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Globalization and Vulnerability

Challenges and Opportunities for SHOT around Its Fiftieth Anniversary

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Fifty years ago, SHOT was designed and created—one could say, engineered—in a careful and strategic way.¹ During the subsequent fifty years, SHOT developed into the leading international scholarly society in the history of technology. The maturing of the society and its journal, *Technology and Culture*, went hand-in-hand with the development of the field of the history of technology. Since the initial breaking-away from the history of science, the history of technology has now acquired all of the characteristics of a well-established scholarly discipline: national and international societies, peer-reviewed journals, book series, newsletters, graduate programs, and professorial chairs.² Where does SHOT stand today? What are the key problems in the current history of technology? Which roles do I see for historians of technology in our contemporary societies? Rather than providing a descriptive review on the basis of, for example, recent issues of *Technology and Culture*, I will make a perhaps somewhat provocative argument about the challenges and opportunities that SHOT faces now, at this moment of reaching full maturity at its fiftieth anniversary.

Key challenges in the first years centered on defining the subject matter of the history of technology and the methods by which to research it. In his contribution to this set of essays, Tom Hughes recounts discussions on the definition of “technology,” and on appropriate approaches to study its relation to civilization and culture. Though the patriarchs of SHOT explicitly thought about their relation to the engineering community and to general

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0040-165X/09/5003-0006/600-12

1. See Tom Hughes’s essay, “SHOT Founders’ Themes and Problems,” in this issue of *Technology and Culture*, 594–99.

2. For links to publications, relevant institutions in the history of technology, and other societies, see SHOT’s website at <http://www.historyoftechnology.org> (accessed 29 April 2009).

historians, the thrust of the discussions was internally directed. And necessarily so: a new field had to be created. As Brooke Hindle recollected in 1985, it “started with a motley crew of scholars who were but slightly conscious of their common interest in the history of technology. Individually, they thought of themselves first as engineers, business historians, economists, sociologists, historians of science, or general historians who had wandered into a somewhat strange field.”³ John Staudenmaier has described how after some twenty years, this “motley crew” had indeed created a community of scholars.

Staudenmaier traced this development into a scholarly discipline by analyzing the contents of *Technology and Culture* through its first twenty-five years.⁴ He found a dominating focus on questions that are internal to the development of technology: phases of technical development, technological creativity, the relation between technology and science, the characteristics of technological knowledge, and technology as a cultural phenomenon. This research agenda, I am convinced, was crucial for the constitution of the field, the journal, and the society. The inevitable price was a relative neglect of problems outside the technical realm. Staudenmaier already identifies some of these: socioeconomic development (“the worker perspective”), global development (“cultural conflict in technology transfer” and “non-Western technologies”), and democratization (“critique of capitalism” and “women and technology”).⁵ In this essay, I will make a plea for addressing some of these challenges more centrally, and I will also argue that there are very pertinent opportunities for SHOT to do so now.

Challenges

The challenge for Mel Kranzberg, Tom Hughes, and their colleagues in the early days of SHOT was to create a discipline with a subject matter, a shared set of approaches, and an institutional home. That challenge, we can now conclude, has been met in an extremely successful way. So successful indeed, I will argue, that it is time to move on. Already, since the mid-term review by John Staudenmaier, the windows have been opening and a growing interest in the world outside is evident. Institutional indicators are the increasingly non-American membership of SHOT, the broad range of topics and approaches addressed in SHOT’s annual meetings, and SHOT’s policies to support scholars from developing countries. *Technology and Culture* has begun to publish articles and essays that explicitly address some of the “gaps” that Staudenmaier identified in 1985, and additional publica-

3. Brooke Hindle, in his foreword to John M. Staudenmaier, S.J., *Technology’s Storytellers: Reweaving the Human Fabric* (Cambridge, Mass., 1985), xi.

