

The University in the Networked Economy and Society: Challenges and Opportunities

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The networked information economy and society present a new social, technical, and economic environment within which the university functions. To understand the new challenges and opportunities this environment presents, we need a usable characterization of the core new characteristics of both the environment and the university as a system and how those characteristics interact to define today's challenges.

The Networked Information Economy

The critical characteristic of the networked economy is a radical decentralization of physical capital necessary for the production, storage, distribution, and processing of information, knowledge, and culture. This decentralization has caused a radical distribution of the practical capability to act in these areas, creating new levels of efficacy for individuals, who increasingly shift from being consumers to being users and producers. Individuals have now become capable of doing much more for themselves and for others, both alone and in vastly more effective loose collaborations with others.

In the industrial economy, hobbyists, no matter how committed, could not come together on the weekend and compete with General Motors. The degree of required concentrated physical capital made their decentralized, social practices ineffective as an economic production activity of any significant scale. Like GM, the industrial information economy required models that were able to finance large-grained capital investment: government, through taxes; business, through market transactions; or organized nonprofits, through large-scale and aggregated giving. News production bifurcated between government ownership in many countries and advertising-based

mass media (with the exception of the BBC, hybrid model). Film and music also split among these three, and, for purposes of higher education, the role of the large, organized nonprofit was central, as was the role of government funding.

Decentralized Ownership and Excess Capacity

The networked information economy has not decreased the total capital intensity of information production, storage, processing, and communication, but it has decentralized its ownership. About a billion people on the planet today own the core physical means of producing information, knowledge, and culture: they own machines that sense, capture, store, process, and communicate their thoughts, observations, manipulations, and expressions. These machines are, in turn, “shareable,” by which I mean that, given their production technology and the distribution of wealth in the populations that own the majority of them, they are placed into operation by individuals and families for whom they have excess capacity.

No one can, practically, buy only as much computation power as needed at any given moment. No one buys storage or bandwidth purely to fulfill that day’s needs. These goods are “lumpy” and, for most owners, have significant downtime and excess capacity. In front of these machines sit people who themselves have a wide diversity of experience, wisdom, insight, and creativity and who have a wide diversity of motivations and availability at different stages of life and different moments of the day, week, or year.

The combination of distribution of physical capital and human capital creates a new situation. For the first time since the industrial revolution, the most important inputs into the core economic activities of the most advanced economies are widely distributed in the population. Moreover, there is a significant amount of excess capacity, both physical and human, that is being poured relentlessly into new forms of information, knowledge, and cultural production, as well as into provisioning of networking, storage, and processing capabilities.

If hobbyists could never have competed with General Motors, the same cannot be said for Microsoft or IBM. The rise of free and open source software has created real challenges for mainstream software publishers. Apache, in fact, has captured and held much of the market in web server software, despite 13 years of efforts by Microsoft to take that market. IBM has, on its software services side, adapted and adopted open source software development as a core component of its development ecology. But on the hardware side, IBM has a new primary competitor

for “fastest supercomputer in the world”—the distributed computation projects, such as SETI@home or Einstein@Home.

Wikipedians compete with the commercial encyclopedias, citizen journalists with mainstream media. P2P networks offer real alternatives to proprietary networks as storage and distribution alternatives, as we see in the case of the “domesticated” uses such as Skype and, increasingly, BitTorrent. Mesh networks are beginning, more slowly than necessary because of the legal constraints on wireless equipment deployment and bloated security concerns, to develop a path toward user-owned, last-100-meter networks. In all these cases we see what I have called *peer production* (large-scale collaboration among individuals without price signals or hierarchical commands), together with large-scale material sharing of shareable goods, creating social alternatives to the traditional models thought necessary in the industrial information economy.

