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Institutional Design and Governance in the Microbial Research Commons

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25. Institutional Design and Governance in the Microbial Research Commons
– Charlotte Hess[58]

Syracuse University

I was invited to talk about institutional and governance issues in microbiological research commons. While the microbial commons is a new type of commons and a part of the larger knowledge commons sector, I would first like to situate it within the study of the traditional national-resource commons. The challenges in constructing a viable commons are:

1. Understanding the nature of the resource and the users;
2. Dealing with the complexity of new—and especially global—commons; and
3. Managing possible fragility and threats.

The microbial commons is an example of a dynamic, international, *new commons*. While this commons encompasses *in vivo*, *in vitro,* and *in silico* resources, the focus here will be on the latter: the microbial commons in digital format.

Commons are about the relationship between a resource and human institutions or rules. The salient question in the governance of any commons is: how can fallible, heterogeneous individuals come together with incomplete information to make rules and decisions in order to effectively manage and sustain a resource? The analysis of this question about effective sharing requires an interdisciplinary approach that combines law with biological, economic, and other social sciences.

The first literature that resembles the approach that commons scholars take today was produced in the 1950s and applied the field of economics to the fields of biology and fisheries[59]. The concerted study of commons, however, did not really take off until the late 1980s with the organization of the International Association for the Study of Common Property (IASCP).[60] So you can see that this is a relatively new area of study.

Many of the early IASCP studies were focused on either demonstrating the accuracy or refuting Hardin's thesis of the tragedy of the commons.[61] Other predominant foci continue to be:

1. The threat of enclosure and the lessons of the historical enclosure movements in Europe;
2. The relationship between formal and informal property rights and the health of the resource; and
3. How different types of social dilemmas, such as free riding or non-compliance, lack of trust, competition, or secrecy, affect the outcomes.

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[58] Presentation slides available at:
http://sites.nationalacademies.org/xpedio/idcplg?IdcService=GET_FILE&dDocName=PGA_054555&RevisionSelectionMethod=Latest.
[59] See Gordon, H. Scott. 1954. "The Economic Theory of a Common-Property Resource: The Fishery*,"* 62 *Journal of Political Economy*; and Anthony D. Scott. 1955 "The Fishery: The Objectives of Sole Ownership.*"* 63 *Journal of Political Economy.*
[60] The name was changed to the International Association for the Study of the Commons (IASC) in 2006. See *http://www.iasc-commons.org/.*
[61] Hardin, G. 1968. "The Tragedy of the Commons." *Science,* Dec. 13, at 1243.

The growing international commons literature on traditional, natural-resource commons allowed scholars to more deeply analyze how commons work and to better understand why they fail. For Elinor Ostrom, it led to her seminal book, *Governing the Commons* in 1990. Ostrom applied a complex set of instruments to eighty-six case studies to commons of different sectors and varying geographical regions. From her analysis, she was able to determine eight design principles that long-enduring, robust commons shared.

The Ostrom design principles[62] are:

1. Group boundaries are clearly defined;
2. Rules governing the use of collective goods are well matched to local needs and conditions;
3. Most individuals affected by these rules can participate in modifying the rules;
4. The rights of community members to devise their own rules is respected by external authorities;
5. A system for monitoring member's behavior exists; the community members themselves undertake this monitoring;
6. A graduated system of sanctions is used;
7. Community members have access to low-cost conflict resolution mechanisms;
8. For CPRs that are parts of larger systems: appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

The Ostrom design principles are considered today as useful tools by many scholars in commons study. All the commons in the study, however, were managed by relatively small, homogenous groups. We do not know if these principles scale up nor do we know how the design principles would apply to the microbial commons. We might be able to use some of the principles as a place to start, although certain principles—such as group boundaries being clearly defined—may be harder to apply. Other principles, such as the importance of monitoring mechanisms, may take on even greater importance.

Interest in *new commons*, for the most part, emerged after the World Wide Web had gained ubiquity in the mid-1990s. They tend to have several characteristics that distinguish them from traditional natural-resource commons. Many are human-made resources, such as open source software, the Internet, and scientific research commons. Or they are resources that have been newly recognized as commons, such as urban landscapes, parking spaces, parks, and even garbage dumps. Many new commons have arisen out of the development of new technologies or the growth of new communities. Unlike traditional natural resource commons, new commons tend to be dynamic, quite complex, and heterogeneous. Many are global in scale and have fuzzy boundaries. There is a great deal that we do not yet know about new commons, particularly how they work and if they can be sustained.