4. Staudenmaier, *Technology’s Storytellers*.

5. These are my terms. In parentheses I have quoted Staudenmaier’s terms from his fifth chapter, “Beyond Whig History.”

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tion channels have been created to relate the work in the history of technology to current societal questions and debates in communities outside SHOT.⁶ On the basis of these recent accomplishments, SHOT can do more. SHOT is now institutionally and intellectually strong enough to identify its main challenge outside academia. I want to argue that the challenge for SHOT at this juncture of time, around its fiftieth anniversary, is to engage with two questions that are among the most urgent challenges of humankind: globalization and vulnerability.

Why focus on these two challenges? Surely I do agree that poverty, hunger, child mortality, illness, environmental damage, and socioeconomic inequalities are the most fundamental threats to a sustainable global development.⁷ My reason for proposing globalization and vulnerability as key challenges to be addressed by SHOT is twofold. First, the challenges of globalization and vulnerability are inextricably bound up with all the basic challenges mentioned above: addressing globalization and vulnerability will provide a crosscutting and innovative way to contribute to an alleviation of poverty, illness, and inequality. Second, and most importantly in the context of this meeting, the challenges of globalization and vulnerability call for the specific expertise of historians of technology and other students of technology in culture. Globalization and vulnerability are, I will argue, fundamental characteristics of our technological cultures: both are thoroughly technological, and historians of technology are needed to describe and analyze how they shape our current societies. Analyzing globalization and vulnerability is thus a pertinent way for historians of technology to engage with such basic problems as poverty, hunger, and illness. Let me briefly discuss both in turn.

GLOBALIZATION

Globalization refers to increasing global connectivity, integration, and interdependence in all spheres of life: economic, social, technological, cultural, political, and ecological. In most cases, it points to processes such as enhanced economic interdependence, increased cultural interaction, rapid advance of information and transportation technologies, and novel governance and geopolitical challenges—all resulting in connecting people and the biosphere more tightly into one global system. Globalization is a container term that hides as much as it illuminates. It also has extreme normative connotations, producing a red haze of anger before the eyes of opponents as much as an exalted look of delight in the eyes of proponents. It is useful to remember that globalization is, like all overused terms, all at once a real phenomenon, a theoretical concept, and a political and commercial

6. See especially <http://etc.technologyandculture.net> (accessed 29 April 2009).

7. See the United Nations Millennium Development Goals, at <http://www.un.org/millenniumgoals> (accessed 29 April 2009).

strategy. For my purposes in this essay, I will focus on the phenomenon of globalization and leave conceptual analysis and discussion of globalization politics aside. Whatever aspect of globalization we focus on, it is always thoroughly technological.⁸ No economic globalization without the gold standard, transportation technologies, and stock-market interconnectedness.⁹ No cultural globalization without TV, radio, and the Walkman.¹⁰ No informational globalization without the internet.¹¹ No political globalization without standardization and harmonization technologies.¹² No developmental globalization without technology, whether indigenous or in international cooperation.¹³

Let me give you one example, related to cotton handloom weaving in India.¹⁴ The handloom-weaving industry in India is crucial for rural development in the world's second largest country (measured in population size). In the past decades, this industry has changed dramatically

as a result of altered demand patterns, new economic scenarios and shifts in government policies. From a relatively self-contained industry that ably met demands for cloth, imbalances have emerged along the entire production-marketing chain and globalized macro-economic processes further aggravate these.¹⁵

8. I will not try to review the literature on globalization and will only mention a few references by historians of technology (broadly conceived). For a general discussion of the relevance of using a history of technology perspective to analyze the phenomenon of globalization, see chapter 8 in Thomas J. Misa, *Leonardo to the Internet: Technology and Culture from the Renaissance to the Present* (Baltimore, 2004).

9. On the economics and politics of globalization by the Dutch around 1900, see Joseph N. F. M. à Campo, *Engines of Empire: Steamshipping and State Formation in Colonial Indonesia* (Hilversum, the Netherlands, 2002). On the role of financial and economic models in shaping (global) markets, see Donald A. MacKenzie, *An Engine, Not a Camera: How Financial Models Shape Markets* (Cambridge, Mass., 2006).

