enclosure of the Academic Commons." *Academe* 88(5) http://www.aaup.org/publications/Academe/2002/02so/02sobol.htm

Bollier, David. 2002. *Silent Theft: The Private Plunder of our Common Wealth*. New York: Routledge.

Boyle, James. 2002. "Fencing Off Ideas: Enclosure and the Disappearance of the Public Domain." *Daedalus* 131(2):13-25.

Boyle, James. 2003. "The Second Enclosure Movement and the Construction of the Public Domain." *Law and Contemporary Problems* 66/1-2 (Winter/Spring):33-75. http://www.law.duke.edu/journals/lcp/downloads/LCP66DWinterSpring2003P33.pdf

Brody, T., H. Stamerjohanns, S. Harnad, Y. Gingras, C. Oppenheim. 2004). "The Effect of Open Access on Citation Impact."Poster presentation at *National Policies on Open Access (OA) Provision for University Research Output: an International meeting*, Southampton, 19 February 2004. http://opcit.eprints.org/feb19oa/brody-impact.pdf

Bromley, Daniel W. 1989. *Economics Interests and Institutions. The Conceptual Foundations of Public Policy*. Oxford: Basil Blackwell.

Brown, John Seely, and Paul Duguid. 2000. *The Social Life of Information.* Boston: Harvard University Press.

Bush, Vannevar. 1945. "Science The Endless Frontier: A Report to the President." Washington, DC: U.S. Government Printing Office. http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm

Cardenas, Juan-Camilo. 2003. "Real Wealth and Experimental Cooperation: Experiments in the Field Lab." *Journal of Development Economics* 70(2):263-289.

Carnevale, Peter J., and Tahira M. Probst 1997. "Conflict on the Internet." In *Culture of the Internet*. Mawpah, NJ: Lawrence Erlbaum

Commons, John H. [1924] 1968. *The Legal Foundation of Capitalism.* Madison: University of Wisconsin Press.

Computer Science and Telecommunications Board, National Research Council. 2000. *The Digital Dilemma: Intellectual Property in the Information Age*. Washington, DC: National Academy Press.

Crawford, Sue E. S., and Elinor Ostrom. 2005. "A Grammar of Institutions." In *Understanding Institutional Diversity*, ed. Elinor Ostrom, 137-74. Princeton, NJ: Princeton University Press. Originally published in *American Political Science Review* 89(3) (1995): 582-600.

Cronin, Blaise, 2005 "On Libraries and the Digital Environment." Presentation given at the Indiana University Herman B Wells Library, Bloomington Campus http://video.indiana.edu:8080/ramgen/vic/blaise_cronin_20051201.rm?start=00:09:30.

Crow, Raymond. 2002. "The Case for Institutional Repositories: A SPARC Position Paper." Scholarly Publishing & Academic Resources Coalition, Washington, D.C., July. http://www.arl.org/sparc/IR/ir.html

Dalrymple, Dana. 2003. "Scientific Knowledge as a Global Public Good: Contributions to Innovation and the Economy." In *The Role of Scientific and Technical Data and Information in the Public Domain: Proceedings of a Symposium*. J. M.Esanu and P. F. Uhlir, eds. Washington, DC: National Academies Press. http://www.nap.edu/books/030908850X/html

Davenport, Thomas H. and Laurence Prusak. 1998. *Working Knowledge: How Organizations Manage What They Know*. Boston: Harvard University Press.

David, Paul A. 2000. "A Tragedy of the Public Knowledge 'Commons'? Global Science, Intellectual Property and the Digital Technology Boomerang." Stanford Institute for Economic Policy Research, Stanford University, Stanford, CA. (SIEPR Discussion Paper, no. 00-02). http://ideas.repec.org/p/wpa/wuwpdc/0502010.html

Davis, Philip M. 2003. "Tragedy of the Commons Revisited: Librarians, Publishers, Faculty and the Demise of a Public Resource." *Portal* 3(4) (October): 547-62. http://people.cornell.edu/pages/pmd8/3.4davis.pdf

Dietz, Tom, Elinor Ostrom, and Paul C. Stern. 2003. "The Struggle to Govern the Commons." *Science* 302 (Dec. 12): 1907-12.