Figure 25–1 is a map of new commons[63] based on the emerging literature of new commons sectors. As one can see, the knowledge commons is quite dominant and takes on many forms.

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[62] See Ostrom, E. 1990. *Governing the Commons: The Evolution of Collective Action*. Cambridge University Press.
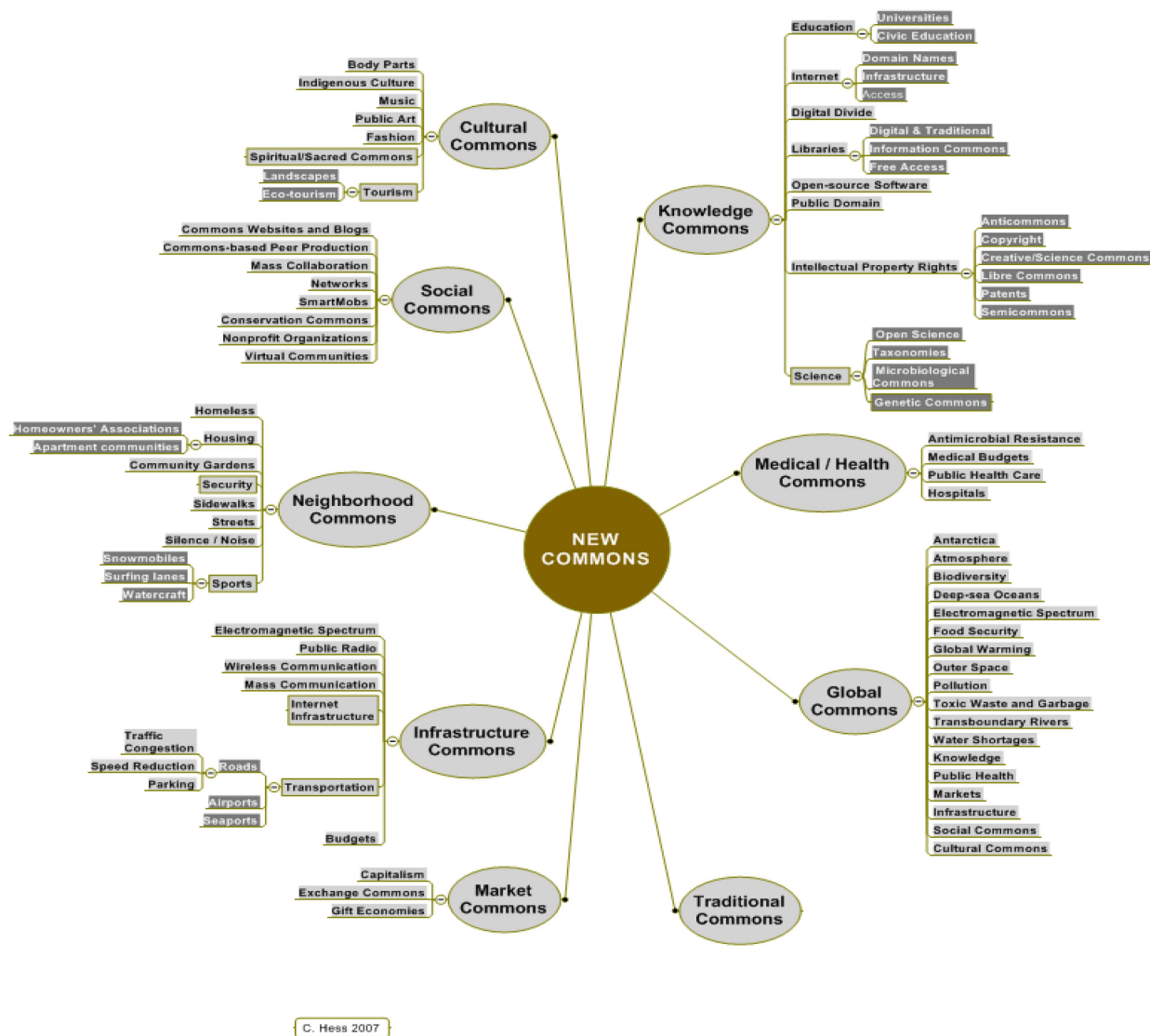
FIGURE 25–1 A map of identified new commons and new commons issues. SOURCE: Ostrom, E. 1990. *Governing the Commons: The Evolution of Collective Action*. Cambridge University Press.

