Vulnerability in Technological Cultures

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We live in vulnerable worlds.* As individuals we run the risk of being mugged in the dark alleys of Maastricht. Our material world may be threatened by floods, earthquakes, or airplane crashes—depending on where we are. Our social institutions such as family or church may be eroded by individualisation. And our culture, some argue, is being attacked by McDonald's and other immigrants.

These examples show that vulnerability is not exclusively associated with physical violence, nor only caused by natural disasters. If you still have some money in the bank after the financial crisis, this may suddenly be spent by someone who stole your credit card details from the Internet. And if you visit the hospital with a mere broken leg, you may return home with a multi-resistant bacteria infection. The Indian village of Sircilla recently became vulnerable due to changing textile markets, resulting in many suicides of weavers who were overwhelmed by financial debts.[1] When I am using the term 'vulnerability', this refers to all sorts of death, destruction and disintegration of humans, technical systems and social networks.

How to understand these vulnerabilities? What use could it be to lump these very different forms of vulnerability together and study them within one framework? Why study them at all?

I will argue today that studying vulnerability is fruitful for both scientific and social purposes. It yields an important broadening of the research agenda as compared to a mere focus on risks. And a focus on vulnerability allows for new approaches to social problems and thus will have effects on the political agenda too.

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 white powder; 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.[2]

Three points I want to make about the concept of vulnerability. The first is that vulnerability can best be studied as vulnerability in a technological culture. My second point is that vulnerability is not simply and exclusively negative: new opportunities emerge from recognizing vulnerability. The third and final point is that issues of vulnerable technical systems are too important to be left to engineers; issues of vulnerable social networks are too important to be left to social scientists; so: questions of vulnerability typically require the kind of interdisciplinary research that Maastricht University is known to deliver.

Vulnerability and technological cultures

We live in technological cultures. Today's societies are thoroughly technological, and all technologies are pervasively cultural.[3] Technologies do not merely assist us in our everyday lives; they are also powerful forces acting to reshape human activities and their meanings. When a sophisticated new technique or instrument is adopted in medical practice, it transforms not only what doctors do, but also the way patients, nurses, doctors think about health, illness and medical care. Coastal defense (I mean: dikes and levees) in the Netherlands and the United States mirror the differences in risk culture in both countries and different ways of being vulnerable.[4] Indeed, one way to summarize two decades of research in the field of science, technology & society studies (STS) is the statement: we live in a technological culture.[5] All technologies are culturally shaped and all cultures are technologically constituted.[6]

So, 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 makes these structures vulnerable at the same time. Such vulnerability is an inherent characteristic of today's technological cultures. If you are not part of the globalised financial system, you do not suffer when the mortgage market at the other side of the

world drops into crisis. If there are no airplanes, terrorists cannot steer them into high-rise buildings. If you do not have dikes, they cannot break. And it is even worse: technologies do not only make accidents possible—they ask for it. Once you have such large technological systems, accidents are inevitable. Accidents, Charles Perrow argued, are 'normal' in complex and tightly knit technological systems.[7] To sum up this step in the argument: most cultures are technological cultures; and technological cultures are inevitably vulnerable.

Let us now again focus on the concept of vulnerability. The origin of vulnerabilities is best studied in its relation to technologies: it can be a lack of technologies (as when the lack of simple water purification technologies causes a high mortality by cholera) or the unintended effects of the use of technologies (as the increased financial debts of Indian farmers because of their need to buy chemical pesticides). Almost all instances of vulnerability are thus shaped by technologies. At the same time our default defense mechanism against vulnerability is to call upon technology. To improve patient safety in a high-risk and technology-intensive environment such as an intensive care unit, we typically invest in more technologies: electronic technologies for monitoring, and social technologies of protocol to discipline the doctors and nurses. When the livelihoods of hand weaving communities in India are threatened by globalizing markets because their customers start buying mass-produced synthetic and brightly printed fabrics, one reaction is to invest in the technology of the powerloom, and to embrace the administrative technologies of centralized marketing and mass culture. When the Netherlands are threatened by sea level rise due to climate change, we invest in higher dikes. I can now make my first conceptual point about vulnerability: vulnerability is best to be studied as a characteristic of technological culture. This will help to bring out the interactions between the various dimensions of vulnerability: technological, scientific, social, economic, political, ethical, and cultural.

