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Change

An Open World

In 2016, McKinsey Global Institute released a report on digital globalization that found that data flows across national borders have increased forty-five-fold since 2005 (Manyika et al. 2016). This flow of video, information, searches, communication, transactions, and intracompany traffic now greatly outpaces the movement of people and traded goods. Data globalization has not favored all parts of the world equally, however, with Africa and South America lagging significantly behind the United States, Western Europe, and China in data flow volume. But there can be little doubt that OKIs have a vital role to play in supporting collaboration across national and digital boundaries in a world that is being transformed by new communication possibilities.

As we updated this manuscript in preparation for print publication in early 2020, the COVID-19 pandemic provided a stark reminder of the value of openness, collaboration, and knowledge sharing to global communities as well as the costs of remaining closed. The research and higher education landscape's capacity to support and manage openness quickly became a defining feature

of efforts to respond to a truly global health emergency. The threat of COVID-19 to health and economies sparked an unprecedented growth in open access to research outputs. Open science, the practice of making research publications, data sets, and methodologies open, transparent, and accessible, helped to speed the production of new, desperately needed knowledge about COVID-19 (Tingley 2020). The rapid sharing of research data and findings via preprint servers and unprecedented international collaboration allowed fifty-three viral genome sequences to be analyzed and made available by February 2020.

Within a month of the release of the first sequence, the structures of potential drug and antibody targets from the virus were identified and shared with global scientific communities—a process that not long before would have taken years. By the beginning of April 2020, BioRxiv, a site for rapid bioscience communication, had 1,048 reports covering the characteristics, structure, sequence, epidemiology, and treatment of the virus, and more than 12,000 viral genome sequences of hCoV-19 had been shared through the open-access virus database GISAID (Freunde von GISAID e.V. 2020).

In these first months of pandemic response, research was shared more quickly and widely than ever before, reducing the duplication of effort, and enabling infectious disease experts and health system operators to build on expert knowledge immediately. In addition to reducing overall research costs and fostering international collaboration, this approach has saved lives.

The open science approaches deployed in the fight against COVID-19 have been inextricably linked to the processes of experimentation and distributed innovation that began elsewhere on the internet. As such, criticisms, clashes, and identity politics that have accompanied the large-scale shift away from closed processes for verifying expert knowledge, and the careful, mediated approaches to sharing it with wider publics, have also echoed the discord that has arisen when other knowledge-making communities have

encountered the darker sides of disintermediation. In spite of their benefits, preprint servers have been criticized as promoting “click-bait science” and subjecting scientific communities to the “tyranny of structurelessness” (Heimstädt 2020).

The politicization of COVID-19's origins, calls to hold China to account for a lack of openness and transparency in sharing information, and demands for legal action against China for the global impacts of the pandemic contributed to the Chinese government's decision to apply restrictions to research into the origins of the novel coronavirus in April 2020 (Henderson et al. 2020; Gan, Hu, and Watson 2020). At the same time, China has insisted on its own efforts to share the science of coronavirus openly. The Chinese ambassador to the United States, Cui Tiankai, said in a webcast, “We are doing our best to have transparency. We are discovering, we are learning. At the same time, we are sharing.” He added that “what worries me is indeed lack of transparency, not in terms of science, not in terms of medical treatment, but in terms of some of the political developments, especially here in the United States.” Transparency has become a political hot potato globally, with all sides demanding openness but little agreement on what that means (Alper 2020).

While COVID-19 may be the most dramatic recent example of both the hope and challenges associated with open approaches to the production of expert knowledge, the tensions and contradictions at play in this space mirror wider transformations that have been underway for some time. The development of free and open-source software, both as a movement and practical infrastructure, is an instance of another space in which open and networked possibilities have led to incredible innovation as well as new dangers and tensions. The collaborative development of highly specific technical resources in the form of code by people who may have never met physically is perhaps the classic illustration of what is enabled by networked digital communications. The lowered cost of discovery means two (or more) people with a shared interest on opposite

sides of the globe can find each other. The massively lowered cost of transferring digital objects means they can contribute to each other's work, and the consequent growth of shared platforms and infrastructures makes that work more widely relevant and usable, reinforcing and growing the network over time.