10. For a broad introduction to the relations between technology and music, see Hans-Joachim Braun, ed., *Music and Technology in the Twentieth Century* (Baltimore, 2002). See also Paul du Gay, ed., *Doing Cultural Studies: The Story of the Sony Walkman* (London, 1997).

11. See Janet Abbate, *Inventing the Internet* (Cambridge, Mass., 1999).

12. See, for example, the European history of technology project "Tensions of Europe" on the development of Europe at <http://tensionsofeurope.eu> (accessed 1 May 2009).

13. For a critical discussion, see Shiv Visvanathan, *A Carnival for Science: Essays on Science, Technology, and Development* (New York, 1997). On the history of irrigation technologies in India, see Esha Shah, *Social Designs: Tank Irrigation Technology and Agrarian Transformation in Karnataka, South India* (New Delhi, 2003), and Chitra Krishnan, *Tank and Anicut Irrigation Systems: An Engineering Analysis* (New Delhi, 2003).

14. Here, I draw on the work of Shambu C. Prasad, *Exploring Gandhian Science: A Case-Study of the Khadi Movement* (New Delhi, 2001). I also benefited much from discussions with Annapurna M., Seemanthini Niranjana, B. Syamasundari, Latha Tummuru, and Shambu Prasad.

15. Seemanthini Niranjana, Annapurna M., B. Syamasundari, and Latha Tummuru, *Marketing Handlooms: Perspectives from Practice* (Secunderabad, A.P., India, 2007), 7.

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It is no overstatement to describe this as a deep crisis in Indian textiles and farming, and thus in Indian rural society. The 1990s witnessed starvation deaths of weavers due to lack of business and suicides by cotton farmers because of insurmountably high debts through the use of pesticides. To address problems of poverty alleviation and development for a large part of the Indian people (and the same applies, *mutatis mutandis*, for local technological systems in other parts in the world), it seems pertinent to raise questions about how the cotton farming and textile sectors in India can be stimulated to help people take command of their own lives again. When we look closer into this question, especially by using a history of technology perspective, we cannot escape analyzing the phenomenon of globalization.

Shambu Prasad provides a fascinating history of cotton farming, trade, and industry.¹⁶ Trained as an engineer, with a Ph.D. in the history and sociology of technology, and currently a key figure in Indian STS, Prasad connects the economic history of British industrialization and the cotton trade with the agricultural history of cotton cultivation, the technological history of the cotton industry, the history of Gandhian science, and current problems of development and democratization. Globalization then appears as an important starting point of the story and as a cause of trouble, but it may also appear at the end of the story as part of a possible solution strategy.

Cotton in India, unlike in other parts of the world, has been used since early history as a general clothing material for rich and poor alike. Indian cotton had reached a stage of perfection in the eighteenth century which made it famous in large parts of the world. Length of staple, which today is the most important factor in defining the quality of the cotton plant, as we will see, was not important; in fact, it was even a hindrance when cotton was carded with a bow, since longer staple cottons created problems in processing by wrapping around the bow. Europeans got involved in cotton as traders of cloth in the seventeenth and eighteenth centuries. Their knowledge of cotton processing and its various techniques was limited, Prasad comments, and they could not make cotton yarn strong enough for the warp. America started to export cotton to Britain from 1780 onward and soon became the biggest supplier of cotton to Britain. Cotton was not native to the United States. Owing to cheap labor from the slave trade and the availability of land due to the resettlement of the Native American population, cotton was for the first time grown with the sole purpose of commerce and export. Britain imported a large share of its cotton from America, but in the nineteenth century, the overreliance on American imports became a concern to the traders and manufacturers of Lancashire, so they turned to India.