But what does this buy us? Is it more than an invitation to look past the end of your nose? Or does it also change what you see there, and how to react to it? I do think so. Let me illustrate this with an analysis of the different forms of vulnerability to flooding in the US, and specifically New Orleans, and in the Netherlands. How is it possible that the US failed to keep dry feet in New Orleans, when large parts of the Netherlands can exist below sea level? Does this suggest that the US Corps of

Engineers is less capable than the Rijkswaterstaat engineers in the Netherlands? I will argue that something else is going on: the difference is not one of expertise, competence or technical quality, but one of coping differently with vulnerability in different technological cultures.

Histories of the Dutch and American coastal engineering professions show that both studied the vulnerability to flooding and consciously learned from natural disasters. Yet, they did so in strikingly different ways.[8] The American practice focuses on predicting disasters and mediating the effects once they have happened; in brief: the focus is on 'flood hazard mitigation'.[9] Dutch practice, in contrast, is to keep the water out.

A long string of hurricanes in the 1950's in the US gave rise to a major effort by both the US Army Corps of Engineers (USACE) and the US Weather Bureau to develop warning systems and protective measures. Several surge prediction models were developed, with differences resulting partly from the different needs of the modellers: *protection* for USACE, *warning* for Weather Service, *insurance* for the Federal Emergency Management Agency (FEMA). The key phrase in the U.S. is 'flood hazard mitigation', and the key ideas are 'prediction' and 'insurance', which suggest that the very fact of flooding is accepted. The risk criterion that is used in designing levees and other coastal defense structures in the US is a 1:100 chance, or a 'hundred year flood'.[10] This criterion is a technical norm, carrying important professional weight among coastal engineers, but it does not carry any legal authority.

How different is the practice in the Netherlands. I can still remember my father pleading, when looking back to *De Ramp*: 'whatever—that never again!' Those words by the first professor of coastal engineering in the Netherlands effectively and emotionally capture the *credo* of Dutch engineers since the 1950's. The water should be kept out, at all costs. In the *Deltaplan* law, the criterion of 1:10,000 was specified: not merely as a technical norm, but as a legal obligation embedded in the 'Delta Law', unanimously approved by parliament.

The intriguing question is how to explain this difference between two technically advanced western countries. And, even when we could trace some of the historical roots of these differences, why have the practices of coastal engineering not converged more—is this not just a matter of choosing the best science and technology, and aren't science and technology not universally valid, everywhere in

the world? What is best for the Netherlands should be best for the US, or should it not…?

My suggestion is that the differences between American and Dutch coastal engineering styles are related to the differences between American and Dutch technological cultures. It is a standard STS point to stress that there is *not* something like a universal science and technology, independent of time, culture and context. There are national styles of coastal engineering, related to the technological cultures in which they are embedded.[11] What then are relevant characteristics of American and Dutch technological cultures? Granted: a few differences pertain more to geographical circumstances than to the cultures themselves—the Netherlands just is a more watery country than the United States of America, with more sea coast and more river borders per square mile, and the Netherlands just does not have hurricanes. But there are striking differences in political culture and the role of the state too. American political culture can be characterized as neo-liberal, without belief in the common good as something that the government should define and protect; there is an inclination to privatize and individualize public functions, rather than calling upon the state to defend their value.[12] Although recently such neo-liberal tendencies have been emerging in the Netherlands too, Dutch political culture is quite different, with a much more accepted central role for the national state in all sectors of society. Another important difference in technological culture is the general public's technical literacy in matters of hydraulics and coastal engineering. Measures to secure lower probabilities of flooding, including high taxes and imposing infrastructures, may be more acceptable when citizens better understand the risks and the technical means of coastal engineering defense. Dutch citizens, both as action groups and as unorganized individuals, play active roles in public debates, hearings, or on the discussion pages of national newspapers when it comes to issues of flooding and water management.[13]