Networked digital technologies are also creating new potentialities for citizen science and social action. It is now possible for user communities to create upstream change in knowledge production processes in order to ensure downstream benefit. An early innovator in this space was PatientsLikeMe, a citizen science–inspired global patient network and real-time research platform established in 2004, entirely outside the university system, with the goal of creating new sources of data for research on ALS (Lou Gehrig's disease), and ultimately speeding the pace of treatment and drug development taking place within the formal research sector. In 2011, the platform expanded beyond ALS, “welcoming any person living with any condition to connect with others, learn and take control of their health.” In 2019, PatientsLikeMe became part of the UnitedHealth Group's Research and Development Unit. PatientsLikeMe (2020) now has more than 750,000 members worldwide and has become “the world's largest personalised health network.” Data contributed by patient communities have been used to support new clinical trials, and patient-reported information is being connected with biological data at unprecedented scale, allowing the development of more nuanced, and patient-centered approaches to understanding diseases.

At the same time, many digitally enabled “open” projects are facing crises of discrimination, particularly around such identity-based facets as gender, race, and ethnicity. Again, open-source software development provides a striking example of this challenge. In open source, networks are built based on shared technical needs and interests. This reinforces the connections between a subset of global populations with early access to networks: predominantly white

men in a small subset of geographies. Early work to enhance diversity within open-source software communities was not pursued. As a result, as our model predicts, these spaces have continued a slide toward a closed state in which participants from other demographics are treated with anger, aggression, and hostility, as evident in the Gamergate movement (Aghazadeh et al. 2018).

Similar stories could be told about Wikipedia (2020a, 2020b) and many other projects that stand out as successes in the creation of OKIs, but that have serious and systemic problems of closed and exclusionary cultures. Learning from these examples, many new projects are expending significant effort to create strong governance structures that address a spectrum of “open” characteristics wherein participants agree to bind themselves to codes of conduct and other processes. These deliberately impose an ongoing burden of thoughtfulness and labor to ensure that the system is optimized for maximal openness.

Open Initiatives in Universities

Understanding the future of this trend and what it means for knowledge institutions is not straightforward. Global data on data flows do not equate to or even map onto global knowledge. A specific narrative about the successful mediation of knowledge in one setting cannot necessarily be generalized, and the growth of open-access policy, platform provision, and outcomes is only a narrow slice of a broader picture. But there are some indications that universities on the road to being successful OKIs can be positioned to engage more productively with these shifts.

Universities in North America, Europe, Australia, and Aotearoa New Zealand have already experienced major changes in knowledge format and accessibility as a result of digital technologies. Since the 1990s, scholarly resources in many disciplines (though not all) have

Case Study 1**Wikipedia**

Wikipedia provides a good example of an open knowledge platform called to account for its embedded gender, ethnic, and racial bias in the creation and sharing of public knowledge. As it became an influential and highly popular free online encyclopedia developed largely by technology-savvy volunteers, the impact of implicit assumptions in some Wikipedia contributions became apparent.

Wikipedia attracted criticism for systemic bias on the basis of gender, race, language, and culture relating to both the topics that are covered by the free online encyclopedia and ways in which contributions are edited. Criticisms of bias began to emerge as early as 2007, but media coverage of the problem took until 2011 to appear (Lam et al. 2011; Tsvetkova et al. 2017). Critiques of Wikipedia's tendency toward biased, exclusionary practices exposed a culture of volunteer Wikipedia editors who were primarily male, white, English speaking, and from the Global North. Sue Gardner (2011), the former Wikimedia Foundation executive director, summarized comments from women providing reasons why they were discouraged from editing, noting that some women experienced persistent overriding of their decisions by male editors who reverted their editing decisions, and removed suggestions or entries they had contributed. Shyong Lam and colleagues (2011, 9) found female contributors were "being reverted disproportionately" and encountered more adversity. This behavior continued in some of the "edit-a-thons" implemented in the hope of fostering a wider range of Wikipedia editors. A further issue has been the underrepresentation of women and people of color as a focus of Wikipedia entries. In order for a biographical entry about a person to be included on Wikipedia, the platform's guidelines require a person to be "notable." Decisions about whether an individual qualifies as notable are inevitably subjective, and prone to implicit gender and racial bias (Boboltz 2015). The status of biographies of notable women continues to be a battleground, with women scientists' biographical entries being challenged and removed from Wikipedia by editors in 2018 and 2019, before being reinstated, such as in the case of physicist and Nobel Prize winner Donna Strickland, astrophysicist Sarah Tuttle, and nuclear chemist Clarice Phelps (Krämer 2019). All three Wikipedia pages existed at the time of this writing.