Here, the history of technology comes in. Machines like Whitney's cotton gin, to separate the cotton fibers from the seedpods, and Arkwright's spinning frame, to mechanize spinning, both helped to industrialize the

16. Prasad, *Exploring Gandhian Science*.

cotton industry, but both worked better with long staple cotton than with short staples. American cotton varieties have such long staples, while the “desi” (indigenous) varieties of Indian cotton have short staples. The European and American machines thus could not cope well with the Indian cotton. A typical chain of globalization events resulted:

The history of cotton growing in India since 1790, when Bourbon, the first exotic variety, was introduced, can be seen as essentially one of the replacement of indigenous varieties of cotton, which had been carefully bred over centuries to provide the world’s best cloths, by American varieties, to suit the emerging mill production of textiles in Lancashire.¹⁷

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Because of a poor understanding of the role of the Western technologies in treating the two types of cotton, the Indian varieties were branded “inferior.” While deindustrialization due to colonial rule has been well researched, there is little understanding, Shambu Prasad observes, of the technical dimensions of this process. The cultural specificity of technological choices becomes clear in his examination of the history of cotton growing in modern India. Prasad thus demonstrated the interpretative flexibility (my words) of the “quality” measures of cotton. If the quality is analyzed from the perspective of (Western) mechanization, you find: short staple is inferior, long staple is best. And the associated technologies are evaluated with the same measure: the Indian technological ensemble (of desi cotton, hand carding, khadi spinning, and handloom weaving) that evolved over generations of practice is thus of low quality, and the European-American technological ensemble (of long staple cotton, machine ginning, carding, spinning, and weaving) that emerged during the Western industrialization is of high quality. But if you analyze quality from the perspectives of Indian farmers, Indian weaving villages, and Indian users of cotton cloth, the staple length is irrelevant and other criteria may tip the evaluation balance in favor of the Indian technological ensemble.

One might have expected a change in policy after India’s independence, but, globalization being what it is, the Western quality criteria remained dominant. Indian agricultural policies continued to emphasize long staple varieties with high yields on rich alluvial soils, needing irrigation and large inputs of fertilizers and pesticides. This added another dimension to the “competition” between exotic cotton varieties and desi varieties, since the indigenous desi varieties are unsuited to increased yields through artificial inputs. In 1947, 97 percent of production was from indigenous varieties, and in 1990, this had decreased to 37 percent.

It is exciting to observe the “battlefields” at this moment. On the farm-

17. Shambu C. Prasad, “Suicide Deaths and the Quality of Indian Cotton: Perspectives from the History of Technology and the Khadi Movement,” *Economic and Political Weekly* 34 (1999): 12–21, quote on 13.

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ing side, Monsanto continues the old history by trying to export genetically modified Bt cotton varieties to India. This is fiercely opposed with a broad spectrum of arguments, ranging from farmers' economics to ecological risks. On the textile side, two opposite strategies can be seen: the first tries to "beat" globalization by reestablishing local technological systems; the second tries to make use of globalization to enter new distant markets. An example of the first strategy is "decentralized spinning," which is meant to offer an alternative for the centralized cotton-spinning mills:

Although weavers in villages are surrounded by raw cotton, they almost always have to get their cotton yarn from spinning mills located miles away. Farmers too face a similar problem; there are hand-operated looms all around them, but they end up selling their raw cotton to ginning mills who then sell pressed bales of cotton to distant spinning mills. The cotton thus travels from the village all the way to spinning mills for conversion into yarn, and then travels back to weavers in villages. If the raw cotton produced in a village could be converted into yarn locally, both farmers and weavers might benefit greatly. But expert spinners have long believed that the economies of scale obtained at big spinning mills that produce yarn on a massive scale cannot be matched at the village level.¹⁸

Technical innovation resulted in micro-spinning machines that are currently being tested and seem to be able to create a viable local economy in weaving villages.¹⁹ Dastkar Andhra, as a non-profit trust that promotes the interests of producer communities in the cotton handloom weaving industry, played an important role in the development of this first strategy as much as in the second. What I have called the second strategy aims at social, economic, marketing, and design innovations so that the weavers may connect to new markets for their high-quality products—new markets that may be located in rich Northern–Western countries, addressing customers who value (and can afford!) the high quality of handspun or micro-spun cloth.²⁰

While my case study deliberately discussed the phenomenon of globalization, this would also mean that at the end of the story, globalization may turn into a strategy for handloom weavers too.