So, to conclude this part of the argument, the flooding of New Orleans and the dry feet of the Dutch cannot be explained by hurricanes or good Dutch engineering only. A focus on the difference in technological cultures provides a more comprehensive explanation. This also suggests strategies for coping. If my analysis makes sense, it is unlikely that just importing Dutch engineering solutions into New Orleans will do the trick. Technologies that do not fit the technological culture in which they are to operate typically do not function properly. Technologies ask for investments in money, space, people; technologies need to be maintained, there

operation governed; technologies need to be understood —at least to some extent—by the people that use them. Dutch technologies may help New Orleans, but without a proper fit with the US technological culture foreign technologies will be as effective as the proverbial refrigerator in a Sahara country without electricity.

Vulnerability is inevitable, not just negative

The second point I want to make about vulnerability is that it is not necessarily only negative. To be vulnerable in the sense of being susceptible to breaking down, being destructed or dying is an unambiguously negative personal experience. But there is more to it. I will argue that vulnerability often is inevitable, and in some instances even can be positive.[14]

I need not say more about the *negative* meaning of vulnerability—previous references to the 1953 Ramp in the Netherlands and the 2005 Katrina flood in New Orleans should suffice.

Let's explore the *inevitable* vulnerability—a form of vulnerability that is not exactly positive *per se*, but an inevitable consequence of something that we have deemed positive. The easiest examples are large technical systems. Many of us enjoy GPS systems for navigation and mobile phones for communication, but these also entail new and inevitable vulnerabilities—due to, for example, lack of battery power, lack of connectivity, or technical failure.

A cultural perspective, however, offers insights that go beyond the technical gadgets. My colleagues Anique Hommels and Eefje Cleophas study the vulnerability of emergency communication.[15] Their analysis of the Enschede fireworks explosion explicates differences between German and Dutch technological cultures of emergency handling (both employing volunteer firemen and firewomen). The German culture of fire fighting is deeply rooted in community life: German fire brigade culture is often described as '*kameradschaftlich'*, while Dutch fire fighting culture is considered 'professional.' Many Germans join the fire brigade in their youth, and the number of German firemen is about three times as high as in a comparable Dutch city. Linked to this is the cultural phenomenon of '*noaberschap'* (or *Nachbarschaftshilfe*), the idea that you help your neighbours whenever they need it. This notion played an important role during the disaster in Enschede. Without being officially called, fire trucks from Germany just pulled in when they heard about the explosion, referring to

their duty of neighbour assistance. The fact that they came unannounced was a mixed blessing, according the chief commander of the Enschede fire department: "Uncoordinated action is the worst thing that can happen… because you loose control, people take risks, there is no communication, certainly not when they begin spontaneously and use their own communication technologies. So on the one hand, you have to be very grateful that it happens—on the other hand, it is important to coordinate this in a different way." The vulnerability of this emergency communication system (i.e. the gaps in coordination) goes hand in hand with positive effects (i.e. quick response because of *noaberschap*).

But there are even examples where vulnerability seems to be directly positive. In a small-scale irrigation system in Tanzania, the dams are not made of concrete or bricks but of sand and clay, because the clay dams require more maintenance. Maintaining the technical dam system, it is argued, will also help to maintain the social cohesion in the village. Here the relative vulnerability of the clay dams is explicitly and strategically employed as something positive.[16] In this example I am not talking of just a failure of the dam technology—that could be compensated for by just another technical back-up device—but of a different frame of mind: to see vulnerability as an opportunity to act, learn and innovate.

