On Countering Recurring Problems that Impede Equitable Development

Aaditeshwar Seth
IIT Delhi and Gram Vaani, India
aseth@cse.iitd.ac.in, aseth@gramvaani.org

I. RESEARCH STATEMENT

The motivation for my research lies in bringing social development impact through information technology. My research method is centred in development practice, where I not just build new information systems but I follow through with deploying and scaling them as well. As part of this process, I have contributed to research at multiple levels. I work at the technological level of building innovative ICT systems aligned with standard CS research streams such as computer networks, data science and machine learning, and information retrieval. I then work at the practice level of deploying and scaling these systems over many years using action research principles, and have contributed to insights in the use of information systems for governance, social and behavior change, and news media. Finally, I work at the theory level to explain observations arising from the interactions between technology and society, based on the learning gained from long-term deployment of these ICT systems. The same perspectives are reflected in my teaching and research, where I encourage students to take a dialectical approach towards their work, so as to appreciate a broader worldview of technology beyond just production of the technological artefact itself. I have recently also put together a course on ethics in applied CS, to take this view to undergraduate students as well so that they strive to ensure that responsible outcomes arise from the technology they are likely develop and manage in the near future after they enter the information technology industry.

I identify myself closely with the ICTD (Information and Communication Technologies for Development) community. I first started working in this area in the mid-2000s as part of my PhD research when our group developed low-cost systems to provide Internet connectivity in rural areas [54]. However, field deployments of these systems in a context where people could not directly use the Internet and required an intermediary to facilitate access, convinced me that voice-based systems, even if non-Internet based, would be more successful in gaining a wider reach and impact. Through interactions with many social sector organizations in India throughout the tenure of my PhD, I zeroed down upon low-cost systems to integrate broadcast community radio with mobile telephony that could empower even less-literate and low-income people to create their own participatory media networks, without a need to use the Internet [55]. This method was also grounded in a novel sociology centric communication theory of information processing, developed as part of my PhD research [24, 26]. I was lucky to win a grant to build upon these ideas, and used it to start a social enterprise in India, Gram Vaani (translates to *Voice of the Village*). Gram Vaani has now grown to a team of 70+ full-time employees and 200+ volunteers, working across India and two other countries, having touched more than 2 million users directly and having facilitated 150+ social sector organizations to incorporate voice-based participatory media technologies in their operations.

The work at Gram Vaani led to not just technological innovations [56, 57], but also highlighted the importance of non-technological aspects of forming collectives, skills building in using technology, and an iterative approach of discovering impact pathways for development [28, 31]. The evidence from our work of bringing impact in improved governance [19], and awareness and behavior change communication [30], have also influenced several government departments and philanthropic foundations to adopt these methods. I am now working on a theoretical grounding based on these experiences, to model how information systems should be designed to change the distribution of power in society and make it more equal [32]. I am also working on improving my underlying communication theory of participatory media [24, 26] to explain the persistence of ideological biases within society, and build content recommendation algorithms that are bias aware, transparent, and tunable by users, to counter the phenomenon of echo chambers that are exacerbated by filter bubbles created through opaque content ranking and recommendation algorithms [58].

Over the years however, despite the growth of such information systems that aim to democratize communication, of which the Internet itself is an example, the relentless march of inequality has continued unabated and has been used by political actors for authoritarianism [59]. This persuaded me to begin working on a new class of information systems that can inform people more accurately about the political economy operating in the world, not intermediated by mass media or political rhetoric influenced by vested interests, to build a more aware citizenry that can bring about better policies grounded in democratic values of inclusion and equality. Some of my initial efforts in this direction include building a system that monitors the bias in mass media [38], discovers corporate-government interlocks [41] and how they might influence policy formulation [39], and uses satellite imagery to measure development at fine spatial and temporal scales. Our goal is to eventually create a community that uses the data produced by these information systems to inform people and enable them to demand more appropriate policies.

Another line of work aligned closely with this approach of providing unbiased and accurate information to people, is a measurement study conducted by my group of 2G/3G cellular Internet connectivity in rural and urban areas [60]. This study brought to light many inconsistencies between the advertised QoS by telecom companies and the QoS actually achieved in practice, and that improved performance could likely be achieved by just more careful network configuration without the need for expensive infrastructure expansion. We then partnered with a consumer rights organization to take these findings to the telecom regulatory authority in India [61], and have since then been engaged to help the government form tighter QoS regulations [62] and to advocate the concept of broadband labels that can lead to more informed consumers.

