Environmental Protection Through E-Regulation:

Critical and Empirical Perspectives Using a Rule of Law Analysis

Rónán Mel Kennedy

A dissertation submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

of

University College London.

Faculty of Laws

University College London

February 26, 2015

I, Rónán Mel Kennedy, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the work.

Abstract

Sometimes the most commonplace and uninteresting tools demand close attention because their mundane nature means that their role is misunderstood. The use of computer technology by government—specifically, by environmental regulators—is one such instance. Information and communications technology (ICT) is increasingly deployed in bureaucratic and regulatory processes throughout the developed world. As in commerce and industry, software code and databases are becoming the invisible 'glue' that interconnects the various actors in the regulatory system and weaves an invisible web of control between decision-makers, regulated entities, and ordinary citizens. However, this topic has received only disconnected academic attention, perhaps because there is little that seems intrinsically interesting about a database.

There is now a substantial body of literature on regulation and ICT. However, this focuses on either 'information' or 'communications', rarely on both together or on the use of ICT for regulation rather than something to be regulated. The issues which ICT raises in this context are not always obvious but nonetheless significant if we are to make the best use of these new tools without unwittingly sacrificing important principles.

There are few theoretical or practical perspectives on the role of ICT in environmental regulation. This thesis applies both in combination, developing a values-based, analytical, and empirically grounded framework in order to contextualise the use of ICT as a regulatory tool.

The ever-increasing deployment of ICT in homes and offices, the built envi-

ronment, and the world at large creates significant opportunities for achieving better environmental outcomes but this new and poorly-understood development also raises questions about the proper operation of the rule of law by an increasingly computerized state. This thesis explores how the widespread implementation of ICT is altering power relationships in the system of environmental regulation. It asks to what extent this new capability of large-scale information capture leads to more or less control on the part of regulators, whether existing balances and imbalances of power are altered by these new tools (even when they are seen as neutral) and what happens when the 'glue' hardens and installed technology makes policy change difficult.

The thesis critically reviews the operation of the rule of law in digitized government, the development of ICT in environmental regulation, the role of scientific models in environmental regulation, and the use of disclosure as a regulatory tool. It combines theoretical perspectives from sociology, chiefly Actor-Network Theory, with insights from semi-structured interviews with staff in regulatory agencies, non-governmental agencies, and regulated entities, to build a model of how the use of ICT for information-gathering, as a means of control, and as a conduit for communications is perceived by practitioners of environmental regulation. It uses this to sketch the contours of a new field of study, '*e-regulation*', centred around the core values of the rule of law.

The thesis places this discussion in the context of a dynamic, networked and globalised social and economic environment. It concludes by discussing how to protect the rule of law in e-regulation, putting forward practical suggestions and proposals for further research.

Preface

This thesis is submitted for the degree of Doctor of Philosophy at the Faculty of Laws of University College London. It is the original, unpublished work of the author. Portions of this research were funded by the Millennium Fund at the National University of Ireland Galway and the Environment, Development and Sustainability Cluster of the Whitaker Institute at the same university. The data used was collected by the author between October 2012 and April 2014, and analysed by the author. The data was subject to UCL Data Protection Registration No Z6364106/2012/10/60, section 19, research:social research.

The poem, 'All Watched Over By Machines Of Loving Grace', is reproduced by the kind permission of the estate of Mr Richard Brautigan. It captures the Californian optimism that often surrounds the application of information and communications technology in environmental regulation. In my research, I have sought to contextualize the appealing vision which it articulates, query the extent to which it may be becoming a reality, and explore the questions which it raises for law as a discipline and the rule of law as an ideal. While I have discovered many unnoticed issues and unsolved problems along the way, I remain positive about the potential of appropriately designed and thoughtfully applied technology to assist in human efforts to bring about better environmental outcomes.

Rónán Kennedy

Galway, October 2014

Acknowledgements

I would like to thank my supervisors, Professors Jane Holder, Richard Macrory, and Pascoe Pleasence for their wide-ranging assistance. Jane, in particular, guided me carefully towards completion while encouraging me to follow my own path forward, and taught me a great deal about the processes of research, critical thinking, and academic discourse along the way. Others at University College London who gave particular assistance included Professor Muki Haklay, Dr Andrea Sella, and Tony Overbury.

The early research was conducted while a visiting student at Tilburg Institute of Law and Technology, and I was very grateful to the staff and students there (and visitors such as Professor Vincent Homburg of Erasmus University) for their engagement with my work. Ben Meehan of QDA Training provided much valuable guidance on the process of qualitative data analysis and the use of NVivo. Professor Dag Wiese Schartum at the University of Oslo provided detailed critical feedback at a key time.

Amongst my colleagues in the School of Law at NUI Galway, Professor Liam O'Malley has encouraged and supported my interest in the interaction between law and information and communications technology for a very long time; Professor Ronán Long pointed me towards this research topic; and Dr Laurent Pech (now Professor at Middlesex University) and Dr Conor Hanly were particularly helpful in providing guidance on rule of law issues. Other Galway colleagues who assisted were Professor Willie Golden, Dr Michael Lang, and Dr Murray Scott from Business Information Systems; and Dr Brendan Flynn of the School of Political Science

and Sociology.

