A call to technologists to ensure that responsible outcomes arise from their innovations

Aaditeshwar Seth
Department of Computer Science and Engineering, Indian Institute of Technology Delhi, New Delhi, India

Received 8 June 2020
Revised 5 September 2020
Accepted 21 November 2020

Abstract

Purpose – The purpose of this paper is to encourage technologists, those who design and manage technology systems, to collectivize and get closely involved in defining the priorities of their organizations, their countries, and the world, so that responsible outcomes can arise from their labour.

Design/methodology/approach – The author examines this problem from three viewpoints: From a design perspective about what is missing in most design practices to build information systems that undesirable outcomes still happen; from an ethics perspective about how to incorporate values in building and managing information systems; and from a political economy perspective about why ensuring responsible outcomes from technology is not easy. The author describes several limitations faced by technologists in achieving this, ranging from gaps in the design methods in use currently, a piecemeal approach to following ethical principles in the design and management of technologies, influence of the organizational culture and structure and the wider political economy of technology itself.

Findings – The author suggests several measures to address these challenges and conclude with a call to technologists to collectivize and engage politically to influence their organizations and governments to invest in meaningful objectives for a just and equitable world, and design and manage the solutions in ethically consistent ways.

Research limitations/implications – It is argued that a new paradigm of information systems is needed for digital platforms, which is grounded in ethics-based guidelines that should be followed by the designers and managers of these platforms to help ensure responsible outcomes.

Practical implications – Having such a paradigm is especially important in today's winner-takes-all digital platform era because these platforms are governed by only a few people; therefore, it is imperative to build guardrails to responsibly manage these platforms, and to have technologists who design and manage these platforms to play a role in their governance.

Social implications – Information systems have the potential to alter power relationships in society, and it is suggested that they should be designed to empower the weak.

Originality/value – To the best of the author's knowledge, this is a unique perspective that draws from his personal experience as a researcher and practitioner designing technologies for social good, and examines the problem from many different viewpoints.

Keywords Political economy, Social development, Design, Deployment, Technology workers, Ethics, Responsibility

Paper type Viewpoint

For all the wonderful positive examples of technology innovations that have made the world a better place, there also exist a plethora of negative examples of misuse or (unanticipated) harms arising from these systems. This article is centred at technologists – the engineers, designers and managers of computer-based information systems – and asks the question: how can technologists ensure that responsible outcomes arise from their hard labour spent in designing and managing computer-based systems? The article does not provide a

Journal of Information, Communication and Ethics in Society

1477-996X
DOI 10.1108/JICES-03-2020-0032

concrete answer but serves to highlight several reasons that make it challenging or not adequately motivating for technologists to uphold ethical values, and finally raises a call to action for them to learn to navigate this complex through collective action.

Building ethical guardrails for technology

We start with arguing that precautionary methods like ethical reviews preceding a technology launch, or ethics by design approaches, are useful but not sufficient in themselves, thereby placing a lot of onus on the technologists to manage their innovations.

Medical ethics has evolved a rich set of protocols to ensure minimal harm from new innovations. It relies on doing extensive evaluations before any innovation is permitted to be released in the world. Although even such an approach is not failsafe and unanticipated outcomes do occur leading to the recall of medical drugs and devices due to flaws that were overlooked during the reviews, the field of computer science and engineering does not follow such checks at all. Ethics-based review protocols do exist for academic research but companies and governments deploying technology at large scales are not required to undergo reviews to understand the ethical implications of their innovations. Why medical-ethics like review protocols are missing in the computer systems ecosystem? One explanation could be that our existence as biological beings has been known for a long time; therefore, medical ethics evolved to test and rigorously evaluate any artefacts that affect our biology. However, our existence as informational beings is only now being discussed, of how information affects our beliefs, shapes our actions and not just individually but at a societal scale (Floridi, 2010). Perhaps regulation will eventually catch up with this view and impose proactive review guidelines, although even this may not prevent exceptions altogether.