In the following sections I discuss my work in more detail, done over the years in collaboration with several research colleagues. Section II describes our motivation, and is followed by Section III covering our past and future work in building information systems. Section IV discusses future work towards a theoretical approach to model information systems, and Section V describes an outline of a course I have put together on the ethics of designing and managing information systems. In brief, the priorities for my research are led by felt needs I observe in the world around me, which is facilitated through the deep links I have formed with the development sector over the years, and while I place emphasis on building and scaling information systems to address some of these problems, I am also committed to taking a step back to theorize conflicts and contradictions in a very dialectical sense to try to conceptualize more overarching frameworks that can help shape how we even define the space of problems and solutions to begin with.

II. MOTIVATION AND GROUNDING

It is distressing to see enduring poverty, inequality, and exploitation in the world. Rittel and Webber [1] called them "wicked problems" to solve because the underlying complex social contexts and plurality of viewpoints does not lead to clean solutions. My belief however is that social complexity is not the cause of failure, rather critical theory [7, 8, 23, 34] provides a lens to examine the design and implementation of development programmes and explains how certain common patterns recur even in different contexts, and impede development. My quest therefore is to find methods to counter this small set of common patterns by building suitable information systems that can suppress these patterns.

Some such patterns are as follows. The mindset of governments to aim for legibility and simplification as a means of control and coordination [2] often leads to the design of regimented solutions that suppress the abilities of people to flexibly solve their own problems; this disempowers them, and eventually fails to produce meaningful outcomes. Another pattern is the laissez-faire approach of minimal regulation and an assumption about individual human agency to always operate rationally and competitively [3]; this leads to the misappropriation of policies for undesirable purposes and reduces the value placed upon cooperation [4]. Third, the Marxist critique about the nature of capital to centralize itself and to grow, to exploit existing inequalities to its advantage without sincere attempts at establishing a level-playing field [5]

and taking guidance from any other fairness objectives, and of capitalists to use their power of capital to subvert regulatory efforts of the government and of media towards fairer objectives [6, 7], is another well-known recurring pattern that leads to exploitation [8]. Let us call these *negative patterns*.

I believe that innumerable initiatives with the stated goals of bringing about equitable development have failed either because their design itself was flawed from the outset due to these patterns governing the mindset of the designers, or the implementation was corrupted by a manifestation of these patterns. Some initiatives are as follows, a few in the context of India. An example of the first pattern of the state to enhance legibility of its citizens, is the technology driven design of the unique identification system in India. It has ironically not made it easier for welfare dependent low-income citizens to engage with the state, which was its stated objective, rather its centralized processes have made it harder for even the civil society to provide assistance to people who cannot operate the system on their own, thereby actually disempowering the poor and their community institutions [10]. An example of the second pattern of a belief in rational competitive individual behavior to regulate markets, is the lack of attention paid to the design in several social media platforms for tools to check and regulate user behavior. This has led to incidences of fake news that have even subverted democratic institutions [11], and it is made worse by ingrained algorithmic biases in most financial investment driven participatory media systems due to the definition of metrics towards financially linked objectives to increase user engagement, rather than have metrics to maximize social objectives like user learning [12]. An example of the third pattern to not place emphasis on skills-building and a fair distribution of resources can be seen in the operational emphasis of microfinance institutions to focus on routine financial metrics. This has led to an inadequate attention being paid to mentoring the borrowers to help them effectively utilize their loans, and has instead made them even more dependent on capitalists [13]. The attraction to concepts like universal basic income and cash transfers in an environment where basic education is weak, can be attributed to these patterns too [14].

Several common methods have been developed within development programmes to keep these patterns in check. This includes a push towards decentralization to give more agency to the people to deal with local complexities, facilitate cooperation and coordination among people to solve problems, an emphasis on skilling to improve the capabilities of participants towards equitably being able to access opportunities, and transparency coupled with actionable regulatory mechanisms to detect and punish negative behavior. Let us call these *positive patterns*.