I am very grateful to the many individuals in environmental regulators and NGOs who were generous with their time and ideas but must remain anonymous.

Above all, I am grateful to my partner Fiona McNulty for her help, support, and comments, and to our daughter Síomha, for giving me a reason to finish this project.

Contents

List of Figures

List of Tables

Table of Cases

Table of Legislation

International Treaties

Official Documents

All Watched Over By Machines Of Loving Grace

I like to think (and
the sooner the better!)
of a cybernetic meadow
where mammals and computers
live together in mutually
programming harmony
like pure water
touching clear sky.

I like to think
(right now, please!)
of a cybernetic forest
filled with pines and electronics
where deer stroll peacefully
past computers
as if they were flowers
with spinning blossoms.

I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace.

(Richard Brautigan (1935–1984))

Part I

The Role of ICT in Environmental Regulation: Towards a More Nuanced Approach

Introduction to Part I

The first part of the thesis explains the central concern of my research, which is the ways in which the adoption of information and communications technology (ICT) by regulatory agencies is altering power relationships within that domain of government operation and how that raises concerns from the perspective of the rule of law. This question is placed in the context of the existing literature on environmental regulation, the ways in which ICT can influence the distribution of power in society, and examples of bias and unforeseen consequences in the development of particular public information systems in India and elsewhere. It discusses issues of methodology in legal research, arguing for a interdisciplinary approach which is pluralistic but rigorous. It provides an account of how the research question was arrived at, summarises briefly the findings chapter (which is in the third part of the thesis), and outlines the remainder of the thesis.

It also defines the often loosely-used word 'information', argues that the rule of law is a significant issue as the notion of 'ambient law' comes to the fore, and explores the positive and negative aspects of the use of ICT in routine administrative work for fundamental principles of fairness, transparency, and equality.

Chapter 1

Locating ICT and Environmental Regulation: A Framework for Research

This thesis explores the way in which environmental regulators and other actors within the overall system of environmental regulation (ER) make use of information and communications technologies (ICT). It uses a combination of theoretical and empirical perspectives to highlight the benefits and issues that arise from these new developments and considers how the application of ICT may impact on adherence to the rule of law in this particular context.

This research was prompted by the realisation that, in a similar fashion to many other organizations (both public and private), environmental regulators were adopting ICT on a wide scale, and while this may bring some benefits, it may have unexpected and unforeseen consequences for their operation. In an early, but brief, case study of the Parking Adjudicators tribunal in London, Sheppard and Raine highlight the importance of the role of ICT in administrative procedures, stating 'the IT systems in place at [the Tribunal] have a significant impact upon the shape and style of the adjudication process and on the supporting administration.'[1] This thesis seeks to explore how the 'shape and style' of ER may change as ICT is adopted.

Although these questions about the use and consequences of ICT have wider ramifications, ER presents a particularly appropriate context within which to ex-

[1] Caroline Sheppard and John Raine, 'Parking Adjudications: The Impact of New Technology' in Michael Harris and Martin Partington (eds), *Administrative Justice in the 21st Century* (Hart Publishing 1999) 330.

plore such issues, as it is so closely tied to developments in both science and technology. The challenges of properly managing the quality of the environment are complex and difficult, particularly as carbon emissions threaten to cause rapid and catastrophic climate change. It requires considering locations, events, and processes through various scales of time and space, from epochal to immediate, and from local to global. As ICT has the capacity to compress time (by storing information, facilitating modelling, and enabling asynchronous communication), space (by enabling long-distance communication and transportation) and complexity (by augmenting memory, performing cumbersome calculation, and streamlining cooperation),[2] it has important applications for this task. Environmental regulation is therefore particularly likely to show signs of what the information systems scholar, Shosana Zuboff, calls the 'additional dimension of reflexivity'[3] which ICT introduces: 'a voice that symbolically renders events, objects, and processes so that they become visible, knowable, and shareable in a new way.'[4]

In attempting to discern what understanding and activities are part of this 'new way' of seeing the environment—the connection between 'informating', Zuboff's coinage which denotes the generation of new information as part of the process of deploying ICT,[5] and the sociologist Arthur Mol's 'informational governance'[6]—this research has proceeded through three distinct but interlinked and overlapping phases: a detailed survey of existing literature on the role of science and information technology in environmental regulation; empirical investigation, through interviews with staff in regulatory agencies, non-governmental organizations (NGOs), and other relevant bodies; and the integration of these two sources of knowledge

[2]Bill Tomlinson, *Greening Through IT: Information Technology for Environmental Sustainability* (MIT Press 2010) 9.

[3]Shoshana Zuboff, *In the Age of the Smart Machine: The Future of Work and Power* (Basic Books 1988) 9.

[4]ibid, 9.