Dinwoodie, Graeme B. 2004. "Private Ordering and the Creation of International Copyright Norms: The Role of Public Structuring." *Journal of Institutional and Theoretical Economics* 160(1):161-180.

Duderstadt, James J., Daniel E. Atkins, and Douglas Van Houweling. 2002. *Higher Education in the Digital Age: Technology Issues and Strategies for American Colleges and Universities*. Westport, CT: Praeger.

Duderstadt, James, et al. 2001. *Issues for Science and Engineering Researchers in the Digital Age*. Washington, DC: National Academy Press. http://www.nap.edu/html/issues_digital/notice.html

Evans, R. Sean, and Brad Bogus. 2004. "Federal Government Information Access in the Wake of 9/11." http://jan.ucc.nau.edu/~rse/FederalAccess.htm

Ewing, John. 2003. "Copyright and Authors." *First Monday* 8/10 (October). http://www.firstmonday.dk/issues/issue8_10/ewing/

Futrelle, Joe. "Emerging Tools for Building Integrated Scientific Data Resources." National Center for Supercomputing Applications. www.ncsa.uiuc.edu/People/futrelle/ppt/NIH0106.ppt

Gibbs, W. Wayt. 1995. "Lost Science in the Third World." *Scientific American* (August):92-99.

Gibson, Clark C. 2005. "In Pursuit of Better Policy Outcomes." *Journal of Economic Behavior & Organization* 57(2):227-230.

Gibson, Clark, Margaret McKean, and Elinor Ostrom. 2000. *People and Forests. Communities, Institutions, and Governance*. Cambridge, Mass: MIT Press.

Ginsparg, Paul. 2000. "Creating a Global Knowledge Network." *BioMed Central*. http://www.biomedcentral.com/meetings/2000/foi/editorials/ginsparg

Golich, Vicki L. 1991. "A Multilateral Negotiations Challenge: International Management of the Communications Commons." *Journal of Applied Behavioral Science* 27(2):228-250.

Grazioli, Stefano. 2004. "Where Did They Go Wrong? An Analysis of the Failure of Knowledgeable Internet Consumers to Detect Deception over the Internet." *Group Decision and Negotiation* 13(2):149-172.

Greco, Gian Maria, and Luciano Floridi. 2004. "The Tragedy of the Digital Commons." *Ethics and Information Technology* 6(2):73-81.

Guédon, Jean-Claude. 2001. "In Oldenburg's Long Shadow: Librarians, Research Scientists, Publishers, and the Control of Scientific Publishing." ARL Publications Distribution Center. http://www.arl.org/arl/proceedings/138/guedon.html

Gupta, Alok, Dale O. Stahl, and Andrew B. Whinston 1995. "The Internet: A Future Tragedy of the Commons." Presented at the Conference on Interoperability and the Economics of Information Infrastructure, July 6-7, 1995, Rosslyn, VA. http://cism.mccombs.utexas.edu/alok/wash_pap/wash_pap.html

Harboe-Ree, Catherine, Michele Sabto, and Andrew Treloar. 2003. "The Library as Digitorium: New Modes of Information Creation, Distribution and Access." In *Proceedings Exploring Educational Technologies: From Strategy to Implementation*, Monash University. http://eprint.monash.edu.au/archive/00000018/

Harnad, Stevan. 2005. "The Implementation of the Berlin Declaration on Open Access." *D-Lib Magazine* 11 (3) http://www.dlib.org/dlib/march05/harnad/03harnad.html

Harnad, Stevan. 2001. "The Self-Archiving Initiative: Freeing the Refereed Research Literature Online." *Nature* 410 (26 April):1024-25. http://www.ecs.soton.ac.uk/~harnad/Tp/nature4.htm

Harnad, Stevan. 2003a. "For Whom the Gate Tolls? How and Why to Free the Refereed Research Literature Online Through Author/Institution Self-Archiving, Now." http://www.ecs.soton.ac.uk/~harnad/Tp/resolution.htm#1.4