Decentralized Capability and Authority to Act

The creativity and innovation that we see on the Internet today are directly tied to the radical decentralization of the practical capability to act, on the one hand, and of the authority to act, on the other. This is where a combination of sensible social norms that diverge from the formal law—self-conscious, commons-based practices—and simple disdain for the law coalesce with the decentralization of capital. The technical/economic shift that networks have created is the location of physical and human capability to act in the hands of users. This technical capability to act, however, requires authority to act in order to be effective.

A variety of laws, some concerned with morality and security but mostly concerned with protecting incumbent business models (such as the intellectual property industries), separate authority to act on information and culture from the newly created capability to act. These have had partial success in slowing down adoption of social production of information and knowledge, but at the broad, macro level of social practices they have failed. Millions of users are creating videos on YouTube, sharing music and mixing it in ways that are sensible but arguably illegal.

The critical policy questions of the networked environment revolve around the battles between the progression of technology, which at the moment (this is not a deterministic trend, it is merely a happenstance of the fabrication technology of computers) is leading to decentralization on the one hand and on the other to the push of policy to moderate that decentralization by limiting the distribution of authority to act.

At one level, the effort to retain organization through assertion of authority is happening through copyrights and paracopyrights as well as patents. At another level, it is asserted through security concerns and the idea of trusted computing. At yet a third level, it occurs around social acceptance of new forms of authority: How do I know that a Wikipedia entry is correct? How do I trust a blog story? Our old forms of assigning credibility and authority to a claim were closely aligned with the institutional origins of the claim. As information production becomes radically decentralized, new models of authority are seeking similar recognition.

The University

The university predates the industrial information economy and has retained much of its preindustrial guild model (not least visible on graduation days). Industrialization entered more heavily in the material sciences and biomedical sciences, where large-scale capital investment was necessary to perform the basic science. At first, this was more purely based on the government-funding model of industrialization, and later it shifted to include market funding, both around patents and more loosely around research support and university–industry relations. Still, research is done by relatively autonomous and small-scale units, and explicit reliance on market signals is not the norm.

The humanities, in turn, are much lower cost and remain heavily oriented toward a teaching-based, subsidy-for-research model, with long apprenticeship periods for graduate students and junior faculty until they are inducted to master status. Research in these areas often continues to depend heavily on individuals working alone, subsidized by their teaching, with fierce claims of autonomy and narrow claims of unassailable authority.

As a subsystem within the knowledge production system of modern society, the university has several characteristics that give it a distinct role. The town–gown tension has long typified the relationship of the university to the market and society as one of partial remove, that is, removed from the pressures and enticements of the market and a dedication to internal system values, usually embodied in the ideas of academic freedom, intellectual discipline, and peer review. As many have shown, the history of science has not, in fact, been quite as insulated as the self-conception sometimes suggests. Nonetheless, the values, practices, and structures of the university have allowed it as an institution to engage as a system that pulls the knowledge production system away from the pursuits driven by market signals, political signals, or popular cultural fad and toward directions

characterized by the relatively high intensity of communication within the academic community, among people engaged in the practice of conversation, writing, mutual commentary, and critique. These practices have, in turn, fed into and been sustained by spatial removal.

The university campus has been a place for students to be immersed in learning and find others like themselves. This is, of course, heavily mixed in with late-teen/early-adult socialization, but it does offer a framework and basis that orients this socialization, with wide-ranging degrees of seriousness, around learning. Scholars do come together and exchange views, read, and mutually reinforce their commitment, through repeat performance of discourse, to the academic enterprise standing distinct from market, polity, and society at large. Again, I do not want to sound starry-eyed; I hear there is occasional backbiting, too. But that is not the point. It is, rather, that the remove of the university—its relative coherence as a distinct subsystem—tends to be based on repeat practices of structured conversation that represent a certain set of values and commitments and, therefore, orient its participants to a particular kind of conversation, inquiry, and output. These practices make the university a discrete subsystem for knowledge production, quite different from, say, industrial research and development.