An alternate approach that has emerged in computer science is to incorporate ethics into the design of computer-based artefacts (ICDPPC, 2018; Duquenoy and Thimbleby, 1999), with principles like privacy or fairness encoded in the design of the technologies itself. We argue that this approach of achieving ethics by design is limited in its potential. We have discussed elsewhere in detail based on our decade long experience of running a technology-based social enterprise, Gram Vaani (translates to *voice of the village*) [1], that even beyond careful initial design, concerns can arise at the socio-technological interface when people begin to use and adapt the technologies to their needs (Seth, 2020b). We describe several aspects such as who is included or excluded from access to the technologies, signalling to shape appropriate usage norms of the technologies, evaluating the line between flexibilities to allow and constraints to impose to control the appropriation of technologies, and ensuring social impact. We show that handling these aspects required careful management of the Gram Vaani technologies once they were deployed. This was done by evolving a rich set of processes, such as collecting feedback about the use of the platforms, development of editorial policies and decisions on the extent to which to allocate financial resources towards meeting the social impact mission of the enterprise. Design changes in the technology were of course subsequently needed to implement these processes effectively, thus making design an evolving process itself, but our point is that the onus to ensure responsible outcomes rested overwhelmingly with the managers, going beyond what the initial technology design alone could ensure. We further suggest that just like the approach to incorporate ethics into the design of innovations it is also required to incorporate ethics into the processes of managing the innovations. Ethics can be that common denominator which can provide the necessary guardrails to evolve both the design and the management processes that can ensure responsible outcomes from technology (Seth, 2020b).

Another reason why ethics by design is not sufficient is the current context in which information systems have deeply permeated our lives already. These systems are being used by millions and billions of people, and are embedded in a complex global web of finance and politics, that it is daunting to even conceive an eventuality in which they will be re-designed or replaced. We may be seeing the classic Collingridge dilemma of failing to control technology until it is too late (Collingridge, 1980). The recourse might be to rather review their internal management processes and ground these processes in ethical frameworks, to minimize future misuse to the best extent possible.

Spotting problems through comprehensive ethical examination

Given the limitations of proactive reviews or ethics by design approaches to ensure responsible outcomes from technology systems, the key question we ask is what prevents technologists from exercising more discretion in their work to ensure careful management and design of the technologies that they are involved with?

An important gap we feel with technologists being able to self-regulate themselves is often an ambiguity in prioritizing goals that the innovations should achieve through their deployment. An example is information feeds in content recommendation systems, where there is an inherent ambiguity of whether to optimize the feeds for profit-making metrics such as time spent by the users on the platform (Tufekci, 2016), or normative user experience metrics such as diversity in content recommendations (Muskaan *et al.*, 2019). Metrics such as time spent are known to lead to filter bubbles and prioritization of information that is sensational, which can lead to good business but causes social harm, whereas metrics such as diversity may lead to less user engagement but would demonstrate a commitment towards pluralism and its potential in shaping social norms. With an ambiguity about the prioritization or compromise between different goals, it is easy even for well-meaning technologists to get lost. Ambiguity in fact becomes a tool to obfuscate objectives that can otherwise be challenged easily, such as a single-point agenda to make money. This can leave technologists confused about what should they be questioning in the first place: The objectives themselves, or a lack of clearly articulated objectives, or problems in the methods to meet the objectives?

We want to add that not all technologists can be expected to empathize with avoiding harms arising from their innovations. Some may indeed face no ambiguity in being driven by money-making objectives, or some may be more focused on computational concerns such as system performance and efficiency. We touch upon these concerns subsequently in the article and focus here on issues that dampen the motivation of even well-meaning technologists to avoid harm.

To address the issues of ambiguity, shown in Figure 1 is a three-layered framework where we suggest that a common ethical system needs to provide underlying guidelines in defining the objectives, design and management processes, of any technological system (Seth, 2020b, 2019). The ethical system can provide clarity in framing what might be good objectives to pursue, and consequently in guiding the design of the system to meet the objectives, followed by processes to manage different aspects of the socio-technological interface during the deployment of the system. The ethics of the design itself, at the middle layer, can be considered on at least three fronts. First, the user interface may have persuasive elements that can nudge users towards certain actions (Schneider *et al.*, 2018), raising questions about informed choice and appropriate design (Berdichevsky and Neuenschwander, 1999). Second, the data and algorithms would raise questions about privacy, biases in the data, the definitions incorporated for algorithmic fairness, etc. (O'Neil, 2016; Chouldechova and Roth, 2018). Third, the system design would present choices such

as whether to build systems that have centralized decision-making elements vs a decentralized design, assisted access vs private access, aimed at collective interactions vs individualized interactions and other such design choices that can shape power relationships between the direct and indirect users of the technological system and with the technology itself (Seth, 2019; Winner, 1980).