Harnad, Stevan. 2003b. "Publish or Perish: Self-Archive to Flourish." In the American Scientist Open Access Forum. http://www.ecs.soton.ac.uk/~harnad/Hypermail/Amsci/2838.html

Harnad, Stevan, and Brody, Tim. 2004a. "Comparing the Impact of Open Access (OA) vs. Non-OA Articles in the Same Journals." *D-Lib Magazine*, Vol. 10 No. 6, June 2004. http://www.dlib.org/dlib/june04/harnad/06harnad.html

Harnad, Stevan Les Carr, Tim Brody, and Charles Oppenheim. 2003. "Mandated online RAE CVs Linked to University Eprint Archives." *Ariadne* Issue 35. http://www.ariadne.ac.uk/issue35/harnad/

Heikkila, Tanya, and Kimberley R. Isett 2004. "Modeling Operational Decision Making in Public Organizations: An Integration of Two Institutional Theories." *American Review of Public Administration* 34(1):3-19.

Heller, Michael A. 1998. "The Tragedy of the Anticommons: Property in the Transition from Marx to Markets." *Harvard Law Review* 111(3):622-688.

Hess, Charlotte. 2005. "A Resource Guide for Authors: Open Access, Copyright, and the Digital Commons." *Common Property Resource Digest* 72 (March)

http://www.indiana.edu/~iascp/E-CPR/cpr72.pdf
Hess, Charlotte. 1995. "The Virtual CPR: The Internet as a Local and Global Common Pool Resource." Presented at "Reinventing the Commons," the fifth annual conference of the International Association for the Study of Common Property, May 24-28, 1995, Bodoe, Norway.
Hess, Charlotte, and Elinor Ostrom. 2003. "Ideas, Artifacts, and Facilities: Information as a Common-Pool Resource." *Law and Contemporary Problems* 66(1-2):111-46. http://www.law.duke.edu/journals/lcp/
Hitchcock, Steve, Tim Brody, C. Gutteridge, Les Carr, and Stevan Harnad 2003. "The Impact of OAI-based Search on Access to Research Journal Papers" *Serials* 16(3) 255-260. Author eprint: http://opcit.eprints.org/serials-short/serials11.html
Holman, JoAnne. 1997. "An Information Commons: Protection for Free Expression in the New Information Environment." (Ph.D. Dissertation, Indiana University, 1997).
Huberman, Bernardo A., and Rajan M. Lukose. 1997. "Social Dilemmas and Internet Congestion." *Science* 277 (July 25): 535-37.
Ianella, Renato. 2001. "Digital Rights Management (DRM) Architectures." *D-Lib Magazine* 7(6) (June).
Imperial, Mark, and Tracy Yandle 2005. "Taking Institutions Seriously: Using the IAD Framework to Analyze Fisheries Policy." *Society and Natural Resources* 18(6):493-509.
Kahle, Brewster, Rock Prelinger, and Mary E. Jackson. 2001. "Public Access to Digital Material." *D-Lib Magazine* 7(4) (October). http://www.dlib.org/dlib/october01/kahle/10kahle.html
Kirsop, Barbara. 2004. "Impact of OA on Science in Developing Countries, with a Report on the recent World Summit on the Information Society (WSIS) meeting, Electronic Publishing Trust for Development [presentation slides].
Kollock, Peter, and Marc Smith. 1995. "Managing the Virtual Commons: Cooperation and Conflict in Computer Communities." In *Computer-Mediated Communication*, ed. Susan Herring. Amsterdam: John Benjamins
Kranich, Nancy. 2003. "Libraries: The Information Commons of Civil Society." In *Shaping the Network Society*, ed. D. Schuler. Boston: MIT Press. http://dlc.dlib.indiana.edu/documents/dir0/00/00/09/75/index.html ;
Lawrence, Steve. 2001. "Online or Invisible." *Nature* 411(6837). http://www.neci.nec.com/~lawrence/papers/online-nature01/
Lee, Edward. 2003. "The Public's Domain: The Evolution of Legal Restraints on the Government's Power to Control Public Access through Secrecy or Intellectual Property." *Hastings Law Journal* 55:94-209.
Lessig, Lawrence. 1999. "Code and the Commons." Keynote Address at the Conference on Media Convergence, held at Fordham University Law School, February 9, 1999. http://cyber.law.harvard.edu/works/lessig/fordham.pdf
Lessig, Lawrence. 2003. "The Creative Commons." *Florida Law Review* 55(3):763-78: 766,768.