In response to gender and race coverage criticisms, the Wikimedia Foundation and US National Science Foundation have provided funding to increase the diversity of Wikipedia as well as improve coverage of content and topics from the Global South. WikiProjects promoting perspectives on gender that extend beyond the gender binary have been established (Wikipedia 2020a, 2020b). Efforts have also been made to address Wikipedia's racial bias, including its limited coverage of Black history in the United States as well as minority peoples, cultures, and languages. As of August 2020, Wikipedia articles had been created in 313 languages, with 303 active and 10 closed (Wikipedia 2020c).

The question of the nature and impact of Wikipedia editing is complicated by the fact that editing is shared by human editors and bots or automated editors. In 2014, bots undertook about 15 percent of the editing, but the extent and editing behaviors of bots vary across Wikipedia's language editions. Bots sometimes revert each other's edits, and can be as unpredictable and inefficient as human editors. For smaller-language versions of Wikipedia, bots edit up to 50 percent or more of the content (Tsvetkova et al. 2017). Bots may be more balanced in their editing than human editors, but they are designed, created, and run by humans, and thus carry cultural and social biases. This case study of Wikipedia exemplifies the challenges of ensuring diversity and openness in knowledge, and the importance of and need for constant monitoring to ensure governance structures and policies respond equitably.

become increasingly available online, with libraries choosing electronic media as a preference. One outcome has been the widening of access to published scholarly materials beyond the physical structures and opening hours of university libraries. This flexibility has proven invaluable in the wake of COVID-19 as universities around the world have scrambled to make courses available to students, even as campuses have been closed and face-to-face teaching has been placed on hold. Less welcome outcomes for many include the shift from "owned" to "rented" collections whereby electronic content has largely been subscribed to rather than purchased, limiting its permanence; the paywalls and increased restrictions based on the licensing of this content; and the closing and shrinking of library buildings and communities of space (Wilson et al. 2019). The costs and management of storage space and demand for student technology study facilities are converging, prompting many libraries to move physical collections off-site or remove items altogether. Particularly in the humanities and creative arts, losing physical access to archives and collections challenges established research practices.

If properly poised, however, open practices could help to broaden as opposed to reduce access to electronic content. Work within university libraries, often in partnership with university presses, is demonstrating

how to reclaim the modes of scholarly production through the creation of open journals, open monographs, open data sets, and new curatorial and exhibitionary practices (Library Publishing Coalition 2020). Without such activities to counter the increased commodification of knowledge objects, access to publicly funded library knowledge resources and physical facilities will be much more controlled and restricted than in past decades, thereby limiting openness.

In addition, universities today produce a wide range of openly available materials and rely on open-source software to distribute them. From well-established pathways with large user bases and broad recognition (e.g., arXiv, Sakai, EPrints, and Samvera) to newer, still-experimental environments with great promise (e.g., the integrative, collaborative scholarly publishing platform Manifold), many aspects of “open” are already accepted, if not prominent in the university landscape. When universities trust that openness will increase the reach of their scholarship without compromising (or being perceived as compromising) its value, they are more likely to begin moving toward the characteristics of an OKI.