[5]Shoshana Zuboff, 'Automate/Informate: The Two Faces of Intelligent Technology' (1985) 14(2) Organizational Dynamics 5, 8.

[6]Arthur PJ Mol, *Environmental Reform in the Information Age: The Contours of Informational Governance* (Cambridge University Press 2008) 80.

into a fresh theoretical perspective on the relationship between ICT and the rule of law in ER in the early years of the so-called 'information revolution', which I label 'e-regulation'.

1.1 Scope of Thesis

This thesis aims to achieve an understanding of the role of ICT in ER, taking a critical realist perspective on the challenges of implementing and improving information systems (IS) in practice and the often-unforeseen impacts that such systems can have on power relationships and thus the rule of law. It is an initial, high-level inquiry into these issues rather than a detailed consideration of a particular legal regime, socio-technical system, or environmental policy problem. It utilizes sociological theories, particularly Information Ecology and Actor-Network Theory, to highlight the way in which the technology itself can become an actant (whether as an enabler or a limiting factor) in organizational, bureaucratic, and administrative processes. It also draws upon literature from information systems, legal theory and regulation in order to build an understanding of the role of ICT in the increasingly digital and algorithm-driven work of government.

Based on an analysis of interviews conducted with practitioners in the field, this thesis concludes that the use of ICT for environmental regulation is very significant in the day-to-day operations of regulators. ICT has substantial benefits for these but the process of organizational change that generally accompanies the use of these new tools often brings significant complications. While individuals working in regulatory agencies are aware of some of the background issues regarding justice and fairness, there is nonetheless a need for a more explicit and deeply embedded understanding of the limiting of their discretion which ICT requires. This need to consider the importance of values in the construction of IS merits closer attention and, for this reason, the thesis concludes with a set of recommendations

for processes that seek to ensure that these issues are properly considered by policymakers, system designers, and developers.

In this thesis, ICT (sometimes also known as 'new information and communications technology' (NICT) or simply as 'information technology'(IT)) is defined (following the European Commission) as

> ... a wide range of services, applications, and technologies, using various types of equipment and software, often running over telecom networks. ICTs include well known telecom services such as telephone, mobile telephone and fax. Telecom services used together with computer hardware and software form the basis for a range of other services, including email, the transfer of files from one computer to another, and, in particular, the Internet, which potentially allows all computers to be connected, thereby giving access to sources of knowledge and information stored on computers worldwide.[7]

1.2 Methodology

This section discusses methodology, summarising the process of thinking through options with regard to theories, frameworks, and approaches. The actual methods applied as the research progressed are discussed in Chapter 8.

1.2.1 Research Methods in Law

Over time, legal scholars have developed a number of different ways of approaching research in law. The traditional division is between 'black letter law' approaches (which focus on positive laws as a subject of study and attempt to construct a coherent narrative, or recommendations for reform in the interests of coherency, from legislation and case law) and 'law in context' approaches (which move the focus away from law and towards the broader social and political context, within which law may be both the cause and solution to a problem). Black letter or doctrinal approaches do not need to go outside the confines of the library. However, as sources

[7] European Commission, 'Information and Communication Technologies in Development. The Role of ICTs in EC Development Policy.' (Communication) COM (2001) 770 final, 3.

of law become more transnational and access to commentary from other jurisdictions becomes easier, a greater awareness of alternative perspectives on law and legal research has developed, although traditional legal texts such as primary and secondary legislation and case law, but also international treaties and other specialised legal texts, continue to have a significant role in the day-to-day work of the lawyer (particularly practitioners). A realisation that positive law is only one part of the overall story of law reform and development has given rise to an increased focus on interdisciplinary approaches to law, which can encompass socio-legal studies, feminist legal studies, critical legal studies and new approaches to international law. A third type of research, which sits somewhere between the two outlined above, is international and comparative research, which examines the differences between differences and similarities between laws in different jurisdictions.[8]

According to Vick, there can be tensions between these points of view, rooted in

> ... the challenges interdisciplinary legal research pose to widely-accepted notions about the purposes of legal scholarship, the relationship between academic lawyers and the legal profession, and the collective identity of the legal discipline itself.[9]

Banakar and Travers claim that so-called mono-disciplinarians see interdisciplinary work as a threat to their status and prefer to dismiss it.[10] There can also be tensions within socio-legal studies itself, between those who seek 'truth' and those engaging in more critical legal studies;[11] There is a strong element of the latter in this research, as my fundamental concern is with the patterns of power that information gathering and communication systems either reinforce or reveal.

---

[8]Michael McConville and Wing Hong Chui, *Research Methods for Law* (Edinburgh University Press 2007).

[9]Douglas W Vick, 'Interdisciplinarity and the Discipline of Law' (2004) 31(2) Journal of Law and Society 163, 164.

[10]Reza Banakar and Max Travers, 'Law, Sociology and Method' in Reza Banakar and Max Travers (eds), *Theory and Method in Socio-Legal Research* (Hart 2005) 6.