We suggest that in any information system, each of these three elements of the design, along with the objectives of the information system, and the management processes, should be guided by a common underlying ethical system that is followed by the designers and managers of the information system. Examining innovations through an ethical lens can therefore provide a systematic approach to technologists to overcome ambiguities of where to place their attention. The objectives, design and management processes can all be questioned based on a clearly articulated common ethical system, and deviations from it can then be identified and addressed. We applied such a consistency check on platforms like Aadhaar (biometric-based unique identity system in India) and Facebook to evaluate whether their stated objectives, and externally visible design and management processes, were in agreement with a common set of ethical values. We found inconsistencies in the observed ethical values across different layers, in both these platforms. In the design of Aadhaar, biometrics were chosen as an authentication factor for reasons of inclusion, as alternates like passwords or mobile phone-based OTPs (One Time Passwords) could impede less-literate and low-income people from using the service. However, adequate management processes were not developed to handle authentication errors due to false negatives, because of which many poor people were denied access to welfare benefits (Khera, 2019). Facebook has similarly championed itself as a platform for user empowerment, but it prefers to control misuse through non-transparent and algorithmically driven centralized management processes, rather than empower and trust users to take ownership of their own communities to establish editorial norms of non-offending usage (Freuler, 2018). This lack of ethical consistency is a likely reason behind much confusion that prevails in the public sphere about these platforms (Seth, 2019).

Finding appropriate solutions

Once technologists do manage to spot the problems accurately, what solutions should they attempt to push? The next fault-line we feel arises from the dominant belief of most technologists, possibly stemming from the nature of their education, in the positivist paradigm of science and technology in which most of them have been trained to operate. Technologists tend to expect, much like a computer system, that specific inputs will lead to specific outputs, and seem to have developed an unfortunate deluded sense of their own prowess to control outcomes. Dahlbom and Mathiassen discuss this in their analysis of a

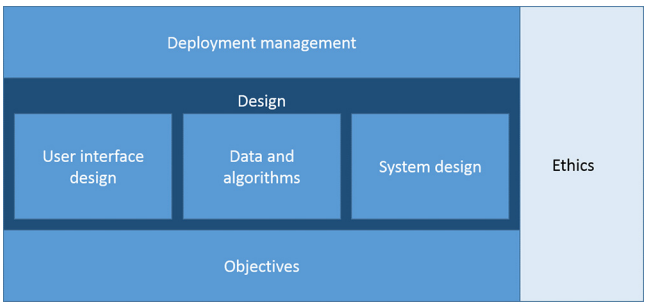

Figure 1.
Ethical underpinnings to information systems

romantic vs mechanistic view of information systems, and argue that the outcomes of technological systems cannot be mechanistically determined (Dahlbom and Mathiassen, 1993). Rather the outcomes are shaped by the context in which the technological systems are deployed. The culture, power relationships between the users, and the agenda of users behind using the technology, all influence the eventual outcomes, and are in turn shaped by the technology as well.

It is probably this mechanistic view of technology among many technologists that they often come up with purely technological solutions to solve problems that might be stemming from deeper societal issues, or they feel confident in designing systems that are flawless to begin with, or they ignore the inherent diversity of people and communities with a belief that they can model all this complexity in a machine. Facebook's audacious attempt at capturing the complexity of society in legible algorithmically driven community standards, or Uber's attempts at formalizing relationships between drivers and users and cities or the arrogance of Aadhaar's designers in undermining the need for protocols to pay attention to cases of technology failure, are examples of a dominant mechanistic rather than romantic view in approaching problems. Technologists need humility to not get carried away with their own technological prowess – there are limits to what technology alone can solve.

A more comprehensive education curriculum can possibly address this problem that seems to have emerged from biases in how most technologists have been trained in the physical sciences and engineering disciplines (Dahlbom and Mathiassen, 1997). The outcry to have courses on ethics for computer sciences is quite a welcome development (Fiesler *et al.*, 2020), although it needs to be supplemented with readings on technology and society, as we point out later (Seth, 2020a). Such educational initiatives will also serve to widen the perspectives of technologists to be mindful of the implications of their innovations, rather than just constrain their attention to optimizing for performance and efficiency metrics.