Universities are expending significant resources and work in grappling with these changes. Normally this happens within a background of existing power, prestige, resources, and practice. While much of the impetus has been driven by outside forces, including funders as well as national and regional policies, we do see specific universities and other research organizations choosing to take a leadership position on these issues, particularly when that openness demonstrates an increase in the return on investment on research or a pathway to lowering the overall costs of scholarly communications. While policy statements and submissions to external assessments do not provide direct evidence of action or outcomes, they have been the catalyst for progress. This can be seen in the case of open access, but also in larger diversity issues, such as the Athena SWAN Charter in the United Kingdom that seeks to advance gender equality in science, technology, engineering, mathematics, and medicine (STEMM).

Case Study 2

The Library Publishing Coalition

The Library Publishing Coalition is an international coalition of libraries and library consortia committed to the vision of “a scholarly communication landscape that is open, inclusive and sustainable.” Established in 2013 with an initial membership of sixty-one academic libraries, the coalition now includes more than ninety predominantly North American institutions. The coalition was created in response to the need for a central space in which the growing number of libraries actively involved in publishing “can meet, work together, share information and confront common issues” (Library Publishing Coalition 2020).

Both the establishment and success of the Library Publishing Coalition reflect the active role that many libraries are playing in the processes of experimentation, innovation, and collaboration needed to create as well as support OKIs. Members of the Library Publishing Coalition are proactively filling gaps in established scholarly communication landscapes by establishing their own open-access publishing operations. They are providing scholars with opportunities to publish open-access monographs, journals, and data sets, and collaborating with research funders, researchers, and established publishers to develop new tools, and explore the possibilities for connecting research with communities in rich, meaningful, and open ways (Schlosser 2018). The Library Publishing Coalition demonstrates that libraries are responding to the new opportunities and challenges associated with digital technologies in ways that are far from passive.

There is increasing proof that engaging with an open agenda is good for universities. Caroline Wagner and Koen Jonkers have presented evidence that countries with greater openness have stronger science. They say that there is “a clear correlation between a nation’s scientific influence and the links it fosters with foreign researchers” (Wagner and Jonkers 2017). In complementary work, Cassidy Sugimoto and colleagues (2017) demonstrated that institutionally mobile researchers have greater research impact. These studies show the potential benefits to universities of greater openness on traditionally valued measures of performance, but also illustrate the risks of a focus on those traditional measures, derived from limited sets of publications and limited metrics with known and serious biases.

Open institutions bring “data shadows” into the light, thus creating more data and potentially more knowledge. The exponential increase in the flow of data is not uniform, however; it is dominated by transatlantic, European, and Asian streams with much lower rates of flow among African and South American streams and countries of the Global South. This demonstrates the ways in which this flow is globalized but not at all global, and highlights the question of missing and unavailable data as well as the unequal distribution of both data and knowledge around the world. Redressing these asymmetries is clearly part of the agenda of future-facing OKIs, not least because doing so would expand the overall knowledge universe enormously, and further diversify its forms, agents, and uses, to the benefit of all.

We can see at least the beginning of institutions looking to gain advantage not by exclusive access to information but rather by the strategic engagement of their data and researchers with others. OKIs will have the capacity to take the available data in massive global data flows and translate them into knowledge. Those flows may travel without regard to local conditions, but open institutions can take transmitted data and translate them into usable and meaningful knowledge, sharing it among groups that might otherwise resist the external incursion of ideas. The potential for global knowledge growth with networked open institutions is great, but networks cannot be uniform across all demographic and national borders. Data must adapt to the given cultural environment, as organizations and people do, and information must be made meaningful if it is to be used for transforming knowledge.

Open Knowledge and Conflict

OKIs cultivate cross-border exchange. A diversity of perspectives and experiences is critical for increasing the value of a knowledge-producing

network. This requires work, and these efforts are often challenging, with increasing difference inevitably leading to conflict. Our world feels ever-more hemmed in by resurgent cross-border conflict among nations, faith groups, class, gender and ethnic groups, and extremism on the Right and Left, all the way across to differences of identity, affiliation, and taste that divide people even as they connect. We can be confident that the current era of globalization in trade, technology, and media—not to mention a few supranational languages (led by Mandarin, Spanish, English, and Arabic)—will not lead to cultural or knowledge uniformity.