My research efforts are along three lines, with the objective of enabling such positive patterns especially to keep the negative patterns in check. First, we are building and operating several ICT-based information systems that directly help implement these positive patterns within development programmes. Our work on participatory media systems to create bottom-up empowerment, and on mass media and satellite-data based systems to create citizen awareness, are examples of such information systems. Second, there is a need to ensure that the design and operations of any ICT-based

information system is not corrupted by the negative patterns themselves, and we will discuss a systems modelling approach we are attempting to guide the design and management of information systems. This work spans multiple levels, starting with values embedded in the design of technologies, to processes to manage them, the structure of teams and organizations that design and build these technologies, and the political economy that shapes the economic and political landscape within which the systems are deployed. Third, to educate students and designers of information systems about these positive and negative patterns so that they build more responsible systems, I have put together a course on the ethics of applied CS in which I specifically outline the faultlines which seem to be at the root of how information systems begin to have unintended consequences. I next discuss these streams of work we are currently pursuing.

III. BUILDING INFORMATION SYSTEMS

A. Transparency and accountability in governance

Driven by a centralization mindset, a solution often implemented by the government to plug leakages in the delivery of welfare schemes for the poor, is to develop comprehensive Management Information Systems (MIS) that can keep track of all transactions, and make them accessible over the web to bring transparency. However, such systems are often subverted because the beneficiaries are unable to access them due to problems of literacy to verify their information themselves, and even if grievances are lodged then often accountability is broken to ensure that prompt and required action will be taken by the officials to resolve the grievances [15]. We eased the literacy challenge by making it simpler for people to access information about their dues and entitlements by making the web-based MIS information available to them in an audio format that could be queried over the phone using IVR (Interactive Voice Response) systems [16]. People could even verify and dispute this information if they found it to be incorrect, which improved accountability in the delivery of these government schemes [17]. We also built information systems where the grievances (and statistics about the grievances) were made publicly available so that people could come to know about the occurrence of similar grievances faced by others to learn from them and build solidarity for wider collective action and bottom-up demand generation towards improved functioning of the development programmes [18]. This further imposed pressure on the administrative agencies to promptly respond to especially community level grievances, and an additional push was given by local social workers who would interact with the officials to follow-up on the grievances [19]. Similar insights have been drawn by a few other systems that have used citizen journalism to bring more accountability in the delivery of government services for the poor [63]. We have advocated vigorously for the adoption of such systems in government programmes for accountability and transparency, and have been reasonably successful at the local levels in persuading officials to work towards proactively addressing entitlement issues of the poor [19].

These projects are examples of countering some often seen negative outcomes from centralization, by positive patterns for building transparency, accountability, and local agency. They build upon several ideas, of the need for appropriately designed technology for the poor and marginalized to counter technology induced widening inequalities [20], the role of media as a watchdog to facilitate social accountability [21, 22], and the need for intermediaries to represent the poor [5].

B. Learning through participatory media

Internet based participatory media emerged during the mid-2000s as an alternative medium to counter government propaganda, mass media bias, and facilitate coordination and cooperation among people [23]. On this last capability, we theorized that participatory media systems are able to help in collective action because they enable people to improve their collective understanding, through two pathways. One, when people coming from similar contexts contribute information then that information helps others sharing the same context to interpret a given topic more easily. Two, when people with different backgrounds contribute information then that information helps provide a more complete picture of the topic [24]. We further showed that the perceived credibility of information may itself depend upon the shared context between different people [26]. Our theory about context, completeness, and credibility being enhanced through the flow of information, had its origins in Granovetter's theory of the strength of weak ties [25], and has formed the basis for much of the work by us in the last ten years in building participatory media systems for rural communities. These insights are also quite useful in today's times to understand echo chambers, and their relevance to the spread of misinformation and the persistence of ideological differences in society.

We chose to build voice-based participatory media systems that could be accessed even by less literate users to share information with one another. We initially worked through FM broadcast community radio [27], and subsequently through IVR (Interactive Voice Response) systems [28], through which people could record voice messages that were heard by other people. Over 2 million users over the years have directly interacted with these systems, hundreds of thousands of voices reports have been published, and several hundred community level impact stories have emerged about positive changes that have resulted from the platforms. The participatory nature of the information systems have facilitated context and completeness enhancing discussions on a wide range of topics including the significant national demonetization event in India, regional policies like alcohol prohibition, and local issues like chit fund scams, to development issues like malnutrition, discussions on social gender based norms about early marriage or son preference, mobilization of strikes by school teachers and health workers on demand for greater pay and permanent jobs, and macro trends of rural-urban migration, wage inequality, and price rise. The users have acknowledged in multiple surveys and field visits about the distinct character of these information systems in giving an opportunity for anybody to voice themselves, and the value of the dialogue to understand different viewpoints of people that leads to different kinds of learning [29, 30].