[11]Robert Lee, 'Socio-Legal Research—what's the Use' in Philip A Thomas (ed), *Socio-Legal Studies* (Dartmouth, Aldershot 1997) 82-3.

1.2.2 Interdisciplinarity

For this particular project, an interdisciplinary approach is essential. It is a study of regulation in practice, with significant legal dimensions and ramifications, but a purely doctrinal analysis of law is not adequate to the task at hand. As Baldwin says, any account of law must include consideration of 'how rules are implemented and enforced'.[12] Indeed, it is difficult to see the traces of the increasing use of ICT both by and within regulators in positive law. These changes in tools and techniques are often taking place without explicit attention from the legislature, and may only be visible in some minor changes to secondary legislation which governs reporting mechanisms.

Research which focused largely or entirely on black letter sources would not be able to observe these changes in practice. In addition, without seeking out empirical data on the functioning of the regulatory system, whether qualitative or quantitative, a study of the growing use of ICT by regulators would be greatly impoverished. This project, of necessity, must include perspectives from disciplines other than law. In addition, the focus of this research project is not on specific regulatory schemes as defined in legislation and therefore this research is not tied to a particular jurisdiction.

Socio-legal research can contribute by investigating the creation and application of environmental policy and regulation, even where there is a lack of formal legal rules and procedures, and in seeking to understand administrative decision-making processes,[13] and there already exists some research on environmental regulation that utilises an interdisciplinary approach. For example, Richardson, Ogus, and Burrows studied the control of the discharge of trade effluents into public sewers, utilising participant observation and interviews.[14] Hawkins conducted a soci-

[12] Robert Baldwin, *Rules and Government* (Clarendon Press 1995) 5.

[13] Denis Galligan, 'Public Law' in Philip A Thomas (ed), *Socio-Legal Studies* (Dartmouth, Aldershot 1997) 211–3.

[14] Genevra Richardson, Anthony Ogus, and Paul Burrows, *Policing Pollution: A Study of Regula-*

ological study of the enforcement of water pollution laws in England and Wales, again using participant observation and interviews.[15] Hilson presents an interdisciplinary approach to the regulation of pollution in England and Wales, adopting a theory of 'regulatory federalism'.[16] Abbot performs a similar analysis of pollution control enforcement across three jurisdictions (Australia, Canada and England and Wales) making use of insights from law and economics (particularly Becker's deterrence model) in order to analyse the cost-effectiveness of different enforcement strategies.[17]

This research builds on the example of these previous studies to explore an under-researched aspect of the functioning of modern regulators. In a fashion similar to those works highlighted in the previous paragraph, this project combines a range of different theories and theoretical frameworks, coming from a wide variety of different disciplines and therefore bringing with them different fundamental assumptions and ways of seeing and exploring the world. The working methods adopted are also a collection of diverse approaches: some are closer to 'traditional' legal research (involving engaging critically with literature produced by other scholars interested in this field); others incorporate tools from socio-legal and 'law-and-society' approaches, such as qualitative empirical research (interviewing staff and regulators who are actively engaged in using these types of tools). Therefore, this research seeks to combine a breadth of theoretical insight with reliable empirical observation in the hope of achieving a more sophisticated picture of the reality of the application of ICT for ER by environmental regulators.

---

tion and Enforcement (Clarendon Press 1982).

[15] Keith Hawkins, *Environment and Enforcement: Regulation and the Social Definition of Pollution* (Clarendon 1984).

[16] Chris Hilson, *Regulating Pollution: A UK and EC Perspective* (Hart 2000).

[17] Carolyn Abbot, *Enforcing Pollution Control Regulation* (Hart 2009).

1.3 Contribution of Thesis

Dunleavy and others argue 'not just that IT has played a significant part in [contemporary rationalization and modernization changes in the public service] but that it occupies a central role in modern public management.'[18] Frissen claims that '[i]nformatisation could very well rival bureaucratisation as one of the most important features of the historical process of modernisation'[19] while Bamberger highlights how

> [t]echnology permits forms of regulation and enforcement and a capacity for both concentration and diffusion of power and authority that have never before existed. It further creates possibilities for governance in contexts heretofore thought ungovernable.[20]

Therefore, the widespread adoption of ICT by bureaucracy is significant for law and legal theory but remains very under-studied.[21] Legal philosophy does not explore the mediums by which law is applied.[22] Constitutional theory remains focused on 'models of power that fail to capture how government now works.'[23]

Although there is a need for economic and political perspectives on regulation to take account of the administrative process,[24] the connections between ICT and environmental protection remain significantly under-researched.[25] As some have

[18]Patrick Dunleavy and others, *Digital Era Governance: IT Corporations, the State and E-Government* (Oxford University Press 2008) 10.

[19]P H A Frissen, *Politics, Governance and Technology: A Postmodern Narrative on the Virtual State* (Edward Elgar 1999) 74.

[20]Kenneth A Bamberger, 'Technology's Transformation of the Regulatory Endeavor' (2011) 26 Berkeley Technology Law Journal 1315, 1315.