The friction created by cross-border conflict can be a driver and catalyst for knowledge. These borderlands provide the most intensive zones of knowledge exchange and competition, bringing previously separate ideas into contact to offer innovative solutions to previously unimagined threats and opportunities. An OKI will be an environment where difference and conflict are always visible, and untranslatable, incommensurable, and incomprehensible knowledge will be a deliberately cultivated part of the landscape. The institutional imperative is to maintain contact across such borders rather than closing them down or seeking to incorporate them into some larger, smoother entity.

Conflict is already woven into the mechanisms and core cultural practices of the university. Peer review is perhaps the most obvious example, as a stage in which authors and referees engage in conflict to test the claims of a scholarly output in a defined arena with highly specified rules imposed by an editor. The method of producing new academics also engages in a discourse of conflict—notably the tradition of a dissertation “defense” where external examiners are engaged as “opponents” to bring different perspectives to challenge doctoral work.

Extending conflict and diversity in an OKI is not without challenges. Look, for instance, at the “creative destruction,” to use Joseph Schumpeter’s term (McCraw 2007), of the once-mighty empires of the press, print publishing, and journalism. Already, many great

mastheads have disappeared. There are survivors and standouts, but upheaval in the publishing sector already has led to transformed business plans, contents, workforces, and demographics of attention. There are few outlets left online or off-line that reach for population-wide undifferentiated readerships as did the old “mass media,” speaking equally to political leaders, business interests, and working families. Now, online communication is propelled by either advertising (in which case content is free), or subscription (in which case audiences are niche). Knowledge making in this sphere is an entirely new game, driven primarily by the tech giants rather than the journalists and media moguls of the past.

A successful OKI will be modular in its external and internal networks. All nodes will not be equal and open to all others. Some will be closed internally, even while connected externally to other nodes and the rest of the system. The chances of getting it wrong are high, and doing so can be catastrophic not simply for an individual organization but an entire sector. It is quite possible that getting the open knowledge institutional settings wrong for long enough, across a sufficiently significant proportion of the sector, will lead the entire species toward an extinction event: universities will be outcompeted and rendered unfit for purpose. The effort required to maintain a dynamic equilibrium, a poised institutional state, requires continuous challenge and work.

Open by Design

The important policy implication for OKIs is that dystopia looms at both extremes: too open leads to chaos, and too closed leads to rigidity. The possibility space for achieving a poised system is quite narrow. We have presented what is in many ways a utopian vision, and contrasted it with the dystopia of top-down control or, worse, failure of the university as a societal institution. In much contemporary

Case Study 3

Activism and the Tyranny of Structurelessness

Although we tend to think of institutions as marble-clad edifices, it is also the case that social movements develop institutional form as they become established in action and across demographics, often in conflict with and struggle against existing institutions (Felski 1989). Protest movements take this path, frequently needing careful internal work to create and maintain dynamic equilibrium, even as they seek to provoke change in the wider social system. An example of one such institution is feminism, which has gone through several evolutionary stages (second- and third-wave feminism, for instance). When second-wave feminism was at its most insurrectionary and militant, in the 1960s and 1970s, activists commonly rejected the imposition of institutional rules and structures on the movement. Yet this led to what Jo Freeman, in a famous 1970 pamphlet, identified as “the tyranny of structurelessness,” showing how the lack of structure jeopardized collective decision making and activism, and thus the movement itself. As Freeman (n.d.) wrote,

If the movement is to move beyond these elementary stages of development, it will have to disabuse itself of some of its prejudices about organization and structure. There is nothing inherently bad about either of these. They can be and often are misused, but to reject them out of hand because they are misused is to deny ourselves the necessary tools to further development. We need to understand why “structurelessness” does not work.