As we shift to the networked information economy, the ability of some parts of the university to skip over industrialization entirely, and the potential for others to transition more gracefully than could some of the actors in industry, creates new opportunities. For purposes of technical architectural design of the university networks and information system, the shift presents three core challenges:

1. how to manage increasingly permeable boundaries between the university and the world, to enable the higher degree of effective participation in the world that students and faculty can have, while avoiding a fragmentation of the coherent university system;
2. how to preserve the practical capability and authority to act in the hands of students and faculty, in the face of pressures to centrally control use in order to avoid “bad” uses, both external (such as copyright violations or security threats) and internal (such as destabilization of the traditional lines of authority in the classroom); and
3. how to build platforms for cooperation that enhance the central experience of the university—intense structured discourse around a set of shared values and practices oriented toward knowledge and education.

Permeable Boundaries

Many contributors to free and open source software projects, to Wikipedia, or to the blogosphere are students and faculty. The relative freedom of both groups from structuring constraints of job performance, and the internal system values regarding their role as knowledge producers and young people exploring the limits of their knowledge and creativity, have made universities an important platform for the system of commons-based social production. Like the university, this system stands apart from market and state. Unlike the university, it is not based on formal accreditation, hierarchy, and membership but on more fluid practices of contribution and loose association. The university can offer its systems to support social production of both its own internal workings and its members in those of the outer world.

Examples of the kinds of contributions university systems can make to the social production system beyond their boundaries include *ibiblio*, the MIT OpenCourseWare initiative, COSL, and Connexions.

- *ibiblio* represents a contribution of resources and expertise. It is an Internet library, archive, or depository of materials that are freely available for reuse, which can be contributed to by anyone and is usable by anyone. *ibiblio* is a collaboration of the University of North Carolina–Chapel Hill with the Center for the Public Domain, itself a nonprofit created by and heavily anchored in the Duke University faculty.
- The OpenCourseWare initiative is an effort to format course materials created by faculty and make them available on the Internet to anyone who wants to use them—self-learners or educators outside MIT—as inputs into their own learning. Here, the university platform both serves a physical role in distributing the materials and builds expertise in preparation and conversion from the idiosyncratic forms used by individual teachers—the vestige of the guildlike freedom individual teachers have—and the needs of a platform of university-level teaching materials available for universal use.
- COSL, the Center for Open and Sustainable Learning at the Utah State University, and Connexions, a collaborative platform for the creation and sharing of educational materials founded at Rice University, offer yet another step up in the level of contribution to capacity to act. Here, the university-based organizations are building tools and

platforms and hosting them to pool contributions, not only from within universities but also, more generally, from the social production system, into a project central to the role of the university—the creation and sharing of educational materials.

A different kind of permeability comes from the increasing capability of researchers to collaborate in networks that ignore institutional boundaries. The Human Genome Project is one such example; the International Haplotype Mapping (HapMap) project is even more so. Science today, in many cases, requires thousands of collaborators and simply cannot be managed within the old silo model. Here, the permeability required is across distinct institutional boundaries.

Permeability allows faculty and students to engage with and in the world. As such, it is an important new dimension of town–gown relations at a time when the kinds of nonmarket, nonstate action that students and faculty are so oriented toward by institutional habit and practice have become so much more important a component of the information production system generally. Yet, as we have noted, the geographic separation, the distinctness of the campus, has also been central to defining the university. There is a certain safety or trust, possible in the classroom, to experiment with ideas, questions, and inquiry that performance on a more public stage makes difficult. Identity is important to trust, and yet anonymity is important to free engagement in the world outside. Managing the tension between engaging the university in the world and preserving the internal trust and structure of university discourse is important and not always easy.

Proprietary systems such as Blackboard seem optimized for allowing teachers to control the discussion and the materials, replicating in many senses the security of the traditional classroom while erecting barriers to student contribution to the syllabus and to external participation in a class. Open blogs and wikis, on the other hand, provide little or no safety other than through obscurity, which at the moment seems enough for those courses that use them. One goal of university platforms should be to develop free platforms that would integrate the benefits of both, most likely building on the increasing use of private wikis as a platform.