18. See the 2006 electronic newsletter article by Surekha Sule, "Reviving the Cotton-to-Cloth Chain," in *India Together*, at <http://www.indiatogether.org> (accessed 1 May 2009).

19. See, for example, the work of the Vortex firm at <http://www.vortexindia.co.in> (accessed 1 May 2009).

20. This sounds easier than it is. It is imperative, Annapurna M. argues, not to fall into the trap of marketing handloom weaving as a form of welfare: this "weakens producers by eroding their self-esteem, and brings down their value in the market place." In addition to issues of design and marketing, logistical problems related to ordering, stocking, and transportation are also nontrivial problems that can arise when accessing international markets. See Annapurna M., "Transitioning Markets, Transcending Consumption," *Economic and Political Weekly* 41 (2006): 3388–93.

VULNERABILITY OF TECHNOLOGICAL CULTURE

The second challenge I am proposing as central to SHOT's agenda around its fiftieth anniversary is the vulnerability of technological cultures.²¹ The word vulnerability is, again, at least three things: something real, a concept, and even a strategy. When we say that a system is vulnerable, we typically want to say that it is susceptible to harm. Vulnerability thus is a property or characteristic of systems—be they technological, ecological, or social. Mostly, vulnerability is used as a specific rather than a generic characteristic: a city may be vulnerable to damage by specific disturbances, such as floods, and not to damage by other disturbances. A city like Washington is vulnerable to terrorist threats in the form of a letter with some sugar powder (temporarily mistaken for anthrax); such a letter would most probably have no effect on an Indian village. The Indian village may be vulnerable to the effects of globalization of the cotton trade, while an American city may thrive on that same aspect of globalization. Turning now to a discussion of the concept of vulnerability, I want to make two points. First, the vulnerability of modern societies can best be studied as a vulnerability of technological culture, and such research especially calls for historians and sociologists of technology. Second, vulnerability is not an exclusively negative characteristic.

Today's societies are thoroughly technological, and all technologies are pervasively cultural.²² Technologies do not merely assist in everyday lives; they are also powerful forces acting to reshape human activities and their meanings. The introduction of a robot in an industrial workplace not only increases productivity, but may radically change the process of production and thus redefine what "work" means in that setting. When a sophisticated new technique or instrument is adopted in medical practice, it transforms not only what doctors do, but also the way people think about health, illness, and medical care. The tank irrigation systems in South India, for example, are shaped by the social and cultural relations between Hindu and Muslim farmers.²³ And coastal defense (read: dikes and levees) in the Neth-

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21. This informal research program started to take shape after the events of 9/11 in an NSF-supported workshop organized by Rosalind Williams and Miriam Levin, with SHOT and the Society for Social Studies of Science (4S), at MIT in March 2002. See the special issue edited by Miriam Levin and Rosalind Williams, "Forum on Rethinking Technology in the Aftermath of September 11: Introduction," *History and Technology* 19, no. 1 (2003): 29–83.

22. This may now sound like a truism to SHOT members, but it needed some explicit arguing in the past. See, for example, Wiebe E. Bijker and John Law, eds., *Shaping Technology / Building Society: Studies in Sociotechnical Change* (Cambridge, Mass., 1992), which builds on constructivist approaches to studying technology such as the Social Construction of Technology (SCOT) and actor-network theory (ANT); see also Wiebe E. Bijker, Thomas P. Hughes, and T. J. Pinch, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, Mass., 1987).

23. Shah (n. 13 above). For a comparison of this case to other styles of water man-

erlands and the United States mirror the differences in risk culture in both countries.²⁴ In sum, all the arguments SHOT's patriarchs used when creating SHOT do boil down to the claim that we live in a technological culture.²⁵ All technologies are culturally shaped, and our culture is technologically constituted.