Similarly the vulnerability of the Dutch living below sea level can be argued to have had the positive effect of stimulating a more cohesive style of politics. In the 12th century the 'water boards' were established. They were the first form of democracy in the Netherlands. The duties of these water boards included communal tasks such as drainage, dike maintenance and sluice management, and they could claim taxes. A few times per year they held inspections, and when parts of the hydraulic infrastructure were found out of order, the responsible persons were severely fined. Only during the 18th century a more central oversight developed gradually, and in 1796 the first national agency, *Rijkswaterstaat*, was established.[17]

Dutch political culture still shows several characteristics that can be traced back to this early history of water politics. First, there is a certain trust in technical solutions and in technocracy. Indeed, close links exist between policy makers and scientists (including social scientists) and engineers. A sense of vulnerability, because of the century-long relation with high water, is combined with a style of proactive and consensual policy making and a capacity to react swiftly to crises. In such reactions,

Dutch politics will often take a pragmatic approach to find *ad hoc* and flexible solutions, even when this means that regulations need a 'flexible interpretation.'[18] The Dutch have a long tradition of planning and actively shaping their environment. This not only applies to the geophysical Netherlands, but also to Dutch society—Dutch political culture displays a general belief in the malleability (or *maakbaarheid*) of society. Finally, the political culture in the Netherlands is distinctly consensual and oriented towards co-operation and compromise. This is not to say that there are no opposed interests or conflicts; but in the end the Dutch need a form of co-operation to find a feasible solution, under the penalty of being flooded. If you deem this 'Poldermodel' style of political-economic co-operation positive, as I do, then that is a positive effect of the vulnerability of the Netherlands.

In some obvious sense, weavers working on handlooms are vulnerable to the effects of globalizing textile markets and efficient mass production. But the decentralized nature of the handloom technology and trade also implies a flexibility that may allow for a swift reaction to changing colour preferences of the upper middle class who is prepared to pay a bit more for sustainable products. The vulnerability of the small and decentralized handloom weaver may turn into strength when the context changes and flexibility is more valuable than cost-efficiency.

I have talked about Tanzanian clay dams, Dutch polders and Indian handloom weavers. Also at the most general level, I want to argue that vulnerability can be considered a necessary condition for the survival of a society: only if a culture is capable of learning, innovating, and flexibly reacting to external threats, it will be sustainable in the long run. For innovation one has to be creative and take risks.[19] And that implies some degree of vulnerability. A culture needs to be flexible, and thus a bit vulnerable, in order to survive. Vulnerability is inevitable in a technological culture, and to some degree it is even positive.

Implications for understanding and intervening

I have made two points: that vulnerability of both humans and technical and social systems is best studied as vulnerability in technological cultures; and that vulnerability can have positive implications. Let me try to add a third point. Let me try to answer one of the most dreaded questions after a presentation in our department's research seminar: *so what?* Does all this have any implications beyond a

better scholarly understanding of the development of technology in society; does it yield consequences for moving beyond the confines of academia?[20]

First, I hope that the language of vulnerability will help me to address questions of community, democracy, justice. The language of risk, with its tendency towards quantification, optimization and management seems less fit to deal with these broader issues.[21] Vulnerability is, I have argued, part of *la condition humaine*, and especially part of the human condition in technological cultures. But the fact that vulnerability is inevitable, does not make us less responsible for responding to it, dealing with it, shaping a just and democratic society around it.

To illustrate how an analysis of vulnerability opens up for questions of justice, I will turn to yet another example—the Muslim minority in India. The vulnerability of Muslims in the state of Gujarat is partly caused by their condition of being a minority in a Hindu state, and partly by the high-tech economic development that the present Hindu government is pushing through.[22] This government pursues the creation of a new technological culture that is very different from the plural, syncretic culture of the old Gujarat in which Muslims and Hindus lived well as neighbours. The new state vision projects a global Gujarat of special economic zones, science cities, high-tech infrastructures, privatized ports—and Hindu identity. It seeks an erasure of the old history with its trades and crafts, its memories and its identity politics. "Let us forget and move on", the new middle class prays. But with the erasure of memory, new vulnerability is created. Vulnerability needs a memory because memory prevents erasure, allows living.[23] Justice demands memory and it is precisely this that the vulnerable Muslims in Gujarat are asked to abandon. They are asked to give up the right to their own story as part of the move into a new Hindu technological culture. This analysis of the vulnerability of Muslims within the new technological order of Gujarat as resulting from a combination of techno-economic development and religious identity politics sheds new light on the relations between technology and justice, between economy and democracy. The consequences are not just for the Muslims, but also for the Hindus who now may have to face counter violence, including terrorist attacks. The Gujarat state policies thus breed specific vulnerabilities that may result in a broader break-down of society. Democracy and justice are the only way out, not as something given by the powerful to the poor or

under-privileged, but as the only radical way to make a technological culture that does not generate such vulnerabilities.