Operating the systems also required the instantiation of several positive patterns to counter some of the recurring

negative patterns. This included the creation of offline collectives of community reporters as opposed to individual driven agents [31], processes for skills-building of users to equitably support them in utilizing the systems rather than have the systems get appropriated by the more skilled users [28, 30], and a financial sustainability model which at a small scale can function without the need for corporate and government advertising revenue that may bias the neutrality of discussions on the platforms [32]. To explain our observations about the interaction between these positive and negative patterns, we also make use of Latour's actor network theory [33] and Habermas' principal communicative actions framework [34].

I are now actively working on two further pieces of research. One, I recently discovered the cybernetics inspired conversation theory by Gordon Pask [35] which formalizes the learning process as a conversation between two entities, and extends it further to the interaction of multiple actors [36]. I am attempting to use this to ground our own theory of context, completeness, and credibility, and layer it on social networks to explain how ideologies form and opposing ideologies interact with one another. I am also attempting to apply it to the area of social and behavior change communication through participatory media. Two, we are building content recommendation algorithms that are bias aware and can be tuned by the users, to enable conversations that gradually nudge users to cross ideological boundaries [9]. We will implement these algorithms within the voice-based participatory media systems described above, and also an online a news feed which recommends news articles from the mass media from across diverse ideologies. The underlying theory, and applications built upon the theory, will inform the growing concerns today about echo chambers, the role they play in the spread of misinformation and persistence of ideological differences, and the potential for algorithms to avoid filter bubbles by incorporating fairness and diversity in their results for ranking and recommendation of content [58].

C. Monitoring of mass media and the political economy

The first two information systems we described were about enabling communication between people, and between people and government departments, both parties ultimately being composed of human agents. The next two information systems we describe are about machines communicating with people, but towards the same goals of countering negative patterns.

Media effects of agenda setting, framing, and priming as forms of propaganda by vested interests are actively studied topics [37]. With a goal to monitor the incidence of such propaganda to shape public opinion, we have built a data analysis framework wherein we analyse the coverage of different policies in the English mass media and social media in India, and are able to eventually label different newspapers in terms of their ideological alignment [38]. We have also used this framework to understand the political economy behind the formation of different policies by understanding the possible interests and ideological biases of people involved with these policies [39]. Further, we have developed method to uncover the social network between important corporate people, bureaucrats, politicians, companies, thinktanks, non-profits, etc – the power elite [40] – to add a further dimension to how interconnections between these actors may influence their political expressions to shape public opinion for different policy preferences [41]. Our goal is to use the observations made by this mass media and social media monitoring framework to enable self-regulating mechanisms within the media ecosystem, and to inform people about the political economy behind policy formation to understand what interests and ideologies might be shaping policies.

This information system for monitoring the mass media and the political economy thus aims to overcome negative patterns in the wider systems of democracy in the world, where information asymmetries are deliberately created by the state and by the market, to undermine informed decision making by the people. It draws inspiration from the analysis of the transformation of the public sphere by Habermas [7].

D. Monitoring of socio-economic development

Sometimes due to the lack of availability of data or good quality data, and sometimes due to differences in interpreting the data, conflicting conclusions are drawn about socio-economic development [42]. A general method we are adopting to reduce such conflict is to use alternate sources of factual data as proxies that may be correlated with socio-economic development, and use these proxies to resolve divergent claims. Two data sources we are specifically using are satellite data and agricultural commodity prices data. Day-time satellite imagery is able to capture features such as the density of construction, surface area under roads, extent of cropland, etc [43], and nightlights intensity is known to reflect economic development [44]. We are building deep learning models that make use of this satellite data to predict different socio-economic indicators over time, so that development can be tracked at fine spatial and temporal scales. Similarly, we are learning models based on time series data of agricultural commodity prices to predict trade imperfections such as volatility, price manipulation, and hoarding. Both these big data sources are available at much higher time and space granularity than what is possible through manually conducted surveys and censuses, which gives them an added advantage of providing high resolution indicators at low costs.