[21]Keith Culver, 'E-Government as a New Frontier for Legal Theory' in Ari-Veikko Anttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007) 495.

[22]Katja de Vries and Niels van Dijk, 'A Bump in the Road. Ruling Out Law From Technology' (2013) 25 Ius Gentium: Comparative Perspectives on Law and Justice 89, 90.

[23]John Morison, 'Modernising Government and the E-Government Revolution: Technologies of Government and Technologies of Democracy' in Nicholas Bamforth and Peter Leyland (eds), *Public Law in a Multi-Layered Constitution* (Hart Publishing 2003) 159.

[24]Steven P Croley, 'Theories of Regulation: Incorporating the Administrative Process' (1998) 98 Columbia Law Review 1.

[25]Piyush Mathur, 'Environmental Communication in the Information Society: The Blueprint From Europe' (2009) 25 The Information Society 119.

commented,[26] this is surprising. These technologies have been available for approximately half a century, used in government from the outset, and widely available in developed countries in the present day.[27]

In addition, they are making a significant difference to established and mature markets: the radical reconfiguration which the advent of the Internet and peer-to-peer file-sharing has brought about in the music industry is well-known.[28] More recently, claims have been made that ICT is key to developments in human rights protection globally, such as the role of social media in the so-called Arab Spring[29] and the ongoing controversy surrounding revelations of large-scale government interception of online traffic.[30] However, this lack of academic attention is also understandable, as the use of ICT has largely been in back rooms, not immediately obvious to or clearly understood by those not part of the secular priesthood of technologists until recently.

1.3.1 Existing Research

Unfortunately, lawyers and legal theorists have not responded quickly enough to the challenges which ICT poses to traditional thinking about governing and the rights of the governed. Although scholars in sociology,[31] public policy,[32] and regulation[33]

[26] Dunleavy and others, *Digital Era Governance* (n 18) 248.

[27] See Section 5.2.

[28] Peter K Yu, 'The Escalating Copyright Wars' (2003) 32 Hofstra Law Review 907.

[29] Philip N Howard and others, 'Opening Closed Regimes: What Was the Role Of Social Media During the Arab Spring?' (2011) ⟨http://pitpi.org/index.php/2011/09/11/opening-closed-regimes-what-was-the-role-of-social-media-during-the-arab-spring/⟩ accessed 19 May 2014; Ekaterina Stepanova, 'The Role of Information Communication Technologies in the "Arab Spring"' [2011] (15) Ponars Eurasia 1.

[30] Ian Brown and Douwe Korff, 'Foreign Surveillance: Law and Practice in a Global Digital Environment' [2014] European Human Rights Law Review 243; Jemima Stratford and Tim Johnston, 'The Snowden "Revelations": Is GCHQ Breaking the Law?' [2014] European Human Rights Law Review 129.

[31] Judy Wajcman, 'Addressing Technological Change: The Challenge to Social Theory' (2002) 50(3) Current Sociology 347, 347.

[32] Helen Margetts, *Information Technology in Government: Britain and America* (Routledge 1999) xv; ibid, 25.

[33] Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) 34.

have pointed out that technology is key to many changes in society, government, and governance, very little research has been done on the connections between ICT and legal or administrative processes,[34] the work of bureaucracy,[35] or regulation.[36] The role of digital computers in governance has attracted some attention since the late 1960s, although the focus was more on privacy,[37] with some published research in the 1970s[38] and the 1980s.[39] It then dwindled as a topic of academic interest,[40] although Schartum identified the growing importance of computers as 'case-processing systems' in the early 1990s.[41] The field of 'public management information systems' was slow to develop during the 1990s, and largely ignored by mainstream information systems (IS) journals; the focus was on the more public consequences, not on behind-the-scenes routine.[42]

At this remove, it is only possible to speculate as to why scholars ceased to

[34]Dunleavy and others, *Digital Era Governance* (n 18) 9.

[35]Jane E Fountain, 'The Virtual State: Toward a Theory of Federal Bureaucracy in the 21st Century' in Elaine Ciulla Kamarck and Joseph S Nye (eds), *Democracy.com? Governance in a Networked World* (Hollis Publishing 1999).

[36]A search in the top information systems journals—defined as those in the Association for Information Systems 'Senior Scholars' Basket of Journals' (http://aisnet.org/?SeniorScholarBasket), which are the European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, and MIS Quarterly— in July 2014 for articles with 'power' in the title only finds 38 articles; 'regulation' finds 9, which generally deal with privacy and competition law; 'rule of law' finds none; 'e-regulation' finds none.

[37]Vance Packard, *The Naked Society* (Penguin Books 1966).

[38]Laurence Tribe, 'Policy Science: Analysis or Ideology?' (1972) 2(1) Philosophy and Public Affairs 66; Kenneth C Laudon, *Computers and Bureaucratic Reform: The Political Functions of Urban Information Systems* (Wiley 1974); Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976).