Not only have the number and types of commons expanded over the past 25 years, but the way that we think about commons has changed considerably as we have learned more about them. In the 1980s, the term "common property" was the preferred term applied to commons institutions. After many case studies and a literature began to be built, researchers found that commons could exist in all kinds of property regimes. In Africa, for instance, there are many community forests or commons that are managed and used collectively, but privately owned.

Elinor Ostrom argued the importance of distinguishing between the resource and the regime—the regime being the property rights, and the resource being a type of

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[63] In Hess, C. 2008. "Mapping New Commons." *http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1356835* .

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economic good: a common-pool resource. The oft-used schema of the four types of goods: public goods, private goods, toll goods and common-pool resources was, in fact, developed by Ostrom and Ostrom in the 1977 paper "Public Goods and Public Choices."[64]

With the rise of new commons, there are now a number of legitimate scholars who are using the word "commons" without defining it as either a property regime or as an economic good. In fact, whether in new or traditional commons literature, the word "commons" is rarely ever defined. In the new commons literature, the word "commons" is almost always the preferred term (rather than common-pool resources or common property). As an emerging area of study, much of the literature is aimed at identifying a particular resource as a type of commons. Only in the legal literature do we find rich and multilayered studies, particularly of the knowledge and cultural commons[65]. Ostrom and I discussed the lack of any clear definition of "commons" at length while working on our book *Understanding Knowledge as a Commons.* (2007, MIT Press). We decided to attempt a definition and settled on the following: *A commons is a resource that is shared by a group of people that is subject to social dilemmas.* In further study, I have found that new commons almost always carry with them an element of vulnerability. Resources shared in commons are vulnerable to threats of various types of enclosure and capture (Hess fn. 6). And this vulnerability creates an ever-present need for monitoring and protection.

We do not know a great deal about new commons nor how to govern them, and we know much less about global commons. One important thing we do know about most global commons is that they are also local, either in creation or in implementation. Unlike with traditional commons, we can much more easily study how new commons come into existence. We have learned, for instance, that the considerable attention to the knowledge commons has arisen because of the collective witnessing of enclosure or threats of enclosure of open knowledge as a public good. New capabilities of information technology allow the capture (enclosure, privatization) of data and information that was previously "uncapturable." In other words, the commons is created by the enclosure or threat of enclosure of a public good.

Ostrom has more than once pointed out that the governance of a commons is really hard work. Since they tend to be self-governing and participatory, some types of a social dilemma are inevitable. Commons governance, therefore, requires ongoing attention, persistent effort, mindful adjustment of rules, and adaptation to new situations. As Vincent Ostrom has often noted, members of a commons are "artisans" who "craft" appropriate institutions. Finally, communication is essential in order to build trust and reciprocity.

Figure 25–2 shows a useful framework that facilitates a better understanding of the commons concept.

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[64]Ostrom, Vincent, and Elinor Ostrom 1977. "Public Goods and Public Choices." In *Alternatives for Delivering Public Services; Toward Improved Performance*. E. S. Savas, ed. Boulder, CO: Westview. Reprinted 1999 in *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis*. M. D. McGinnis, ed. Ann Arbor: University of Michigan Press. (Institutional Analysis). Online (on 4-1-11) at *http://theworldbuilders.witesman.com/v372/Ostrom%20public%20goods%20and%20public%20choices.pdf*