Like with the previous system of monitoring mass media, the observations made by this information system will be used to inform people about trends derived from the data, and to enable people to ask questions when they see conflicting claims being made by others. We plan to take it further by also coupling this big-data driven analysis with bottom-up quantitative and qualitative surveys conducted through participatory media networks, to add explanatory power to the observations made from big-data. We will recruit panels of users from different locations and with different domain knowledge, to be surveyed through automated and semi-automated ICT tools to understand more about any interesting big-data analysis observations that are made. For instance, a weekly prediction about the incidence of hoarding in agricultural markets can be cross-checked by contacting local farmers from that location about any rumours that they may have heard. News media reports from the area can also give possible indications, and even investigations can be commissioned. Similarly, an observation from satellite data

about significantly higher growth in a district or part of a district as compared to growth rates seen otherwise, can be used to trigger investigations to understand unique features about the district that may have caused this growth, such as the degree of industrialization in the area or any political affiliations that may have been instrumental in the change.

Such an information system to keep the people abreast with conclusions drawn from proxy indicators can help counter negative patterns that manipulate the data for vested interests. Introducing these new information loops into the wider systems of media and democracy in the world, can help change system behavior in the cybernetic sense by reducing noise [45].

IV. RESPONSIBLE DESIGN AND OPERATION OF INFO SYSTEMS

In the previous section, we discussed several ICT-based information systems we have been designing to counter negative patterns that impede the effectiveness of development programmes. From the systems thinking perspective [46, 47, 48], these negative patterns are essentially system archetypes that lead to undesirable behavior, and the ICT-based information systems are a means to alter the archetypes and thereby change the system behavior. I am interested in going further that if such information systems can be formally described to analyse whether they are reinforcing negative patterns or positive patterns within the wider systems in which they are implemented, then such a formalization can guide the design of information systems in a more robust manner.

I feel that a unifying concept for formalization of the patterns I have described, and the resulting information systems we are building, is the calculus of power. Negative patterns seem to centralize power, in the form of ability for coercion or capital control or information control or regulatory control, while positive patterns seem to decentralize power by providing avenues for skilling, cooperation, transparency, and avoiding regulatory capture by the powerful. Seeing systems as leading to the accumulation or distribution of power may give us cues about how to compare different system designs targeted at achieving the same goals. Power is a multifaceted concept and attempts have been made at conceptualizing frameworks for empowerment [49]. I am keen to take this further by combining such frameworks with a systems modelling approach to build a method for evaluating information systems in terms of whether they empower or disempower people. I have modelled this for the Aadhaar unique identification system in India which I feel reinforces several negative patterns and is disempowering for the poor and marginalized, and compare it with alternate system designs that build upon empowering positive patterns [10].

Even with an ideal system design however, my own experience with building participatory media systems for learning and improvement of governance, has highlighted that negative patterns can manifest themselves even internally within the operations of these information systems, and thereby lead to undesirable consequences. Some common ways in which this happens is when more skilled users are able to appropriate the systems for their benefit at the cost of lesser skilled users, or when system managers resort to rigid operational processes that are easy to monitor but withdraw

agency and flexibility from the people, or when monetary incentives deviate from the social goals of the system, or there is lax regulation or inadequate agency and capacity of the users to regulate undesirable behavior on the system. Many concerns about social media in today's context can be related to the emergence of such negative patterns on social media platforms. To understand this through our own experience of working with participatory media systems, I recently drew up the concept of a socio-technological interface that needs to be managed to ensure that responsible outcomes arise from the use of such information systems [32]. I emphasize that laissez-faire market driven rapid expansion of technology needs to pay careful attention to managing the socio-technological interface, which may take technology companies beyond their core role as technology producers but is an essential task to guard against the fallouts that may arise from their technology platforms. I plan to formalize the concept of the socio-technological interface using the same systems modelling approach of the distribution of power, to evaluate whether or not a given information system has galvanized itself to managing this interface.

V. TEACHING ETHICS ABOUT INFORMATION SYSTEMS

As an educator in the area of computer science, I feel a responsibility towards training students to understand the ethical implications of ICT-based information systems, because the students will soon graduate and step out into the industry to build and manage such systems in the future. If therefore they are made aware of the broader implications that their innovations may have, then as designers of these systems having a close understanding about how they work internally, they will be able to build safeguards in their systems and strive to ensure that the systems are not misused [50]. With that view in mind, I have put together a course outline on the ethics of information systems that I hope to teach soon [51].