[39]James N Danziger and others, *Computers and Politics: High Technology in American Local Governments* (Columbia University Press 1982); William H Dutton and Kenneth L Kraemer, *Modeling as Negotiating: The Political Dynamics of Computer Models in the Policy Process* (Ablex Publishing Corporation 1985); Kenneth C Laudon, *Dossier Society: Value Choices in the Design of National Information Systems* (Columbia University Press 1986); Kenneth L Kraemer, *Datawars: The Politics of Modeling in Federal Policymaking* (Columbia University Press 1987); Kenneth L Kraemer and John Leslie King, 'Computers and the Constitution: A Helpful, Harmful or Harmless Relationship?' (1987) 47(1) Public Administration Review 93.

[40]Kenneth L Kraemer and Jason Dedrick, 'Computing and Public Organizations' (1997) 7(1) Journal of Public Administration Research and Theory 89.

[41]Dag Wiese Schartum, 'Dirt in the Machinery of Government—Legal Challenges Connected to Computerized Case Processing in Public Administration' (1994) 2 International Journal of Law and Information Technology 327, 330.

[42]Hans J Scholl, 'Electronic Government: A Study Domain Past Its Infancy' in Hans J Scholl (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010) 12–3.

pay attention to the role and impact of ICT in the administrative process. Although changes were clearly underway in the 1990s, academics seem to have either been unaware of this or choose to ignore it, perhaps because it was largely occurring in back offices or 'in rather ordinary, transparent, and easily usable ways'.[43] Dunleavy and others also highlight how the 'slow-moving machine bureaucracies were deeply unfashionable areas for organization theorists or even public management writers to study'.[44] In addition, coming to grips with these issues required a level of technical skill and understanding which not all possess. As Parnas points out,

> [t]echnology is the black magic of our time. Engineers are seen as wizards; their knowledge of arcane rituals and obscure terminology seems to endow them with an understanding not shared by the laity. The public, dazzled by the many visible achievements of modern technology, often regards engineers as magicians who can solve any problem, given the funds. Many are so awed by technological advances that they make no attempt to understand how things work.[45]

Perhaps this led to academics and bureaucrats being unwilling or unable to explore the topic of computerization in any great detail. Dunleavy puts forward more prosaic reasons for the neglect of paper- and ICT-based systems in public administration and public management theory: its low status; the delay in widespread adoption by government of new technologies; that information-processing functions generally operated without crises; the hierarchical distance between IT staff and high-level decision-makers; and a general theoretical neglect of the importance of information in the functioning of government.[46] More recently, Rouvroy has lamented the lack of attention which governmentality scholars have paid to ubiq-

[43] Kevin Robins and Frank Webster, *Times of the Technoculture: From the Information Society to the Virtual Life* (Routledge 2004) 65–6.

[44] Dunleavy and others, *Digital Era Governance* (n 18) 19.

[45] David L Parnas, 'Foreword' in Lauren Ruth Wiener (ed), *Digital Woes* (Addison-Wesley 1993) ix–x.

[46] Patrick Dunleavy, 'Governance and State Organization in the Digital Era' in Robin Mansell and others (eds), *The Oxford Handbook of Information and Communication Technologies* (Oxford University Press 2007) 408–411; For an exception, see Christopher C Hood and Helen Z Margetts, *The Tools of Government in the Digital Age* (Palgrave Macmillan 2007).

uitous computing, ambient intelligence, or autonomic computing.[47] Even popular writing on software in society, such as Steiner's *Automate This*,[48] omit consideration of the use of algorithms in government, focusing instead on areas such as finance, sports, and medicine.

This is therefore a significant, if not vital, topic which demands urgent and careful consideration by scholars and policymakers but has been very much ignored until recently.[49] Kraemer and King's call for the study of the impacts of these new technologies[50] is even more urgent a quarter of a century later:

> ... technologies are sufficiently important—and so inextricably intertwined with other factors, such as legislation, the distribution of wealth, race and gender relations, international affairs, and so on, that we must learn to subject technologies to the same rigorous political scrutiny and involvement that should be accorded to those other factors.[51]

1.3.2 Gaps in the Literature: The Absence of the Rule of Law as an Issue

Therefore, the study of ICT and its relationship to legal and regulatory systems is a topic that is still in its infancy as the subject of academic attention, although its consequences are pervasive and the potential resulting improvement or disimprovement in public services are obviously important to all citizens.[52] What literature does exist is focused on intellectual property[53] and the challenges for le-

[47] Antoinette Rouvroy, 'Technology, Virtuality and Utopia: Governmentality in an Age of Autonomnic Computing' in Mireille Hildebrandt and Antoinette Rouvroy (eds), *The Philosophy of Law Meets the Philosophy of Technology* (Routledge 2011) 123.

[48] Christophe Steiner, *Automate This: How Algorithms Took Over Our Markets, Our Jobs, and the World* (Penguin 2012).

[49] Alex Faulkner, Bettina Lange, and Christopher Lawless, 'Introduction: Material Worlds: Intersections of Law, Science, Technology, and Society' (2012) 39(1) Journal of Law and Society 1, 18.