[65] I am referring to the work of Yochai Benkler, James Boyle, Brigham Daniels, Brett Frischmann, Michael Heller, Mark Lemley, Lawrence Lessig, Jerome Reichman, Carol Rose, and others.
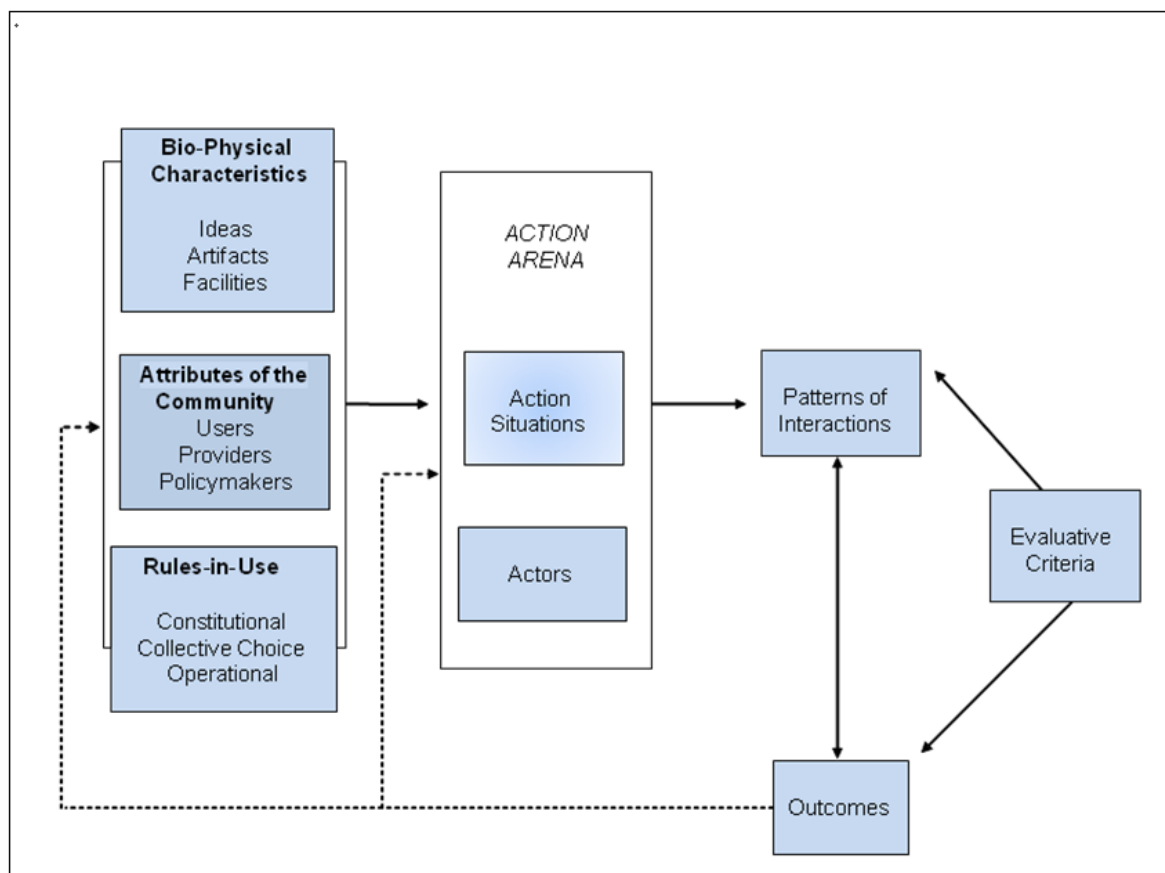
FIGURE 25–2 Institutional Analysis and Development (IAD) framework.
SOURCE: Adapted from Ostrom, Elinor, Roy Gardner, and James M. Walker 1994.
Rules, Games, and Common-Pool Resources. University of Michigan Press.

The left part contains various exogenous characteristics, including the biophysical characteristics, the attributes of community, and the rules in use. In a microbial commons those are important for everybody to understand clearly: What exactly is the (common) resource? Is there really one microbial commons, or are there many? The culture collections will have different attributes than the digital information databases, and those will have different attributes than proprietary literature databases, which will have different attributes than the secondary literature. Who are the information users and who are the providers? What kind of rules (including laws, norms, etc.) are in place? Do they work? Are they appropriate?

The middle section, the action arena, concerns specific actions taken, how people interact and what they do. This is the area on which game theorists and modelers are usually focused.

On the right side, the *patterns of interaction* are the institutional reactions of the action arena. The *outcome* is the current state of the resource and/or the resource users. It is the area of analysis that many researchers start with. For instance, why is this land constantly degraded while a parcel of land 50 miles away is doing really well? Why do some science collaboratories thrive while others run into problems of conflict and noncompliance? The researchers start with an outcome and trace it back through the framework.