The vulnerability of the Muslims, adivasi and dalits in Gujarat may seem different from the other kinds of vulnerability I have been talking about during this afternoon.[24] It is not. The violence that creates this kind of vulnerability in modern India is inextricably connected to the changing technological culture. Whether it is the economic development and the chain of modern research institutions in the Gandhinagar-Ahmedabad corridor, or the push from the green to the gene-revolution, or the almost religious belief in an Indian nuclear programme—these only make sense as part of a specific technological culture. (In exactly the same way the radical advice by the recent Dutch Deltacommission to step-up the water management investment and innovation only makes sense in the context of Dutch technological culture.[25]) And all these interventions create new vulnerabilities. The Gujarat policies have inescapable effects on all groups in society, and certainly on the weak and poor (who will be paying the costs for the new Deltaplan is not yet clear). And I hope to have shown that the perspective of vulnerability does open up for broader questions of justice and democracy.

But still: so what? What use is it to tell these stories? Why not read a proper novel, or—on this location—listen to a real preacher? What use is this cultural science research into the relations between technology and society? What is the answer to the 'so-what' question? I will give you two answers: the STS mirror and the STS kiss.

My colleague Jessica Mesman studied the vulnerability of newborn babies in neonatology intensive care units (NICU).[26] As an anthropologist (and a nurse) she spent several years observing the NICU doctors, nurses, children and parents. Her aim was to figure out how the interplay of knowledge and skills, of technologies and humans, was successful in coping with such extremely vulnerable lives as these small babies. Her project turns the standard way of looking at patient safety upside-down. This standard way is to prevent accidents by detecting and eliminating causes of error. To do so, protocols and safety devices are developed. Mesman wondered: why don't things go wrong much more often in these very complex, high-risk settings? How is it possible for protocols to maintain safety, despite the fallible technologies, unrealistic rules, and incompatible procedures and systems that are inherently imperfect by their very nature? To answer this, she looked beyond the deficit-model of safety (I mean:

safety is the lack of error), and started to include the texture of the safety itself, including its informal and unarticulated dimensions. Patient safety, she showed, is also realized by unplanned but effective actions, hidden competences of the doctors and nurses, and informal social structures in the NICU.

The neonatology people liked her book. Why? Did this cultural scientists tell them anything they did not already know? No and yes. *No*: Mesman only reproduced what the NICU inhabitants told her. But *yes*: she retold what she saw in her STS (science, technology and society studies) language, and that was new. Her book holds up a mirror to the neonatologist. And like all mirrors, the STS mirror does not simply reproduce, it is not innocent: as you may have a better tan, may look slightly taller or slimmer when you look into the mirror of a fashion shop, the STS mirror highlights certain observations and adds interpretation, theory, explanation.

Well, that is at least something: the cultural scientist holds op a mirror to the world she has been studying, and those who look into the mirror may benefit from what they see and thus benefit from the cultural science research. But you may feel that this is a cheap and easy way out: after all, the effects of learning are completely delegated to those who look into the mirror, to those who have been studied. The STS-er seems to come away untouched and with clean hands.

But then the Maastricht University hospital asked this STS researcher to join a committee to improve neonatology safety; and she accepted an invitation to participate in a task force on patient safety with practitioners from hospitals and industry. This is more than holding up a mirror. This is engaging, and making dirty hands. Here we need a new metaphor. What we see here is an enactment of the Sleeping Beauty fairytale and the *STS Kiss*. Like in the case of the mirror metaphor, all the knowledge and beauty is in the world (sleeping Princess) studied by the anthropologist (the Prince). But after kissing her awake and making here aware of her own knowledge, skills and insights, the Prince does not turn away, but engages with the world—even marries the Princess. To say that the STS researcher is now making dirty hands, would be an unfortunate mix-up of metaphors with the beautiful and clean princess, but I trust that you are getting the message.