Rich methods of participatory design already do exist to assist technologists in embracing a more romantic view of technology (Sanders, 2008). Methods of ethnographically informed user-centred design, co-design, etc., attempt to understand the context in which the technology is deployed, and to understand the effects of the technology. Unfortunately, however, in many cases, these methods are applied only to help designers and managers understand their users as consumers of applications. It is rare to come across cases where emergent undesirable outcomes are noticed and addressed unless there are business advantages emerging from it. Value sensitive design (VSD) (Friedman *et al.*, 2013) takes a different approach and aims to embed constraints in the technology itself to galvanize it against any potential misuse. Most examples however in which the VSD strategy has been used, are static contexts that are unlikely to scale to the diversity of environments in which the technology is deployed (Seth, 2020b). This requires careful ongoing management of the socio-technological interface through user feedback and consultation. Such examples are however rare where users can participate in the governance of the systems themselves, to control and shape the use of the systems for outcomes desired by the users.

The original Scandinavian tradition of participatory design was centred on such an ideal approach, to jointly determine with the users what objectives to achieve through the technology, and accordingly design it (Spinuzzi, 2005). Mumford's ETHICS (Effective Technical and Human Implementation of Computer Based System) framework also operationalized a similar approach (Mumford and Weir, 1979). Action research has even more ambitious goals to continually shape interventions through participation of the community, requiring a long-term engagement with the community for slow and careful evolution through experimentation and consultation (Hayes, 2011). Other industry centric frameworks suggest using a risk-assessment approach to design technology (SoDIS – Software Development Impact Statements), or to evaluate the design

against human rights frameworks (DIODE – Definitions, Issues, Options, Decisions, and Explanations), or build the capacity for reflexivity to effectively manage the technology (RRI – Responsible Research and Innovation) (Rogerson, 2017). However, why are such frameworks not in more active use? What prevents technologists from finding solutions in collaboration with their users, from giving more agency to users in governing the technologies, and from recalibrating their own sense of technology determinism?

Motivations challenged by organizational and political situatedness

The answer to these questions above lies in two formidable gaps that impede the ability of technologists to find appropriate solutions, adopt participatory design methods or advocate for the adoption of these solutions by their organizations. The first challenge is intra-organizational, emerging from the organizational structure and culture of the companies or government departments where technologists might be working. Most large organizations are structured along functionally segregated roles that can prevent a free flow of information across all units (Suchman, 2002). Engineers, for instance, may not hear all that the ethnographic study teams have to say about problems that some users' segments may be facing, and these problems may go unaddressed. Further, different teams and individuals may be operating under different ethical systems, and insufficient socialization among them can lead to inconsistencies in how they choose to respond to various observations. Teams that interact with users in person may be more empathetic in their response to user problems, whereas teams that are removed from direct user interactions may choose to prioritize other issues, or respond differently. For example, cases of defrauding less technically skilled users through fraudulent mobile money transactions (Edmund, 2015) may bring different responses depending upon different underlying ethical systems within which the team members may be operating. Some may want to run training workshops for the users, while others may want to improve the technology and find technical solutions to spotting fraud, while yet others may choose to do nothing and encourage the users to learn on their own, and some may even want to create user associations that can democratically discuss and decide on the best route that the company should choose.

Even if a common ethical approach can be defined as suggested in Figure 1, it is not straightforward to have this incorporated in day-to-day actions of the different teams. This is clear in the case of data privacy, where even a unanimous embrace of strong privacy norms by companies has essentially not moved beyond serving a compliance function, and privacy rights continue to be exercised through the inadequate notice and choice mechanism (Waldman, 2018). The power of the privacy department within companies, their integration with different teams, resources available for education and sensitization of large teams to concerns about privacy, are some reasons why the adoption of a common set of underlying ethical principles remains broken within organizations. Clearly, unless aspects such as the organizational structure, having a common understanding of the organizational mandate, and cultures of interaction between diverse teams, are not reconfigured it will remain difficult for technologists to identify and apply appropriate solutions.

The second challenge emerges from the broader political economy of technology itself (Seth, 2019). Figure 2 shows the wider business and political landscape within which technologists are embedded. The nature of technology used in the information systems of today requires large amounts of capital, which in turn requires financial investment, and puts the company owners on a path to achieve rapid scale-up to meet investor expectations, as opposed to growing slowly with careful iterations applied on the design and management processes to ensure responsible outcomes. Companies of today are unlikely to have any appetite for iterative and consultative methods like participatory design or action research.