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Figure 25–3 shows an adaptation of new framework developed by Ostrom and a group at Arizona State University to analyze the robustness of complex social-ecological systems. It focuses on the institutional configurations that affect the interactions of resource users and resource systems. One of the purposes of this framework is to help researchers look closely at the individual system at hand and not defer to "blueprint solutions."
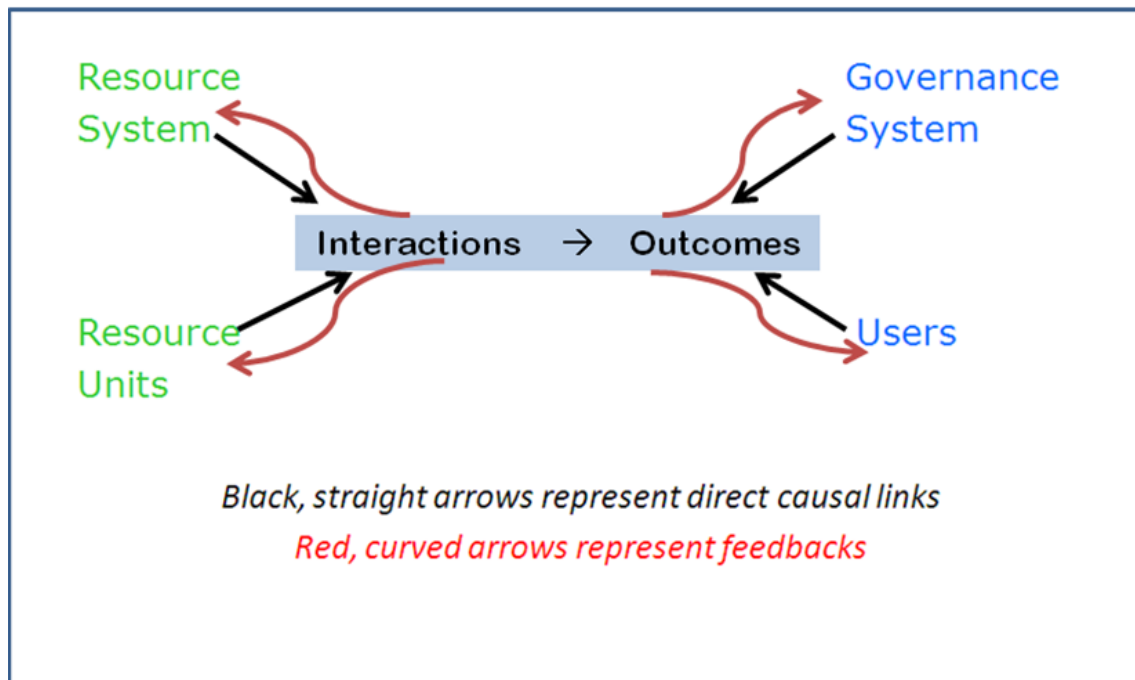

FIGURE 25–3 Diagnostic tool for analyzing a social-ecological system (SES)[66]

In either case, it is always essential to identify and understand the physical nature of the resource at hand. From that perspective the microbial commons shares many characteristics with other digital scholarly or scientific information. It is still surprising to many how extremely fragile digital information is. Important *e*-information is being lost every day in many ways. Scientific information has been withdrawn by the U.S. Government under the Patriot Act. Where publishers have gone out of business, access to once available files can be closed off. Primary genomic data is being rapidly patented and therefore cordoned off to most future research. Digital information is also being lost due to inattention, lack of robust preservation strategies, underfunding, or people simply do not know what to do with it obsolete formats. Until the recent NSF and NIH mandates, many universities were not taking responsibility in the storage of massive datasets developed by their scholarly community. In the global south, there is also unequal access to digital information because of a lack of technology, a lack of infrastructure, a lack of

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[66] SOURCE: Ostrom, E. 2007. "Sustainable social-ecological systems: An impossibility?" *http://www.indiana.edu/~workshop/publications/materials/conference_papers/W07-2_Ostrom_DLC.pdf*. and Anderies, John M., Marco A. Janssen, and Elinor Ostrom 2004. "A Framework to Analyze the Robustness of Social-Ecological Systems from an Institutional Perspective." *Ecology and Society* 9(1). *http://www.ecologyandsociety.org/vol9/iss1/art18/*.

electricity, or a variety of other reasons. In other words, scientific information in general, is still quite siloed in the digital era.