So, contemporaneous (and many historic) cultures are technological cultures because technology plays a crucial role in constituting them. However, technological development does not only support and strengthen the structures of societies. The high-tech character of modern societies also makes these structures vulnerable at the same time. Such vulnerability is an inherent characteristic of today's technological cultures. Sometimes this quality can turn into a problem or even a disaster, and during the last decades we have witnessed several high-tech-related disasters. The *Challenger* space shuttle explosion, the Chernobyl nuclear accident, the Bhopal chemical disaster in India, the Exxon Valdez oil spill—these all remind us that large technological systems are vulnerable to human errors and technical malfunctions with far-reaching consequences. Accidents, in such large technological systems and in technological culture more generally, are normal.²⁶

The second point I want to make about vulnerability is that it is not necessarily something negative. Vulnerability of a culture can even be considered a necessary condition for its survival: only when a culture is capable of learning, innovating, and flexibly reacting to external threats will it be sustainable in the long run. For innovation, as Schumpeter has argued, one has to be creative and take risks.²⁷ It has also been argued that for a smooth functioning of technical systems, it is sometimes necessary to take risks. When air-traffic controllers want to upset the air-traffic system (for example, because of a labor conflict), they need not strike—working to the rule is enough. John Law's analysis of the dramatic train accident at Ladbroke Grove, London, in 1999 showed that normal train-traffic practices involve some limited but regular breaches of rules. When a traffic controller is notified of a SPAD (Signal Passed at Danger [a train passing a red light]), he is supposed to cut power to make the train immediately stop. However,

agement, including New Orleans and the Netherlands, see Wiebe E. Bijker, "Dikes and Dams, Thick with Politics," *Isis* 98 (2007): 109–23.

24. Wiebe E. Bijker, "American and Dutch Coastal Engineering: Differences in Risk Conception and Differences in Technological Culture," *Social Studies of Science* 37 (2007): 143–52, and Cornelis Disco, "Delta Blues," *Technology and Culture* 47 (April 2006): 341–48.

25. I deliberately use this oxymoronic phrase, "technological culture," to underscore the need to transcend the popular opposition between culture and technology.

26. See the classic text by Charles B. Perrow, *Normal Accidents: Living with High-Risk Technologies, with a New Afterword and a Postscript on the Y2K Problem* (1984; reprint, Princeton, N.J., 1999).

27. On "creative destruction," see J. A. Schumpeter, *Capitalism, Socialism, and Democracy* (1942; reprint, New York, 1975).

sometimes this is a “technical SPAD,” which does not cause any damage. Therefore

the prevailing practice of the signalmen across the network was in fact to “wait and see.” . . . [T]his was a system imperfection which may have helped to keep the wheels turning almost all of the time. If the “signals on” button were pressed every time there were a SPAD, then it would have been pressed 660 times across the rail network in the UK in 1998/9. The result? There would have been dozens if not hundreds of additional technical SPADs. There would have been an unknown number of passenger injuries caused by emergency braking, together with massive disruption to the railway timetable and delays to the travelling public. And there would have been financial penalties for Railtrack and the relevant Train Operating Companies.²⁸

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In other words, a completely invulnerable system will probably not function well for any prolonged period. A culture that is not also a bit vulnerable will not survive.

This argument mirrors the warnings that historians and sociologists of technology have regularly made against a belief in “technological fixes.” As sociologist Benjamin Sims observed when introducing a special panel on Hurricane Katrina at the 2005 4S meeting, “one danger of relying too much on technological fixes is that these typically create yet more layers of infrastructure, which can make emergency response organizations even less likely to plan for contingencies in which critical infrastructure is destroyed.”²⁹ It is, I think, also in line with recent attention to the functioning of “messy systems.” Messiness, initially, does not exactly sound as solid, trustworthy, terrorist-proof, and invulnerable; but though such messiness may induce a certain vulnerability, it may also make a system flexible enough to react to unforeseen circumstances. Also reflecting on Hurricane Katrina, Jameson Wetmore thus argued:

The loose system of distributed responsibilities that is often associated with large socio-technical systems can work well. It allows different groups with different visions to participate without forcing them to strictly adhere to predefined roles for which they may not be suitable. The differences can lead to conflicts, which must then be negotiated, but such flexibility often allows differing opinions of what the systems should look like to coexist. Thus, different groups may end up attack-

28. John Law, “Ladbroke Grove, Or How to Think about Failing Systems,” paper published by the Centre for Science Studies, Lancaster University, UK, available at <http://www.lancs.ac.uk/fass/sociology/papers/law-ladbroke-grove-failing-systems.pdf> (accessed 1 May 2009).