End-to-End Versus Centralization

The end-to-end principle, originally characterized by Saltzer, Clark, and Reed as an Internet design principle, has now developed into a broader architectural principle, for some even a political commitment. At core, its argument is that functions should, to the extent possible, be

pushed to the edges of a network while keeping the core of the network as simple as it can be. This, in turn, allows for innovation to come from anywhere and to go anywhere, without requiring large systemic modification in the network itself. As a broader architectural principle, it is tied to building as little as possible of the functionality into the hard-to-change elements of a system.

The end-to-end principle has come under significant pressure for several years now, for a variety of good reasons. Usability, security, standardization within an organization, pricing, and quality of service have all been interjected as reasons to implement more significant elements of services into the network itself, rather than leaving everything to the edges. Universities have the opportunity to control their own networks and have various reasons to do so. Be it managing P2P file sharing because of fear of lawsuits, system burden, or malicious software, or the will to separate out what is available to registered students and others, universities have strong motivations to control their systems.

This is, I think, a mistake.

Most, if not all, of the best examples of collaboration online where universities have played a role started with demonstration projects and beyond, done by individual faculty members or students. Innovation in institutional engagement, just like innovation in voice over Internet protocol or instant messaging, comes from the edges, not the core. Furthermore, precisely because the individual members of university communities can play such an important role in the social production system in general, university systems should resist the urge to centralize. Instead, the emphasis should be on implementing solutions to whatever concerns there are through (1) identifying or developing solutions that can be implemented at the ends of the network, preserving the autonomy of users, and (2) where the practices are unacceptable to the university, solving them through the university's disciplinary system in a formal, transparent way, rather than architecturally in ways that have negative spillover effects on other, desirable uses.

It is important in this context to remember that people exist in multiple systems of constraint and affordance. Technical systems are only one kind of system, and different affordances and constraints for any given individual or community can be implemented in one or more of these systems. In the case of technical constraints on usage, the costs, in terms of incapacitation, imposed by technical solutions seem larger than the costs, in terms of imperfect enforcement, of using an institutional disciplinary system.

The basic commitment of university system architecture needs to ensure that each member of the community has the systems capability to be an active contributor and participant in communication—both internal to the university and external, to the networked world at large. Authority and capacity to act on all things digital should be located at the edges, rather than centralized in the university system. Solutions to what are perceived as threats to that system should be designed not purely with the technical system in mind but with the range of interlocking systems—technical, organizational, cultural, and institutional—that the university is made up of. These solutions should be implemented through the system that will have the least negative impact on the capacity of the university to function as a learning and research community and platform.

Building Platforms for Cooperation

The observable emergence of online cooperation coincides with several academic trends in thinking about human cooperation. These go beyond a selfish rational actor model, emphasizing a diverse set of motivational profiles, not all selfish, and the centrality of communication and human interaction to forming preferences for cooperation and the commitment to ongoing cooperative processes. Where implemented, cooperation-based systems seem primarily aimed to construct human systems capable of observing a complex and rapidly changing environment, learning about new conditions and practices within it, and pursuing them in flexible, adaptive ways.

One anchor of these trends is the large literature in several disciplines on the prevalence of observations of human cooperation inconsistent with the predictions of the selfish, rational actor model. In experimental economics, we see a line of work on human proclivity to cooperate in patterns that are rational but inconsistent with uniformly selfish preferences. This work is distinct from the mainstream concern of experimental economics—behavioral deviations from rationality. From this literature we learn that somewhat more than half the population predictably behaves as cooperators or reciprocators in social dilemma and altruism-adducing games, while about one-third act as selfish actors. Various manipulations are associated with decay of cooperation, while others are associated with increasing cooperation. These findings suggest that, under appropriate designs, cooperators cooperate, reciprocators cooperate and invest in punishing defections by selfish agents, and selfish agents increase cooperation over time to avoid that punishment. While the literature itself is not oriented toward characterizing design levers for systems of cooperation, it is possible to synthesize these out of it.