As we have heard from others today, the amount of scientific information is growing exponentially, and it is getting harder to collect it, to preserve it, and to store it. I say this not as a scientist, but as an information professional who is trying to keep track of the scholarly and scientific information that a single university is generating. It is very challenging. Many predict that there will be dramatic changes to how science is done and that few traditional processes will survive in their current form by 2020.

Considering the microbial commons in the academy, we are all aware of the conflict between the desire to open up information and make it accessible and the increasing mandates on the university to monetize or commoditize information, coupled with the growing influence and power of the universities' technology transfer offices.

Another problem is the high transaction costs and lack of strong incentives for university scientists to annotate an organism's genome in collaborative information repositories.[67] The prevailing system, described by Syracuse University faculty, is outmoded, inefficient, circuitous, and does not count toward tenure. There is a clear time lag and disconnect between current practices in digital scholarship, whether it be genomic annotation or experiments with new media. Official recognition and clear rewards need to be built into university tenure and promotion structures.

Some interesting work is being done by forest researcher Charles Schweik at UMass-Amherst on cooperation in open source communities. He unpacks the traditional theories of collective action to show how people will cooperate online in nontraditional and unprecedented ways. He has found that in environmental commons norms, rules, and governance structures often help to overcome tragedies. His research suggests that too much governance structure and rules may get in the way of collaboration.[68]

With regard to scholarly communication, one thing that has not been mentioned here is the changing role of the university library (which is relevant to how we access scientific research). Traditionally, the mission of academic libraries was to collect, organize, disseminate, and preserve the cultural and scholarly record. However, with each passing year in the digital environment, libraries are moving farther away from that mission because the massive amount of digital scholarly in multiple formats that is being generated on campuses today is not what is being collected by research libraries. Libraries are still focusing only on the published record which, because of ever-declining budgets, is a decreasing percentage of the whole. It is a huge problem, and in addressing it is important to think about preexisting infrastructures. One should, for instance, use library expertise when it makes sense in terms of organization and archiving and build library–academic departmental collaboration for funding open access. I would also suggest making sure that the tenure and promotion process take reputation, global networks and research distribution into account. Some universities, such as Harvard and MIT, have already passed open access mandates, but most universities are not yet addressing that. The bottom line here is that academic libraries face huge challenges and need to work more fluidly with researchers. University scientists should support them

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[67] See Welch, R. and L. Welch. 2006. "If You Build, They May Come." *Nature Reviews Microbiology* 7, 90 (February 2009) | doi:10.1038/nrmicro2086, examining why researchers seem reluctant to be more directly involved in the annotation of microbial genomes.
[68] See Schweik Open Source Project with links to articles at *http://www.umass.edu/digitalcenter/ossuccess/*.

with their departments because I do not know if they are going to be sustainable otherwise. This is a very critical issue.

What do we know about what works? There are several different models that are working in the new commons environment. We need to study them. If nothing else, we can use the time-worn measures of equity, efficiency, and sustainability in guiding what we are building.

In conclusion, we need to do more outreach to build greater awareness of the commons and of open access. We need to document the steps that we are taking and the lessons we are learning in the course of building the microbial commons, because not much is known about this process. We need to translate our knowledge to a wider, nonscientific community.

I would like to encourage you to join the International Association for the Study of the Commons, form a panel, and present your work at the upcoming 2011 conference in Hyderabad, India.

Question and Answer Session

PARTICIPANT: There were many rich points in your presentation, but I was particularly interested in your plea at the very end for the integration of libraries in the knowledge production process. This is a point we are trying to make in developing the open knowledge environments—that there is a fantastic role for libraries there. Do I understand you in supporting that?

DR. HESS: Absolutely.

PARTICIPANT: That was one of our objectives, and that is why we are thinking that there is a large role for the universities. It has so many opportunities for integrating knowledge that cannot be done anywhere else, so it would seem to be a way of transforming the way universities organize the production of knowledge.

DR. HESS: I fully agree. It is not just going to happen on the academic side, but also on the side of the libraries. Some of these are really not in tune with what you are doing and not really focusing on gray literature or on databases that are not in their library. There are so many aspects where that coordination needs to happen on both ends. So absolutely, you are on target as far as that goes.