Levin, Simon. 1999. *Fragile Dominion: Complexity and the Commons*. Reading, MA: Perseus Books.

Lougee, Wendy Pradt. 2002 “Diffuse Libraries: Emergent Roles for the Research Library in the Digital Age.” Washington, DC: Council on Library and Information Resources. (Perspectives on the Evolving Library). http://www.clir.org/pubs/reports/pub108/contents.html

Lutzker, Arnold. 1999. “What the DMCA and the Copyright Term Extension Act Mean to the Library Community: Primer.” http://www.ala.org/washoff/primer.html.

Lynch, Clifford. 2003. “Institutional Repositories: Essential Infrastructure for Scholarship in the Digital Age.” ARL Bimonthly Report 226. http://www.arl.org/newsltr/226/ir.html

Madison, Michael J. 2000. “Complexity and Copyright in Contradiction.” *Cardozo Arts and Entertainment Law Journal* 18:125-74.

Madison, Michael J. 2003. “Reconstructing the Software License.” *Loyola University Chicago Law Journal* 35 (Fall): 275-340.

McCord, Alan. 2003. “Institutional Repositories: Enhancing Teaching, Learning, and Research.” EDUCAUSE Evolving Technologies Committee. http://www.educause.edu/ir/library/pdf/DEC0303.pdf

Mele, Christopher. 2003. "Cyberspace and Disadvantaged Communities: The Internet as a Tool for Collective Action." In *Communities in Cyberspace*. M. A. Smith and P. Kollock, eds. New York: Routledge

Mendelson, Laura L. 2003. “Privatizing Knowledge: The Demise of Fair Use and the Public University.” *Albany Law Journal of Science and Technology* 13:593-612.

Merges, Robert P. 1996. "Property Rights Theory and the Commons; The Case of Scientific Research." *Social Philosophy and Policy* 13(2):145-167.

Murali, N. S., H. R, Murali, P. Auethavekiat, P.J. Erwin, J. N. Mandrekar, N. J. Manek, and A. K. Ghosh, 2004. “Impact of FUTON and NAA Bias on Visibility of Research.” *Mayo Clinic Proceedings*, Vol. 79, No. 8, 1001-1006, August 2004 http://www.mayoclinicproceedings.com/inside.asp?AID=611&UID=

National Research Council. 2002. *The Drama of the Commons*. Committee on the Human Dimensions of Global Change, ed. Elinor Ostrom, Tom Dietz, Nives Dolšak, Paul Stern, Susan Stonich, and Elke Weber. Washington, DC: National Academy Press. http://www.nap.edu/catalog/10287.html

Noonan, Douglas S. 1998. "Internet Decentralization, Feedback, and Self-Organization." In *Managing the Commons*. J. A. Baden and D. S. Noonan, eds. Bloomington: Indiana University Press.

Oakerson, Ronald. 1978. “The Erosion of Public Highways: A Policy Analysis of the Eastern Kentucky Coal-Haul Road Problem.” Ph.D. Dissertation, Indiana University, Department of Political Science. http://dlc.dlib.indiana.edu/documents/dir0/00/00/07/33/index.html

Oakerson, Ronald J., and S. Tjip Walker 1995. "Analyzing Policy Reform and Reforming Policy Analysis: An Institutionalist Approach." In *Policy Analysis Concepts and Methods: An Institutional and Implementation Focus*. D. Brinkerhoff, ed. Greenwich, CT: JAI Press.