In the course, I will touch upon four aspects in the design of information systems where ethical questions frequently arise. First, the design of the user interface may be such to nudge users towards specific actions, thereby raising concerns about the potential of technology for persuasion without prior disclosure to its users, and the power that the technology designers or managers may hold in persuading users towards certain views or actions. Second, the system may incorporate algorithms that have intentional or unintentional biases built into them, which leads to questions about whether the algorithms produce results that are fair and transparent based on different definitions of fairness appropriate to the context. Third, the nature of the system design itself can raise questions about whether it empowers the people or disempowers some of them, or whether it reinforces positive patterns or negative patterns. Fourth, the socio-technological interface will need to be managed to prevent unintended consequences arising from the use of technology. ICT professionals will need to think at all these four levels to evaluate the ethical implications of information systems built or managed by them.

To reason about their choices clearly, the students will also need to appreciate that there can be many different frameworks to even think about ethics, and this clarity may help them understand why their perspectives may differ from that of

others. This will help them strive to find a meeting point through informed consensus, rather than make uninformed choices that can be risky because they can lead to unexpected consequences. The students will also need to understand the historical context about other technologies, of how these technologies have interacted with society, and the political economy of the state and capital that may have shaped the scaling of these technologies and the consequences arising therein, even how the mass media may have contributed to the interpretation of these consequences for people. Finally, I will discuss ways in which ICT professionals may be able to control what kind of technologies are built and for whom, so that they can ensure that their labour gets utilized in accordance with their ethical beliefs. As methods for control by ICT professionals, I will discuss corporate governance structures such as co-determination [52] and worker representation [53] which have been successful in making companies work towards goals that are both beneficial to society as well as more humanizing for their employees.

As an overarching goal of the course, I will advocate to the students to take up a position aimed to bringing power-based equality in society, and to build the capacity of people to utilize opportunities for themselves to grow in a sustainable manner [5]. My hope is that with this course, the students will begin to appreciate not to take the outcomes arising from technology for granted, and take proactive steps to ensure that adequate attention is paid to ensuring that responsible outcomes arise from the technologies developed and managed by them.

REFERENCES

[1] Rittel, H.W.J and Webber, M.M. 1973. *Dilemmas in a General Theory of Planning*. In Policy Sciences 4

[2] James C Scott. 1998. *Seeing like a state: How certain schemes to improve the human condition have failed*. Yale University Press.

[3] F.A. Hayek. 1944. *The Road to Serfdom*. Routledge Press, UK.

[4] E. Ostrom. 1990. *Governing The Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.

[5] Chambers, R. and Conway, G.R. 1991. *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. IDS Discussion Paper 256.

[6] Joseph E Stiglitz. 2012. *The Price of Inequality: How Today's Divided Society Endangers Our Future*. WW Norton & Company.

[7] J. Habermas. 1962. *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. MIT Press, USA.

[8] Karl Marx. 1867. *Capital: A Critique of Political Economy, Vol. I. The Process of Capitalist Production*.

[9] **Muskaan, M.P. Dhaliwal, and A. Seth. 2019.** *Fairness and Diversity in the Recommendation and Ranking of Participatory Media Content*, **KDD workshop on Intelligent Information Feeds.**

[10] Reetika Khera. 2017. *Impact of Aadhaar in Welfare Programmes*. In Economic and Political Weekly.

[11] Jan A.G.M. van Dijk and Kenneth L. Hacker. 2018. *Internet and Democracy in the Network Society*. Routledge.

[12] Cathy O'Neil. 2016. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. Crown USA.

[13] S. Radhakrishnan. 2015. *"Low Profile" or Entrepreneurial? Gender, Class, and Cultural Adaptation in the Global Microfinance Industry*, World Development Vol. 74.

[14] Jean Drèze. 2017. *Sense and Solidarity: Jholawala Economics for Everyone.* Permanent Black.

[15] Rajesh Veeraraghavan. 2013. *Dealing with the Digital Panopticon: The Use and Subversion of ICT in an Indian Bureaucracy*. In Proc. ICTD.