29. Benjamin Sims, “‘The Day after the Hurricane’: Infrastructure, Order, and the New Orleans Police Department’s Response to Hurricane Katrina,” *Social Studies of Science* 37 (2007): 111–18, quote on 115.

ing the same problem from different directions, making the system more robust and ultimately increasing in effectiveness.³⁰

These observations apply more generally, I think, when analyzing the vulnerability of technological culture.

When the Netherlands moved away from its centuries-old decentralized and democratic form of water management to a more centralized system of a storm-surge barrier and other advanced and large technological systems, it created a system of coastal defense that is on the one hand less vulnerable, but also less flexible.³¹ I can think of scenarios in which more flexibility (with the associated vulnerability) would have been appreciated.

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Opportunities

I have proposed that two challenges are facing SHOT at its fiftieth anniversary: globalization and vulnerability of technological culture. I will now argue that there also are specific and pertinent opportunities to address these challenges at this phase of SHOT's life.

The first opportunity is conceptual. Technological determinism has been with us as a haunting ghost since the conception of SHOT. Constructivist approaches such as SCOT criticized technological determinism head-on in the 1980s and thus paved the way for a more external orientation and political relevance of the history of technology. Technological determinism, I have argued previously, is politically debilitating, because it suggests that social and political interventions in the course of technology are impossible, thus making any democratic debate about technology a futile endeavor. If that were an adequate description of the world, the externally directed challenges to SHOT that I just proposed would be equally futile. On the other hand, an exclusive attention to the social construction of technology without addressing the technological impact on society would be a fairly empty-handed endeavor as well. SHOT's scholars have repaired this unbalance in the past decade by revisiting technological determinism and developing a more comprehensive analysis of technology and society.³² This gives historians of technology all the conceptual apparatus that they need to address bigger challenges in the world, such as globalization and vulnerability.

30. Jameson M. Wetmore, "Distributed Risks and Responsibilities: Flood Hazard Mitigation in New Orleans," *Social Studies of Science* 37 (2007): 119–26, quote on 123–24.

31. See Wiebe E. Bijker, "The Oosterschelde Storm Surge Barrier: A Test Case for Dutch Water Technology, Management, and Politics," *Technology and Culture* 43 (2002): 569–84.

32. In this balancing act, it is crucial to conceptualize the *obduracy* of technology in addition to its *social constructedness*; see Anique Hommels, *Unbuilding Cities: Obduracy in Urban Sociotechnical Change* (Cambridge, Mass., 2005). Key texts in revisiting technological determinism include Thomas J. Misa, "How Machines Make History, and How

The second opportunity is strategic and indicates possible alliances for SHOT. In various domains, a cry for help can be heard to address issues of what I have called “technological culture.” These range from the American engineering programs’ need to provide “an understanding of professional and ethical responsibility”³³ to the call for “constructive technology assessment” in Europe³⁴ and the Dutch government asking me as a historian-sociologist of technology to chair an advisory committee on nanotechnology.³⁵ These are all examples where it was recognized that standard approaches to the problems of technology and society do not help. In such instances, I like to suggest, historians of technology can volunteer. But volunteer to do what? That is the third issue that I want to discuss under this heading of opportunities.