We can learn from this that openness does not entail or necessitate structurelessness, nor can institutions avoid the rule-making process. Freeman recommended reflexivity, such that the process by which openness is achieved is made explicit in organizational routines, especially where there is internal conflict or debate.

literature, that dystopia is presented as total corporate control of the academy, or if not that, then the loss of the university’s qualities to the pursuit of metricized rankings of excellence (Donoghue 2008; Readings 1996). But there is equally a dystopia in which there is too much freedom—a data deluge or information overload in which anything goes, and no knowledge is more valid than any other.

All institutions are arrayed on a spectrum between order and chaos, between the costs of disorder and the costs of dictatorship (Hartley, Wen, and Li 2015, 176–179). Somewhere on that gradient is a dynamic optimum (figure 1.1), a complex state poised between

total control (rigidity) and chaos (collapse), where the system displays desirable qualities of resilience, adaptability, and dynamic efficiency because it has enough flexibility to change and enough structure to remain stable.

The space for policy is not at the extremes but rather in the narrow zone of uncertainty where the pressures of order and disorder can be “poised.” “Networks on the boundary between order and chaos may have the flexibility to adapt rapidly and successfully through the accumulation of useful variations. . . . Poised systems will . . . typically adapt to a changing environment gradually, but if necessary, they can occasionally change rapidly. These properties are observed in organisms” (Kauffman 1991).

All institutions can be arrayed about the institutional possibility frontier (figure 1.2) as a trade-off between social costs of disorder and dictatorship (see Djankov et al. 2003).

The nature of this “optimal institutional zone” means it is not something that can be defined in advance but instead must be found through search, with some inevitable trial and error involved. A successful system manages this process and tension continuously. Some degree of organization is required, but flexibility is also necessary for the system to thrive. In the same way, open markets, open competition, and personal freedom still require regulation, both formal via rule of law and social via informal sanctions, to keep the playing field level for cooperating players, discourage free riders, assist disadvantaged or developing groups, and train new entrants

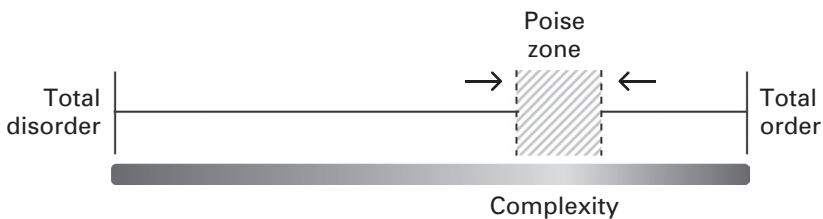


Figure 1.1
Openness as a poised system.

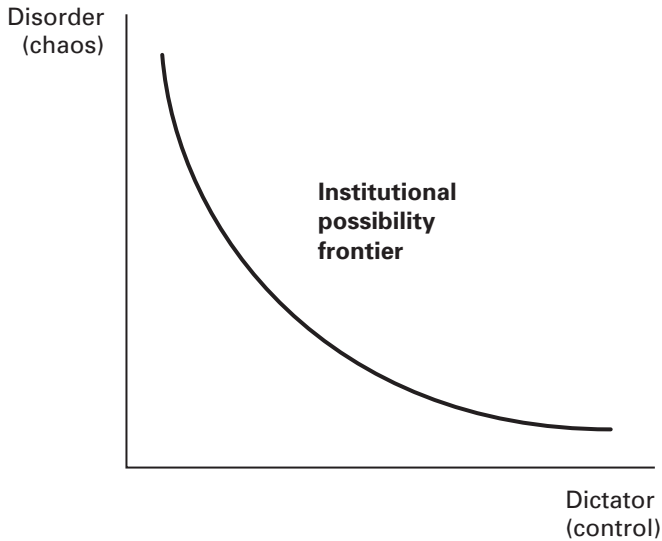


Figure 1.2

Institutional possibility frontier for open knowledge.

into the system. But overregulation, prohibitions, private deals (corruption), and the arbitrary or capricious exercise of power all damage the workings of the system as a whole.