Odlyzko, Andrew. 2002. “The Rapid Evolution of Scholarly Communication.” *Learned Publishing* 15(1) (Jan.): 7-19. http://www.catchword.com/alpsp/09531513/v15n1/contp1-1.htm

Open Citation Project. 2005. The Effect of Open Access and Downloads ('hits') on Citation Impact: A Bibliography of Studies.” http://opcit.eprints.org/oacitation-biblio.html#harnad-brody04a

Ostrom, Elinor. 1985. "Formulating the Elements of Institutional Analysis." Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, IN. (Working Paper, no. W85-15). http://dlc.dlib.indiana.edu/archive/00000738/

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* New York: Cambridge University Press.

Ostrom, Elinor. 1998. “A Behavioral Approach to Rational Choice Theory of Collective Action.” *American Political Science Review*. 92(1): 1-22.

Ostrom, Elinor. 2005. *Understanding Institutional Diversity*. Princeton University Press.

Ostrom, Elinor, Joanna Burger, Christopher Field, Richard B. Norgaard, and David Policansky. 1999. “Revisiting the Commons: Local Lessons, Global Challenges.” *Science* 284(5412):278-82. http://www.sciencemag.org/cgi/content/full/284/5412/278

Ostrom, Elinor, Roy Gardner, and James M. Walker, eds. 1994. *Rules, Games, and Common-Pool Resources*. Ann Arbor: University of Michigan Press.

Ostrom, Elinor, Larry Schroeder, and Susan Wynne. 1993. *Institutional Incentives and Sustainable Development: Infrastructure Politics in Perspective*. Boulder, CO: Westview Press.

Ostrom, Vincent. 1983. "Configurations of Relationships in Human Societies." Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, IN. (Working Paper, no. W83-21) http://dlc.dlib.indiana.edu/archive/00000115/

Ostrom, Vincent. 1973. *The Intellectual Crisis in American Public Administration.* Tuscaloosa: University of Alabama Press.

Ostrom, Vincent. 1997. *The Meaning of Democracy and the Vulnerability of Democracies: A Response to Tocqueville’s Challenge*. Ann Arbor: University of Michigan Press.

Poteete, Amy R., and David Welch 2004. "Institutional Development in the Face of Complexity: Developing Rules for Managing Forest Resources." *Human Ecology* 32(3):279-311.

Polski, Margaret M. 2003. *The Invisible Hands of U.S. Commercial Banking Reform: Private Action and Public Guarantees*. Boston: Kluwer Academic.

Polski, Margaret M., and Elinor Ostrom. 1998. “An Institutional Framework for Policy Analysis and Design.” Bloomington: Indiana University, Workshop in Political Theory and Policy Analysis, Indiana University. (Working paper W98-27)

Pringle, J. 2004. Do open access journals have impact? *Nature* (Web Focus). http://www.nature.com/nature/focus/accessdebate/19.html

Reese, R. Anthony. 1995. "Reflections on the Intellectual Commons: Two Perspectives on Copyright Duration and Reversion." *Stanford Law Review* 47(4):707-747

Rheingold, Howard. 2002. *Smart Mobs, The Next Social Revolution: Transforming Cultures and Communities in the Age of Instant Access*. Cambridge: Basic Books.

Richardson, Richard C. 2004. "A Conceptual Framework for Comparative Studies of Higher Education Policy." The Alliance for International Higher Education Policy Studies (AIHEPS), New York, NY. www.nyu.edu/iesp/aiheps/drafts/09**2004**Draft.pdf

Samuelson, Pamela. 2003a. "Digital Rights Management {and, or, vs.} the Law," Communications of the ACM: 46/4 (April).

Samuelson, Pamela. 2003b. "Mapping the Digital Public Domain: Threats and Opportunities." *Law and Contemporary Problems* 66(1&2): 147-71. http://www.law.duke.edu/journals/lcp/

Savenije, Bas. 2004. "The SPARC Initiative: A Catalyst for Change." Presented at the "The Digital Library and e-Publishing for Science, Technology and Medicine". TICER, Geneva, June 15, 2004. http://www.library.uu.nl/staff/savenije/publicaties/ticer2004.htm

Schlager, Edella, and Elinor Ostrom. 1992. "Property Rights Regimes and Natural Resources: A Conceptual Analysis," *Land Economics* 68(3): 249-62.