Even governments have been impatient to rollout new technologies at nationwide scales without adequate testing. A startling example is from India with Aadhaar enabled direct cash transfers (conditional and unconditional) to bank accounts of low-income people: A pilot revealed several challenges because of which the poor preferred getting cash in their hands instead of in their bank accounts, but even before any evaluations of the pilot could commence, the Aadhaar platform was mandated nationwide for cash transfers in all public welfare schemes (Mohan, 2018).

Next, social objectives and business objectives tend to be different from each other, and companies therefore naturally gravitate towards meeting profit goals often at the expense of ignoring social issues that may emerge as a collateral outcome. The algorithmic objectives coded in the Facebook news feed, as mentioned earlier, is an example where business and social objectives are in conflict with one another. Governments in theory do exclusively want to meet social objectives, and that too in a democratic manner, but tight interlocks also exist between governments and companies, and capital has often succeeded in shifting the state's priorities away from social objectives (Sen *et al.*, 2018; Stiglitz, 2012). For example, governments like to use technology as a means of imposing greater control and coordination of the population with a high modernity assumption of bringing social good, even though such initiatives have often disempowered the people and reinforced inequities (Scott, 1998), and capital in its constant search for new customers ingeniously provides such technological innovations to the governments (Sen *et al.*, 2019). The governments too are no less opportunistic, and governments like in India have effectively used information systems to mould public opinion not only for their own populist agenda but to also endorse a vision of bringing social change through technology while obfuscating the scenarios when it leads to harm.

The situation seems disappointing. Technologists may get better at spotting problems arising from their innovations, they may improve their own capabilities to come up with effective solutions to handle these problems, and increasingly adopt responsible innovation frameworks, but can they acquire sufficient agency to reconfigure their organizations to pay attention to these problems, and how can they deal with an entire global system of finance and politics that seems to be too powerful to render all such efforts meaningless?

A call to technologists

What started as an inquiry into understanding how technologists could ensure more responsible outcomes from their innovations, has ended with political questions about well-meaning technologists not just acquiring agency within their organizations to reconfigure internal priorities and methods, but to also find ways to influence the global systems of technology and capital, education curricula and draw more and more of their colleagues

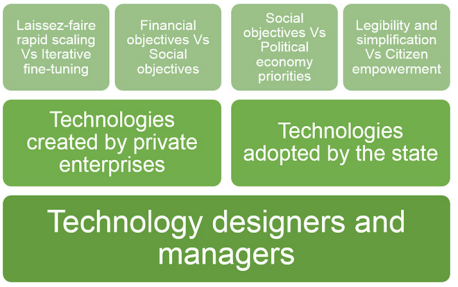

Figure 2.
Political economy in which technology exists

towards this goal. Daunting as it may seem, technologists should undertake this ambitious project for four reasons. First, other avenues to ensure responsible outcomes may not be feasible in themselves. We have discussed earlier about the limitations of regulations that impose review boards, ethics by design approaches, and internal compliance procedures. Given the growing monopoly power of a few big-tech companies, and limited consumer awareness largely due to the fast pace of technology development, consumers too may find it difficult to demand ethical practices from organizations whose products and services they consume. This only leaves the technologists to be more responsible in their work, and to demand that ethical practices are followed in the organizations where they contribute their labour. Second, information systems if designed and managed ethically indeed have the potential to alter power relationships in society to empower the weak (Seth, 2019; Hirschheim and Klein, 1989; Winner, 1980). Who better than the technologists to design and scale more such systems, as long as they can be conscious of their limitations and take steps to overcome them. Third, the socialized nature of their profession and the socialization platforms that they have built, provide them with both the skills and the tools to collectivize and coordinate globally across organizational and national barriers. This was even predicted by Marx as an outcome of capitalism's tendency to centralize the means of production, which requires building a more educated and skilled workforce that is capable of coordination and discipline, and can challenge capitalism (Adler, 1990). Finally, with more use of information systems for authoritarianism, both by governments (Khera, 2019) and by companies (Zuboff, 2018), technologists stand to lose considerably. The science and engineering professions are founded upon the free movement of information for communication (Wiener, 1950) but authoritarian use of technology can restrict and corrupt information flows, reducing both the ability of technologists to innovate as well as the effectiveness of their innovations.