Parallel work in experiments and field studies has been done in political science, in particular around governance of commons. There is also crossover work in neuroeconomics to support some of the observations of the experimental work. As to ultimate causes of cooperation, evolutionary biology has seen a trajectory leading it from selfish gene theory of the 1970s to increasing emphasis on cooperation, both through indirect reciprocity and through multilevel selection. In anthropology, we see uses of evolutionary dynamics to explain cultural practices of cooperation, on much shorter timescales and with greater sensitivity to cultural variation, destabilizing the gene–culture binary.

A second, distinct line is seen within organizational sociology. Growing from the work on post-Fordism, trust, and increasing knowledge intensity in firms, sociologists had observed increasing adoption of networked organization models emerging within firms, and in some cases across firms, in supply relationships. Globalization and rapid technological change put organizations under increasing pressure to innovate in their processes, adapt to changes, learn about a rapidly changing environment and increasingly complex processes, and implement learning continuously. Under a variety of monikers, such as *team production*, *quality circles*, and so forth, a variety of business processes have emerged that depend heavily on communication, on relatively higher responsibility in the hands of employees, or on the emergence of trust-based collaboration, replacing the traditional models of market and hierarchies to govern internal relations within and between firms. The two critical points, from the perspective of designing information platforms, are that the turn to cooperative models and decentralization of action is seen as driven by a need to improve the learning and adaptation capabilities of organizations and interorganizational networks, and that many of the characteristics of successful collaborations fit those that one sees coming out of the experimental work.

A third line of work is the emergence, within software systems design, of an effort to characterize “social software” as its design objective, that is, designing software that is intended to be run for and by a group of people, fostering their interaction, including its social dynamics. This literature at the moment is in a heuristic stage and tends to characterize successful and unsuccessful practices. Nonetheless, it offers a good basis for observing cooperation in practice, running on a designed system with, therefore, relatively easily characterizable design features.

These lines of work do not speak to each other, yet they all point to the increasing importance of human cooperation across multiple domains, arrived at from a wide-ranging and diverse set of approaches and methods.

They allow us to begin to characterize what design elements would be necessary to foster cooperation and therefore allow us to design systems for cooperation more systematically.

Going into the details of such systems here would be beyond the goal of this discussion. To presage future work, I will simply note that these design levers will include communication, as a central necessary facility, as well as humanization, trust, clear norms, fairness, discipline and punishment, transparency, self-selection, group identity, crowding out, cost, and leadership. A major challenge of the next few years will be to refine this literature into testable design levers, translate these into working designs, and learn from experience about how best to build systems for the diverse beings we in fact are.

Conclusion

Throughout the period of the industrial information economy, the university maintained a stance apart from much of the rest of that economy. As we move to a networked information economy, the distinct values of the university—its relative freedom from the pressures of the market, polity, and popular fashion—are a major source of strength. Universities can become an even more significant force in the knowledge production system, one that distinctly pulls in the direction of professional values. Universities can provide an anchor “against” commercial incentives and build a strong complementary system with the amateur commons-based peer production system, as we have indeed seen in areas such as free and open source software.

University networks and technical platforms will have to focus on managing the increasingly permeable boundaries among universities, and between universities and the world outside them. University platform design should be focused on ensuring that faculty and students have the greatest degree possible of authority and capacity to act freely, innovate internally, and participate externally. And university systems should be attuned to the need to build platforms for cooperation, as the new practices of cooperation and sharing become more prevalent and more based in a broader shift from an image of hierarchical or market-oriented systems to systems based on individuals collaborating with each other in loose networks.