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This issue is related to new insights in what we may call the “politics of knowledge.” A committee for the Dutch Advisory Council for Science and Technology Policy (AWT) was asked to advise the government on possible contributions by the humanities in addressing problems of the information society. The resulting report made a plea for an “engaging humanities.”³⁶

This plea for an engaging humanities, and more specifically for an engaging history of technology, builds on the diagnosis by Helga Nowotny, Michael Gibbons, and others that the emphasis in the production of scientific knowledge has shifted from a disciplinary, university-centered, and internally motivated style (mode 1) to a multidisciplinary, dispersed, and externally directed style (mode 2).³⁷ Another diagnosis pointing in a similar direction is made by Silvio Funtowicz and Jerry Ravetz, who argue for the need of “post-normal science” to address the problems of scientific and

Historians (and Others) Help Them to Do So,” *Science, Technology and Human Values* 13 (1988): 308–31; and Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, Mass., 1995).

33. U.S. Accreditation Board for Engineering and Technology (ABET), “Criteria for Accrediting Engineering Programs,” available at <http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/E001%2008-09%20EAC%20Criteria%202012-04-07.pdf> (accessed 1 May 2009).

34. See, for example, the project “Technology Assessment in Europe: Between Method and Impact” (TAMI), at <http://www.rathenau.nl> (accessed 1 May 2009). See also Arie Rip, Thomas J. Misa, and Johan Schot, *Managing Technology in Society: The Approach of Constructive Technology Assessment* (London, 1995).

35. Gezondheidsraad (Health Council of the Netherlands), “Health Significance of Nanotechnologies,” The Hague, 2006, available at <http://www.gr.nl> (accessed 1 May 2009).

36. Wiebe E. Bijker and Ben Peperkamp, *Geëngageerde geesteswetenschappen: Perspectieven op cultuurveranderingen in een digitaliserend tijdperk* (The Hague, 2002). Some of the argument is also made in Wiebe E. Bijker, “Engaging Humanities: Problems of the Information Society Not to Be Left to Engineers,” in *Technik Welt Kultur: Technische Zivilisation und kulturelle Identitäten im Zeitalter der Globalisierung*, ed. Karl R. Kogler and Max Kerner (Köln, 2003), 103–39.

37. Michael Gibbons et al., *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies* (London, 1994); Helga Nowotny, Peter Scott,

TABLE

	<i>Knowledge interest</i>	<i>Mission</i>	<i>Servicing</i>	<i>Scientific attitude</i>	<i>Legitimation</i>
JULY 2009 VOL. 50	symbolic	to study historical and cultural heritage	elites	traditional: hermeneutic and empirical	internal
	instrumental	to contribute to social and economic development	clienteles	pragmatic: action-oriented	external
	democratic	to provide critical and normative reflection	civil society	normative-critical: evaluating and provoking	general

moral uncertainty that characterize our current technological cultures (my term) or risk societies (Ulrich Beck's term).³⁸ A shift from mode 1 to mode 2 science is also affecting the humanities. Rather than deploring the loss of classic virtues and the old values of mode 1 humanities, I would rather argue that a shift toward mode 2 can be a valuable and promising development, just as a post-normal science needs contributions from the humanities in addition to those from the natural and social sciences.

The child should, however, not be thrown out with the bathwater: society cannot do without the classic functions of the humanities. The table summarizes three functions of an engaging humanities, to underscore the plea that the old and new knowledge interests need to be combined.

To extend this argument to SHOT: an engaging form of the history of technology can combine the two classic knowledge interests of symbolic study and critical reflection with a third instrumental one to contribute to building a better world. Such a history of technology need not sell itself to market forces and thus cease to offer critical reflection on political and cultural change in society. It also does not need to be exclusively directed by external agendas and thus cease to safeguard cultural heritage. It would allow for addressing the external challenges of globalization and vulnerability while at the same time maintaining the scholarly integrity that was built up in the first fifty years of SHOT.

and Michael Gibbons, *Re-thinking Science: Knowledge and the Public in an Age of Uncertainty* (Cambridge, 2001).

38. S. O. Funtowicz and J. R. Ravetz, "Science for the Post-normal Age," *Futures* 25 (1993): 739–55; Ulrich Beck, *Risikogesellschaft: Auf dem Weg in eine andere Moderne* (Frankfurt am Main, 1986).