Although there may not be any obvious solutions, many breadcrumbs are scattered from recent history for technologists to try and find a path. A few examples are as follows. To have workers gain power within organizations, there is already precedence for mechanisms such as co-determination where employees have board representation in companies to influence decisions (Fox, 2018). To think about what kind of technology architectures to favour, Schumacher advocated many decades ago to design small technology which is appropriate to the local context and can be understood and controlled by the people, as opposed to large industrial systems that might favour economies of scale (Schumacher, 1973). Ostrom showed that people can indeed cooperatively evolve methods to manage the commons (Ostrom, 1990), and open-source systems have demonstrated that rapid innovation can emerge through shared knowledge and resources – neither private ownership of the new assets nor capitalization of the assets is a necessity for innovation. Harvey in fact argues that capitalism needs continuous technology innovation to survive and not the other way around, and hence capitalism cleverly makes the media and state complicit in manufacturing the need for innovation (Harvey, 2003). In short, none of the social structures are a given, and technologists should discover new structures to carve out a path as moral exemplars (Huff and Rogerson, 2005).

We do believe that technologists are capable of establishing a moral compass for themselves and the world, albeit with some strategic effort. Since technologists operate within organizations, collective action approaches may offer some guidance, especially given limited evidence of the state or capital being able to provide such a compass. The recent events of white-collar collectivization at companies such as Google, Amazon and Microsoft (Campbell, 2018) should be celebrated, as a bottom-up effort by technologists to force their companies to operate more responsibly. Although white-collar collectivization

was also attempted as part of the Lucas Plan in 1976, to find humanitarian uses of aerospace technology, the proposal was eventually not accepted by the company's management (Cooley and O'Grady, 2016). Perhaps therefore technologists first need to work towards corporate governance structures that legitimize such collectivism. Although the goal with such collectivization is different from the traditional blue-collar collectivization for better wages, working conditions, regular employment, etc., important lessons can be drawn from years of blue-collar unionism so as to not repeat the same mistakes. Technologists need to avoid contractualization and commodification of their labour which only atomizes them, reduce job-hopping so that they can change their organizations from within, and find their political bearings on inequality, redistribution, state-market relations and other axes that sometimes polarize them (Arndt, 2018). It will also be important for technologists to adopt a common manifesto such as one that advocates to promote technology use which empowers the weak and does not place more power in the hands of those who are already powerful (Seth, 2019). Finally, to do this well, technologists will need to find ways to understand and work more closely with users of the platforms they design and operate, especially users who are different from them. This may include blue-collar workers who depend on technological platforms for their livelihood and are affected by the algorithms and processes encoded in the working of the platforms. It may include low-income populations in far flung rural areas who might be first-time users of information technology and face some unique challenges with this technology. It may also include users at the intersection of different marginalities who would be occupying little-known contexts of technology use unfamiliar to the technologists.

If done well, collective efforts by technologists could ensure that technology becomes a unanimous force for good, that it is used to solve some of the big problems we see around us of inequality, exploitation, intolerance, propaganda and the environment, among others, and does not become a tool to exacerbate these problems further. In today's political, socio-economic and environmental context, technologists can no longer remain naïve in their understanding of the world and forsake their responsibility to govern how their innovations get used. Technologists need to learn to navigate the various complex variables mentioned above so that they can influence their organizations and governments to invest in meaningful objectives for a just and equitable world, and design and manage the solutions in ethically consistent ways. A clarity of purpose, humility to continuously course correct to steer their innovations, and gaining political power through collective means to exercise their judgement, can help technologists achieve this. Technologists should aim to architect a new system, and not remain like a bee that rather strengthens the existing system and prevents a departure from the status quo (Cooley and O'Grady, 2016).

Note

1. Gram Vaani operates voice-based participatory media platforms in rural areas of India. These platforms enable even less-literate populations to share information with one another, ask questions, and raise demands to the government for their rights and entitlements.

References

Adler, P.S. (1990), "Marx, machines, and skill", *Technology and Culture*, Vol. 31 No. 4, pp. 780-812.

Arndt, C. (2018), "White-collar unions and attitudes towards income inequality, redistribution, and state-market relations", *European Sociological Review*, Vol. 34 No. 6, pp. 675-693.