[50] Kraemer and King, 'Computers and the Constitution' (n 39) fn48.

[51] Richard E Sclove, 'Making Technology Democratic' in James Brook and Iain A Brook (eds), *Resisting the Virtual Life: The Culture and Politics of Information* (City Lights Books 1995) 88.

[52] Jonny Holmström and Daniel Robey, 'Inscribing Organizational Change With Information Technology' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 165–6.

[53] For example, Andrew D Murray, *The Regulation of Cyberspace: Control in the Online Environment* (Routledge-Cavendish 2006).

gal practitioners.[54] The focus is on 'code as law'[55] (the ways in which software can constrain consumers more effectively than legal rules) or perhaps 'code meets law'[56] (the interaction between the two types of rules in property regulation) but not on 'law through code'[57] (in the sense of software implementations of regulatory schemes). Issues arising from the use of expert systems in law were discussed in the 1990s,[58] but this technology has not developed to the extent expected at the time. The use of computers for legal decision making was studied in Scandanavia in the early 1990s,[59] but very little has been published on this in English.[60] There is only one published article directly on the topic of ICT and environmental regulation in law reviews,[61] together with a small cluster of articles on closely related topics and some literature from other disciplines, but as yet no coherent perspectives, approaches, or frameworks have developed.

The seminal article in the field is Professor Daniel Esty's 'Environmental Protection in the Information Age'.[62] Esty states that we either have entered or are entering into an 'Information Age', a transformation which is driven by ICT.[63] This is situated within an economic analysis of environmental law,[64] relying on the work of James Krier and others.[65] In what is so far the only comprehensive article on

[54] For example, Richard Susskind, *The Future of Law: Facing the Challenges of Information Technology* (Clarendon Press 1998); Richard Susskind, *Transforming the Law: Essays on Technology, Justice, and the Legal Marketplace* (Oxford University Press 2003); Richard Susskind, *The End of Lawyers?: Rethinking the Nature of Legal Services* (Oxford University Press 2009).

[55] Lawrence Lessig, *Code: And Other Laws of Cyberspace, Version 2.0* (Basic Books 2006).

[56] R Polk Wagner, 'On Software Regulation' (2005) 78 Southern California Law Review 457.

[57] For isolated examples, see Danielle Keats Citron, 'Technological Due Process' (2008) 85 Washington University Law Review 1249; Danielle Keats Citron, 'Open Code Governance' [2008] University of Chicago Legal Forum 355.

[58] Jacques Fremont, 'Computerized Administrative Decision Making and Fundamental Rights' (1994) 32 Osgoode Hall Law Journal 817.

[59] Jon Bing, 'Code, Access and Control' in Mathias Klang and Andrew Murray (eds), *Human Rights in the Digital Age* (Glasshouse Press 2005) 204–5.

[60] An example is Schartum, 'Dirt in the Machinery of Government' (n 41).

[61] Daniel C Esty, 'Environmental Protection in the Information Age' (2004) 79 New York University Law Review 115.

[62] ibid.

[63] ibid, 155–70.

[64] ibid, 124–5.

[65] James E Krier and W David Montgomery, 'Resource Allocation, Information Cost and the Form

the application of ICT for environmental regulation, Esty is very optimistic about the potential of these new tools to achieve better outcomes and argues that in the 'Information Age',

> ... we stand on the verge of an environmental revolution perhaps as important as that which launched the modern environmental movement four decades ago. The technological advances of the Information Age provide an opportunity to make environmental protection more data-driven, empirical, and analytically rigorous. ... [A]s information gaps become less pervasive, institutional design options for addressing environmental problems will expand and we will be able to rethink our regulatory choices.[66]

Esty comprehensively outlines the advantages: ICT makes possible the large-scale and inexpensive tracking of pollution emissions. It can also be used for data management, analysis, and retrieval, making 'data mining' possible and making it easier to manage complexity. It also allows information to be disseminated widely and rapidly.[67]

These new possibilities reshape the environmental decision-making context. Hitherto invisible environmental problems, such as the depletion of fish stocks, can be brought to light through analysis of data. The impact of emissions over time and at a distance can be better understood. The interconnection of environmental hazards, such as the composition and sources of polluted air, can be more easily tracked. Data visualization, such as representations of the hole in the ozone layer over Antarctica, can help to mobilise individuals to take action and better explain the scientific evidence for damage.[68]

Computer modelling allows for better forecasting. With improved processing speeds, and genetic algorithms, models can be tested and adapted in very little time. This expands the scope and span of control available to policymakers. It can

---

of Government Intervention' (1973) 13 Natural Resources Journal 89.

[66] Esty (n 61) 119–20.

[67] ibid, 156–61.