Sexton, John. 2003. "The Role of Faculty in the Commons Enterprise University." Present on the Occasion of the First Meeting of the Trustees Council on the Future of New York University, June 12, 2003. http://www.nyu.edu/president/faculty.enterprise/faculty-enterprise.pdf

Shiva, Vandana. 1997. *Biopiracy: The Plunder of Nature and Knowledge*. Boston: South End Press.

Smith, A. T., and M. Eysenck, 2002. The Correlation Between RAE Ratings and Citation Counts in Psychology. Technical Report, Psychology, University of London, Royal Holloway. http://cogprints.org/2749/

Smith, P. 2001. "Indigenous Peoples and Forest Management in Canada." In *The Nature and Culture of Forests: Implications of Diversity for Sustainability, Trade and Certification*. T. J. Rolfe, ed. Vancouver: Institute for European Studies, University of British Columbia.

Shulenburger, David E. 1999. "Moving with Dispatch to Resolve the Scholarly Communication Crisis: From Here to NEAR." *ARL Newsletter*, Issue 202 (February). http://www.arl.org/arl/proceedings/133/shulenburger.html

Shulenburger, David E. 2001. "Principles for as New System of Publishing for Science." In *Proceedings of the Second UCSU/UNESCO International Conference on Electronic Publishing in Science, Paris, February 20-23, 2001*. http://eos.wdcb.rssi.ru/eps2/eps02019/eps02019.pdf

Suber, Peter. 2002. "Open Access to the Scientific Journal Literature." *Journal of Biology* 1(1) (June): 3. http://www.earlham.edu/~peters/writing/jbiol.htm

Swan, Alma, and Paul Needham. 2005. "Developing a Model for E-prints and Open Access Journal Content in UK Further and Higher Education." *Learned Publishing* 18(1). http://cogprints.org/4120/

Swan, Alma, and Sheridan Brown. 2005. "Open Access Self-archiving: An Author Study." Key Perspectives.

http://www.keyperspectives.co.uk/OpenAccessArchive/2005_Open_Access_Report.pdf

Tabb, Winston. 2004. “Academic Libraries: New Directions, New Partners.” Presented at the 7th International Bielefeld Conference, “Thinking Beyond Digital Libraries: Designing the Information Strategy for the Next Decade,” Bielefeld, Germany, February 4, 2004. http://conference.ub.uni-bielefeld.de/proceedings/tabb.pdf

Testa, J., and M. E. McVeigh. 2004. “The Impact of Open Access Journals: A Citation Study from Thomson ISI.” Author eprint: http://www.isinet.com/media/presentrep/acropdf/impact-oa-journals.pdf

Thorin, Suzanne. 2003. “Global Changes in Scholarly Communication.” Presented at e-Workshops on Scholarly Communication in the Digital Era, Feng Chia University, Taichung, Taiwan, August 11-24, 2003. http://www.arl.org/scomm/disciplines/Thorin.pdf

Turner, Roy M. 1993. "The Tragedy of the Commons and Distributed AI Systems." Presented at the 12th International Workshop on Distributed Artificial Intelligence. (University of New Hampshire Computer Science Department Technical Report, no. 93-01).

Vaidhyanathan, Siva. 2002. "The Content-Provider Paradox: Universities in the Information Ecosystem." *Academe* 88(5)

Waters, Donald. 2002. “Good Archives Make Good Scholars: Reflections on Recent Steps Toward the Archiving of Digital Information.” Council on Library and Information Resources (CLIR). http://www.clir.org/pubs/reports/pub107/contents.html

Young, Oran R. 1996. "Rights, Rules, and Resources in International Society." In *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*. S. S. Hanna, C. Folke, and K-G. Maler, eds. Washington, DC: Island Press.