Engaging cultural science research is crucial to understand the wider implications of technology being embedded in society, and current societies being constituted by technology. This also applies to better understanding the issues of

security, risk, and vulnerability, including the strategies to manage these. This kind of STS research is about turning vulnerability into a source of strength, into an opportunity for innovation, into justice and democracy. But to realize these, the STS mirror is not enough; and the Princess should not be passively beautiful. The Prince needs to be prepared for a slap in the face from the Princess, before she gives him the time of day. Engagement between scholars and practitioners will never be easy, the goal is not pre-set, and the rules of the game need to be invented on the move. But there is no way back: once the mirror is held up, once the Princess is kissed awake, once the Prince has ducked her slap—engaged cultural studies of vulnerability will never be the same.[27]

This afternoon, I have agued that our worlds are inevitably vulnerable, that this vulnerability is best understood from the perspective of the specific technological cultures, and that there are more fruitful ways of dealing with these vulnerabilities than trying to bring all risks as close as possible down to zero. This is not an argument to accept the risks of traffic accidents, or to *not* regulate against toxic nanoparticles, or to go bungee jumping. It is an argument to engage in innovative and interdisciplinary ways of handling vulnerabilities to open up for new perspectives on shaping our highly developed societies. Our worlds are vulnerable in their core. Once we recognize that, we will be better capable of coping with and in some instances even benefiting from these vulnerabilities.

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Notes

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[*] I am grateful to Tonny à Campo for her very helpful close-reading of previous drafts.

[1] Internal report for Dastkar Andhra by Shyama Shyamasundari; see also "Sircilla rocked by three more suicides by weavers", The Hindu national newspaper, 28-09-2008. Sircilla is a powerloom centre, where weavers who used to be handloom weavers moved to power looms. The move from handloom to powerloom was an effort to 'modernise' and be more productive and cost-efficient on labour. The current crisis in Sircilla originated because the powerloom weavers have not been able to modernise to the next level to be even more cost-efficient, and so they completely lost their markets to newer textiles centres.

[2] See Prasad (2001).

[3] See, for example, the collection edited by Bijker and Law (1992)

[4] See the comparison by Bijker (2007)

[5] I deliberately use this oxymoronic phrase 'technological culture' to underscore the need to transcend the popular opposition between culture and technology (Bijker 1995).

[6] This is a methodological and heuristics argument about how to study the development of technology and society in their mutual interactions, and should not be confused with recent political discussions about 'Dutch culture.' See Koenis (2008) for a critical analysis of this other use of the concept of 'culture.'

[7] See Perrow's (1999 (1984)) classic.

[8] See the American history by Wiegel (1996: 555) and the Dutch history by Bijker (1996)

[9] See also Wetmore (2007).

[10] The common phrase 'hundred year flood' is deceptive if understood to mean that such a flood will only occur once every 100 years. The problem of misunderstanding probabilistic reasoning in this way by the general public certainly exists as much in the Netherlands as in the U.S.

[11] See, for example, Thomas Hughes' (1983) classic study of different styles of electrical engineering and electricity distribution networks.

[12] See Mukerji (2007)

[13] This claim should probably be toned down in the light of social trends that also exist in the Netherlands: individualization, consumerism, and lowering memberships of social organisations such as political parties and labour unions. The low turnout in all elections, and especially in my favourite ones—for Europe and the Dutch water boards—is perhaps also indicative.

[14] In addition to Charles Perrow's work on normal accidents, Ulrich Beck's (1986; Beck 1992) seminal study of the *Risikogesellschaft* is a crucial foundation for this analysis of vulnerability in technological cultures be. Below I will return to the question why I need the concept of 'vulnerability' rather than 'risk.'