[16] **D. Chakraborty and A. Seth. 2015.** *Building Citizen Engagement into the Implementation of Welfare Schemes in Rural India*, **In Proc. ICTD.**

[17] **V. Srinivasan, V. Vardhan, S. Kar, S. Asthana, R. Narayanan, P. Singh, D. Chakraborty, A. Singh, and A. Seth. 2013.** *Airavat: An Accountability System to Increase Transparency and Accountability in Social Welfare Schemes in India*, **In Proc. ICTD (poster).**

[18] **A. Seth, R. Bhatia, A. Katyal, D. Kapoor, Balachandran C, V. Venkat, A. Moitra, M. Shivam, P. Naidu. 2012.** *Application of Mobile Phones and Social Media to Improve Grievance Redressal in Public Services*, **In Proc. Mobile Web for Development (MW4D).**

[19] **Chakraborty, D., Ahmad, M.S., and Seth, A. 2017.** *Findings from a Civil Society Mediated and Technology Assisted Grievance Redressal Model in Rural India*. **In Proc. ICTD.**

[20] Tim Unwin. *Why we shouldn't use terms such as "bridging the digital divide" or "digital leapfrogging"*, Oct 2018, and *Contributions to UNESCO's first Partners' Forum: notes from the underground*, Sep 2018. https://unwin.wordpress.com/

[21] Siebert, F. S., Peterson, T., & Schramm, W. 1956. *Four Theories of the Press*. N. Strataford: Ayer Company Publishers.

[22] Katrin Voltmer. 2009. *The Media, Government Accountability, and Citizen Engagement*. In P. Norris, editor, Public Sentinel: News Media and Governance Reform, World Bank e-Library, chapter 6.

[23] Fuchs, C. 2017. *Social Media: A Critical Introduction*. SAGE.

[24] **Seth, A. and Zhang, J. 2008.** *A Social Network Based Approach to Personalized Recommendation of Participatory Media Content*, **Proc. ICWSM.**

[25] M. Granovetter, *The Strength of Weak Ties*, American Journal of Sociology, Vol. 78, No. 6, 1973.

[26] **Seth, A., Zhang, J., & Cohen, R. 2015.** *A personalized credibility model for recommending messages in social participatory media environments*. **World Wide Web, 18, 1, 111-137.**

[27] **Koradia, Z., Balachandran, C., Dadheech, K., Shivam, M., & Seth, A. 2012.** *Experiences of deploying and commercializing a community radio automation system in India*. **In Proc. ACM DEV.**

[28] **Moitra, A., Das, V., Gram Vaani, Kumar, A., and Seth, A. 2016.** *Design Lessons from Creating a Mobile-based Community Media Platform in Rural India*. **In Proc. ICTD.**

[29] Aparna Moitra, 2018. *Mobile-based Community Media for Development: The Case of Jharkhand Mobile Vaani*. PhD thesis, Delhi University.

[30] **Chakraborty, D., Gupta, A., Gram Vaani, Seth, A. 2019.** *Experiences from a Mobile-based Behaviour Change Campaign on Maternal and Child Nutrition in Rural India*, **To appear in ICTD.**

[31] **Moitra, A., Kumar, A., and Seth, A. 2018.** *An Analysis of Community Mobilization Strategies of a Voice-based Community Media Platform in Rural India*. **Information Technologies & International Development 14 (2018).**

[32] **A. Seth. 2019.** *Ensuring Responsible Outcomes from Technology*. **In Proc. IEEE COMSNETS, Invited Paper.**

[33] Latour, B. 2005. *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.

[34] Habermas, J. 1984. *The theory of communicative action: Reason and the Rationalization of society, Vol. 1*. Boston, MA: Beacon Press.

[35] Pask, G. 1976. *Conversation Theory, Applications in Education and Epistemology*. Elsevier.

[36] Pask, G. and de Zeeuw, G. 1992. *Interaction of Actors, Theory and Some Applications*. Manuscript, University of Amsterdam.

[37] Scheufele, D. A., and Tewksbury, D. 2006. *Framing, agenda setting, and priming: The evolution of three media effects models*. Journal of communication 57.1.

[38] **Anirban Sen, et al. 2018.** *An Empirical Analysis of Media Bias in India on the Coverage of Economic Policy Issues.* **Under preparation.**

[39] **Sen, A., Priya, Aggarwal, P., Verma, S., Ghatak, D., Kumari, P., Agandh, M.S., Guru, A., Seth, A. 2019.** *An Attempt at Using Mass Media Data to Analyze the Political Economy Around Some Key ICTD Policies in India*, **To appear in Proc. ICTD.**

[40] C.W. Mills. 1956. *The Power Elite*. Oxford University Press.