A good example of this is Creative Commons licenses. These licenses use the existing copyright framework (the environment) to allow the selection of an optimal position between retaining complete control over content (all rights reserved or in the extreme form secrecy) and completely giving up control. A user selects a limited set of restrictions, some rights reserved, that they feel are appropriate to their circumstances (Creative Commons 2019a). Yet the use and indeed legal text of the licenses has changed over time in continuous response to newly discovered issues and challenges. The institution of Creative Commons is as much that process of improvement and testing as it is a set of licenses.

Productivity requires balance among alternative and often contending pressures. Different systems, phases, and regimes experience (or

Case Study 4

Creative Commons International License Porting Project

Creative Commons (2019b) is a US-based nonprofit organization (NGO) “dedicated to building a globally-accessible public commons of knowledge and culture.” Lowering the transaction costs associated with copyright in digitally enabled, global creative landscapes as well as countering the freezing effects of a copyright system that requires author permission for the reuse, sharing, and adaptation of creative works is the heart of the Creative Commons project. Creative Commons licenses do this by helping creators, authors, and content producers to ensure that license information travels with a creative work as it moves through the digital landscape, clearly communicating information about rights that an author or creator has reserved along with those that have been waived to downstream users.

In 2002, Creative Commons released its first, free-to-use copyright licenses. Although the licenses were drafted in accordance with US copyright law, they were enthusiastically adopted by creative communities in other jurisdictions. Global interest prompted discussions about the need for national versions of the licenses and the establishment of Creative Commons International in 2003. Creative Commons International oversaw porting of the core Creative Commons licenses for use in different national copyright legislatures. This included translating the licenses into local languages as well as ensuring that the licenses were legally translated, adapted, and enforceable within local jurisdictions (Maracke 2010).

Creative Commons licenses have now become a key global standard for the sharing and reuse of content internationally. By 2017, more than 1.4 billion Creative Commons (2017) licensed works had been shared online, including via platforms such as YouTube, Wikipedia, Flickr, and PLOS. The mobilization and continued involvement of a community of technical and legal experts, advocates, educators, and scientists has been key to the movement’s success. By 2020, Creative Commons Global Network (n.d.) had chapters in forty-three countries around the world. Continued processes of legal translation, commentary, and critique, the development of scholarship and activism focused on Creative Commons, and technical collaboration have resulted in a vibrant and responsive global movement, rather than a simple legal or technological “fix.”

This process of community building and internationalization came full circle with the release of the fourth version of the Creative Commons (n.d.) license suite. In this version, as opposed to creating derivative versions for each country, the lessons learned from that process were combined in an attempt to create a single internationally applicable set of licenses. This process was entirely dependent on the experience of the international chapters and porting process as well as the capacity to integrate and synthesize that expertise and experience.

are subject to) different settings at the same time. For example, in countries where markets are opening up, rigid control over family relations (private life, gender roles, etc.) may increase (i.e., where inequality is social rather than economic). Political and commercial discourses routinely cite fear of disorder or chaos to justify authoritarian control, but that supposed “solution” (command and control) is just as dangerous. Political disputation is properly about whether more control or openness is required in any given setting. The challenge for policy makers and leaders is to find the optimum point of poise, without knowing it in advance, and then keep the actual situation for any given instance as close to that point as possible.

Digitally mediated shifts in the underlying economics of knowledge production have given rise to new business models and institutions. Newly empowered groups working beyond the bounds of formal institutions are challenging the roles of traditional knowledge brokers, from Wikipedia to the Khan Academy offering free online education anywhere, to hyperlocal community news and affinity groups. In the face of this challenge, particularly where seen as a threat, the risk is that universities will default to being closed. Focusing on traditional networks of knowledge exchange and production is likely to reify these closed structures. In a changing and increasingly uncertain world, universities risk failure or at least a dystopian future if they follow the default path.

This model of knowledge production poised on a boundary between order and chaos implies a need for a dynamic process in which work is required to maintain complex balance. The trick for analysts is not to argue for one extreme or the other. Instead, it is to gather and sift the evidence to work toward this point of dynamic stability that maximizes flexibility and resilience, but also creativity and knowledge creation. Our role is to argue for moving technical, political, and commercial control practices nearer to that poised point, and marshal the evidence on the best route(s) forward.