[15] See Hommels (2008)

[16] Personal communication: Prof. dr. José van Eijndhoven remembered this example from a presentation by Dr. D. A. Mashauri, University of Dar es Salaam.

[17] For more details on early Dutch politics and water management, see Kaijser (2002) and TeBrake (2002).

[18] Non-water examples are the Dutch abortion, prostitution and drugs policies. The swift handling of the recent financial crisis is another example.

[19] See also Schumpeter's (1942 (1975)) 'creative destruction'.

[20] Conversations with Annapurna Mamidipudi about the questions in this section were very helpful.
[21] I am certainly not arguing that all risk-based discourse has that narrow gauge. Much of the work by the Health Council of the Netherlands on this topic can be summarized as arguing for a broadening of the concept of risk (Gezondheidsraad 1995, 1996), and also Beck's *Risikogesellschaft* offers such opportunities. Recent advisory reports by the Health Council (Gezondheidsraad 2006, 2008) and the Scientific Council for Government Policy (WRR 2008) have argued for the use of the precautionary principle, which also broadens the risk discussion to address issues of justice and democracy.
[22] I am indebted to discussions with Shiv Visvanathan, Tridip Suhrud, Aditi Nath Sarkar and Binita Desai. See also (Visvanathan 2008).
[23] Chandrika Parmar's (Parmar 2008) work on violence and memory related to the partition between Pakistan and India is very insightful.
[24] 'Adivasi' is the self-preferred name of tribals, a heterogeneous set of ethnic and tribal groups believed to be the aboriginal population of India. They comprise a substantial indigenous minority of the population of India. They are officially recognized by the Indian government as 'Scheduled Tribes.'
'Dalit' is the self-designation of lowest caste people, also known as untouchables. The official governmental term is 'scheduled caste.'
The government category 'Scheduled Castes and Tribes' is eligible to certain affirmative action posts.
[25] See the recent report by the Deltacommissie 2008 (2008)
[26] See Mesman (2008)
[27] Another example of such collaboration between (STS) researchers and practitioners is the EU-funded project 'Science, Ethics and Technological Responsibility in Developing and Emerging Countries.' This project, with participants from India, Kenya and Europe, aims to formulate a science and technology policy from the perspective of countries in the global south instead of their merely following the agenda's of the north and the west.

The Vulnerability of Technological Culture. Cultures of Technology and the Quest for Innovation. H. Nowotny. New York, Berghahn Books: 52-69. 1.Â In this chapter I want to explore the vulnerability of technological culture: a vulnerability that is at the same time an inevitable consequence of, and a necessary prerequisite for, the advanced technological society in which we live. To do so, I shall first specify what it means to investigate technological culture in addition to analysing technological systems and high-tech society, and then continue with an analysis the concept of vulnerability applied to, respectively, systems, society, and culture. Studying Technological Culture. Advances in manufacturing technology changed American culture by allowing people to become accustomed to the large consumption of goods. The demand for new products encouraged advances in technology. The boom of handheld devices like iPods, cell phones and Global Positioning Systems (GPS) in the 21st century is just an extension of the changes American culture encountered in the American Industrial Revolution.Â While technology changes agricultural techniques, it also changes the environment and thus the cultures of the people affected. When governments build sophisticated dams in order to produce hydro-electricity and provide water for irrigation, the people further down the river suffer. While technology has many positives, it can also lead to negative psychological and physical health effects. Learn about the adverse effects of technology here.Â Technologies, such as handheld tablets, smartphones, and computers, can hold a personâ€™s attention for long periods. This may lead to eyestrain. Symptoms of digital eyestrain can include blurred vision and dry eyes. Eyestrain may also lead to pains in other areas of the body, such as the head, neck, or shoulders. Several technological factors may lead to eyestrain, such as IEEE Xplore, delivering full text access to the world's highest quality technical literature in engineering and technology. | IEEE Xplore.Â For IEEE to continue sending you helpful information on our products and services, please consent to our updated Privacy Policy. I have read and accepted the IEEE Privacy Policy.