[41] **Sen, A., Agarwal, A., Guru, A., Choudhuri, A., Singh, G., Mohammed, I., Goyal, J., Mittal, K., Singh, M.A., Goel, M., et al. 2018. *Leveraging Web Data to Monitor Changes in Corporate-Government Interlocks in India*. In Proc. 1st ACM SIGCAS Conference on Computing and Sustainable Societies.**

[42] Palit, A.. 2013. *Indian Economy, Amartya Sen and Jagdish Bhagwati*, ISAS Brief 290, NUS.

[43] Jean. N, Burke. M, Xie. M, Davis. W.M, Lobell. D, and Ermon. S. 2016. *Combining Satellite Imagery and Machine Learning to Predict Poverty*, Science, Vol. 353.

[44] J. V. Henderson, A. Storeygard, and D. Weil. 2012. *Measuring Economic Growth from Outer Space*, American Economic Review, 102(2).

[45] N. Weiner. 1954. *The Human Use of Human Beings*, Houghton Mifflin.

[46] Donella Meadows. *Leverage Points: Places to Intervene in a System*. Whole Earth, 91(1):78–84, 1997.

[47] Ashby, W.R. 1956. *An Introduction to Cybernetics*. John Willey and Sons Inc.

[48] Bossel, H. 2007. *Systems and Models: Complexity, Dynamics, Evolution, Sustainability*. Books on Demand GmbH, Norderstedt, Germany.

[49] Schneider, H., Eiband, M., Ullrich, D., and Butz, A. 2018. *Empowerment in HCI – A Survey and Framework*, In Proc. CHI.

[50] Dahlbom, B. and Mathiassen, L. 1993. *Computers in Context: The Philosophy and Practice of Systems Design*. Blackwell Publishers.

[51] **A. Seth. 2018. *Course outline: Ethics in Applied CS*, Department of Computer Science and Engineering, and the School of Information Technology, Indian Institute of Technology Delhi, http://act4d.iitd.ernet.in/act4d/index.php?option=com_content&view=article&id=37&Itemid=45**

[52] Justin Fox. 2018. *Why German Corporate Boards Include Workers*. http://www.bloomberg.com/view/articles/2018-08-24/why-german-corporate-boards-include-workers-for-co-determination

[53] Mike Cooley and Frances O'Grady. *Architect or Bee?: 2016. The Human Price of Technology*. Spokesman Books, England.

[54] **A. Seth, D. Kroeker, M. Zaharia, S. Guo, and S. Keshav. 2006. *Low-cost Communication for Rural Internet Kiosks Using Mechanical Backhaul*, In Proc. ACM Mobicom.**

[55] **A. Seth. 2007. *A Proposal to Provide Media Services in Rural Areas of India*, Editor & Publisher and Mediaweek's Interactive Media Conference, Knight News Challenge.**

[56] **Koradia, Z., Premi, A., Chandrasekharan, B. and Seth, A. 2012. *Using ICTs to Meet the Operational Needs of Community Radio Stations*. In Proc. ACM DEV 2010.**

[57] **A. Mahla, D. Martin, I. Ahuja. Q. Niyaz, and A. Seth. 2012. *Motivation and Design of a Content Distribution Architecture for Rural Areas*, In Proc. ACM DEV.**

[58] Celis, L.E., Straszak, D., Vishnoi, N.K. 2017. *Ranking with Fairness Constraints*. In Proc. ICALP.

[59] **A. Seth. 2017. *A Cheatsheet About Development Issues in India*. Gram Vaani.**

[60] **Z. Koradia, G. Mannava, A. Raman, G. Agarwal, V. Ribeiro, S. Triukose, S. Ardon, A. Mahanti, and A. Seth. 2013. *First Impressions on the State of Cellular Data Connectivity in India*, ACM DEV-4.**

[61] **CUTS and IIT Delhi, foreword by Prof Krithi Ramamritham (IIT Bombay). 2016. *Mobile Internet Services in India: Quality of Service*, Presented to TRAI.**

[62] **A. Seth. 2017. *Response to TRAI Consultation Paper on Data Speed Under Wireless Broadband Connections*.**

[63] Mudliar, P., Donner, J., and Thies, W. 2013. Emergent Practices Around CGNet Swara, A Voice Forum for Citizen Journalism in Rural India. *ITID*. 9, 2 (Special Issue), 65-79