Berdichevsky, D. and Neuenschwander, E. (1999), "Toward an ethics of persuasive technology", *Communications of the ACM*, Vol. 42 No. 5, doi: 10.1145/301353.301410.

Campbell, A.F. (2018), "Workers at Google, Amazon, and Microsoft are demanding input on the impact of the technology they build. Vox", available at: www.vox.com/technology/2018/10/18/17989482/google-amazon-employee-ethics-contracts

Chouldechova, A. and Roth, A. (2018), "The frontiers of fairness in machine learning. CCC (computing community consortium) Workshop report", available at: https://arxiv.org/abs/1810.08810

Collingridge, D. (1980), *The Social Control of Technology*, St Martin's Press, England.

Cooley, M. and O'Grady, F. (2016), "Architect or bee?", *The Human Price of Technology*, Spokesman Books, England.

Dahlbom, B. and Mathiassen, L. (1993), *Computers in Context: The Philosophy and Practice of Systems Design*, Blackwell Publishers, Cambridge, MA.

Dahlbom, B. and Mathiassen, L. (1997), "The future of our profession", *Communications of the ACM*, Vol. 40 No. 6, doi: 10.1145/255656.255706.

Duquenoy, P. and Thimbleby, H. (1999), "Justice and design", in Sasse, M.A. and Johnson, C. (Eds), *Proceedings of Human-Computer Interaction (INTERACT 1999)*, pp. 281-286.

Edmund, D.S. (2015), "Phishing in Jamtara: what does it take to carry out online fraud?", *The Indian Express*, available at: https://indianexpress.com/article/india/india-news-india/phishing-in-jamtara-what-does-it-take-to-carry-out-online-fraud/

Fiesler, C., Garrett, N. and Beard, N. (2020), "What do we teach when we teach tech ethics? A syllabi analysis", *Proceedings of the ACM Technical Symposium on Computer Science Education (SIGCSE '20)*, doi: 10.1145/3328778.3366825.

Floridi, L. (2010), *Ethics after the Information Revolution (Chapter 1)*, Cambridge University Press.

Fox, J. (2018), "Why German corporate boards include workers", *Bloomberg*, available at: www.bloomberg.com/view/articles/2018-08-24/why-german-corporate-boards-include-workers-for-co-determination

Freuler, J.O. (2018), "Techlash: why Facebook's approach to #FakeNews ultimately fails", Open Democracy, available at: www.opendemocracy.net/en/digitaliberties/techlash-why-facebook-s-approach-to-fakenews-ultimately-fails/

Friedman, B., Kahn, P.H. and Borning, A. (2013), "Value sensitive design and information systems", in Zhang, P. and Gatella, D. (Eds), *Human Computer Interaction in Management Information Systems: Foundations*, M.E. Sharpe, New York, NY.

Harvey, D. (2003), "The fetish of technology: causes and consequences", *Macalester International*, Vol. 13 No. 7, available at: http://digitalcommons.macalester.edu/macintl/vol13/iss1/7

Hayes, G. (2011), "The relationship of action research to human-computer interaction", *ACM Transactions on Computer-Human Interaction*, Vol. 18 No. 3, doi: 10.1145/1993060.1993065.

Hirschheim, R. and Klein, H.K. (1989), "Four paradigms of information systems development", *Communications of the ACM*, Vol. 32 No. 10, doi: 10.1145/67933.67937.

Huff, C. and Rogerson, S. (2005), "Craft and reform in moral exemplars in computing", in *Proceedings of the International Conference on the Ethical and Social Impacts of ICT (ETHICOMP '05), September 2005, Sweden*.

ICDPPC (2018), "Declaration on ethics and data protection in artificial intelligence", *International Conference of Data Protection and Privacy Commissioners, October 2018, Brussels*, available at: https://edps.europa.eu/sites/edp/files/publication/icdppc-40th_ai-declaration_adopted_en_0.pdf

Khera, R. (2019), *Dissent on Aadhaar: Big Data Meets Big Brother*, Orient Blackswan.

Mohan, R. (2018), "In Ranchi's Nagri block, ration rice comes at a heavy price", *The hindu*, available at: www.thehindu.com/society/in-ranchis-nagri-block-ration-rice-comes-at-a-heavy-price/article23000824.ece

Mumford, E. and Weir, M.W. (1979), *Computer Systems in Work Design: The ETHICS Method: Effective Technical and Human Implementation of Computer System*, John Wiley and Sons, New York, NY.

Muskaan, Dhaliwal, M.P. and Seth, A. (2019), "Fairness and diversity in the recommendation and ranking of participatory media content", *KDD Workshop on Intelligent Information Feeds, August 2019*, Anchorage, available at: https://arxiv.org/abs/1907.07253

O'Neil, C. (2016), *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*, Crown.

Ostrom, E. (1990), *Governing the Commons*, Cambridge University Press, New York, NY.

Rogerson, S. (2017), "Coding ethics into technology", *Hack and Craft News, 3 July, Additional reporting by Chris Middleton*, available at: http://hncnews.com/coding-ethics-technology

Sanders, L. (2008), "An evolving map of design practice and design research", *Interactions*, Vol. 15 No. 6, doi: 10.1145/1409040.1409043.

Schneider, C., Weinmann, M. and Brocke, J. (2018), "Digital nudging – influencing choices by user interface design", *Communications of the ACM*, Vol. 61 No. 7, pp. 67-73.

Schumacher, E.F. (1973), *Small is Beautiful: A Study of Economics as If People Mattered*, Blond and Briggs.

Scott, J.C. (1998), *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale University Press.

Sen, A., Agarwal, A., Guru, A., Choudhuri, A., Singh, G., Mohammed, I., Goyal, J., Mittal, K., Singh, M., Goel, M. and Seth, A. (2018), "Leveraging web data to monitor changes in corporate-government interlocks in India", in *Proceedings of the ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS '18), San Francisco, USA*.

Sen, A., Aggarwal, P., Verma, S., Ghatak, D., Kumari, P., Singh, M., Guru, A. and Seth, A. (2019), "An attempt at using mass media data to analyze the political economy around some key ICTD policies in India", in *Proceedings of the International Conference on Information and Communication Technologies and Development (ICTD 2019), Ahmedabad, India*.

Seth, A. (2019), "A new paradigm to accommodate ethical foundations in the design and management of digital platforms", *Manuscript, IIT Delhi*, available at: www.cse.iitd.ernet.in/~aseth/systems-thinking-2019.pdf

Seth, A. (2020a), *Ethics in Applied Computer Science*, Course contents, IIT Delhi, available at: http://bit.ly/2FARXrs

Seth, A. (2020b), "The limits of design in ensuring responsible outcomes from technology", in *Proceedings of the International Conference on Information and Communication Technologies and Development (ICTD 2020), Guayaquil, Equador*.

Spinuzzi, C. (2005), "The methodology of participatory design", *Technical Communication*, Vol. 52 No. 2, pp. 163-174.

Stiglitz, J.E. (2012), *The Price of Inequality: How Today's Divided Society Endangers Our Future*, WW Norton and Company.

Suchman, L. (2002), "Located accountabilities in technology production", *In Scandinavian Journal of Information Systems*, Vol. 14 No. 2.

Tufekci, Z. (2016), "The real bias built in at Facebook", *New York Times*, available at: www.nytimes.com/2016/05/19/opinion/the-real-bias-built-in-at-facebook.html

Waldman, A.E. (2018), "Designing without privacy", *Houston Law Review*, Vol. 55 No. 659.

Wiener, N. (1950), *The Human Use of Human Beings: Cybernetics and Society*, Houghton Mifflin.

Winner, L. (1980), "Do artefacts have politics", *Modern Technology: Problem or Opportunity? Daedalus*, Vol. 109 No. 1.

Zuboff, S. (2018), *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*, Profile Books.

About the author

Aaditeshwar Seth is a faculty in the Department of Computer Science and Engineering at Indian Institute of Technology Delhi, where he runs the ACT4D (Appropriate Computing Technologies for Development) research group. He is passionate about building technologies that can empower people with information. He also runs a social enterprise, Gram Vaani, which builds voice-based systems for community media in rural areas. Work done by Aaditeshwar's team and students are now in use by over 150 developmental organizations, and more than two million people have directly touched their platforms. Several elements of their work have also been adopted by government departments for scaleup, and have influenced the use of ICTs for development within many international aid and development organizations. Aaditeshwar Seth can be contacted at: aseth@cse.iitd.ac.in