[68] ibid, 160–3.

also improve the policy-making process by grounding it in real results, identifying failing programs and the best solutions. This may lead to greater transparency and a better functioning democracy and it is likely to transform administrative processes.[69]

ICT can help to solve several of the problems that prevent comprehensive and fully effective environmental regulation. In the marketplace, it can help with the search costs involved in finding markets for what were formerly considered to be 'waste' by-products, such as diacids from nylon production, which can be sold to tanneries; increasing precision in defining environmental rights through GPS/GIS; better valuation of potential future harms; shifting decision-making to the market where appropriate; and lowering the cost of contracting for compensation for environmental harms to a level where many more can participate.[70]

For regulators, more precise information can help create more specialised, decentralised, and sophisticated organizations. Quantification and visualization can better communicate environmental problems. Closer identification of problems allows policy-makers to match the scale of the problem with the appropriate scale of response.[71] Poor national performance on comparative measures of environmental performance can be a significant spur for action.[72]

Esty's theoretical perspective on information[73] is economic rather than scientific or social and he acknowledges that '[h]arnessing the power of information technology will require a nuanced understanding of the relationship between environmental information and institutional design.'[74] He highlights some issues, such as the need to transform data into information and then knowledge; the risks from 'disinformation'; the possibility that cyber democracy could become chaotic; too

[69] ibid, 164–70.
[70] ibid, 175–180.
[71] ibid, 182–87.
[72] ibid, 168.
[73] ibid, 130–55.
[74] ibid, 121.

much information can lead to decision-making paralysis; and that information on environmental hazards can be used for malicious ends.[75]

Although there has been little writing that bears directly on the use of ICT in the regulatory process, as Esty notes, '[c]onsiderable attention has been paid to the potential for "information regulation." '[76] Perhaps the most relevant example of this scholarship is the work of Professor Bradley Karkainnen, particularly his article 'Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?'[77] While his approach is not so explicitly rooted in economic theory, his focus is nonetheless on filling in what he calls the 'information gap'[78] and how this might improve the attention which environmental issues get from management within the firm because of market pressures.

Another representative example is Professor Thomas McGarrity's article, 'Hazardous Air Pollutants, Migrating Hot Spots, and the Prospect of Data-Driven Regulation of Complex Industrial Complexes'.[79] This provides a detailed consideration of efforts by the Texas Council for Environmental Quality (TCEQ) to use mobile air monitoring devices in order to better regulate industrial pollution. The TCEQ's approach is focused on 'residual risk' as defined in the Clean Air Act (CAA), that is, risks that remain once the CAA's technology-based standards have been complied with.[80] It made use of mobile monitoring vans to gather information on air pollution in the vicinity of petrochemical plants.[81] He concludes that data-driven regulation has significantly more potential than model-driven efforts.[82]

From sociology, a highly significant writer on the topic is Professor Arthur

---

[75]Esty (n 61) 171–4.

[76]ibid, 125.

[77]Bradley C Karkkainen, 'Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?' (2001) 89 Georgetown Law Journal 257.

[78]ibid, 315.

[79]Thomas O McGarity, 'Hazardous Air Pollutants, Migrating Hot Spots, and the Prospect of Data-Driven Regulation of Complex Industrial Complexes' (2008) 86 Texas Law Review 1445.

[80]McGarity (n 79) 1446.

[81]ibid, 1453–73.

[82]ibid, 1492.

Mol. His approach is based on notions of an 'information age'[83] and 'ecological modernisation'[84] to develop a theory of 'informational governance',[85] in which 'informational processes, resources and struggles move to the centre of environmental governance and politics, increasingly replacing authoritative resources, nation-state power and conventional bureaucratic processes.'[86] According to Mol, we are moving into Castells' 'network society', with globalised communications, (paradoxically) increased uncertainty regarding knowledge, and governance replacing government.[87] From this emerges *informational governance*: 'the idea that information is fundamentally restructuring processes, institutions and practices of environmental governance'.[88] This development is founded on the changes in power and impact in society which ICT facilitates, linked to globalization, the redefinition of the role of the nation-state, and a loss of trust in science.

Informational governance must be distinguished from informational regulation, discussed further below,[89] whose theoretical basis is more in law and economics than in political science or sociology.[90] Informational governance can be paralleled with the development of the 'informational economy': 'a specific form of social organization in which information generation, processing, and transmission become fundamental sources of productivity and power.'[91] From a theoretical perspective, it can be understood as a process of ecological modernization, culminating in a developing ecological rationality. This abstraction of environmental realities into information spaces enables new transformative power. As we relate to our environment more and more through measurements which are then com-

[83] Mol, *Environmental Reform in the Information Age* (n 6) 42–52.
[84] ibid, 60–8.
[85] ibid, 82–91.
[86] ibid, 102.
[87] ibid, 37–53.
[88] ibid, 83.
[89] See Section 4.6.3.
[90] ibid, 85–90.
[91] Arthur PJ Mol, 'Environmental Governance in the Information Age: The Emergence of Informational Governance' (2006) 24(4) Environment and Planning C: Government and Policy 497, 500.

municated and mediated by ICT, there is the potential for environmental issues to be re-constructed, re-interpreted, and re-understood by individuals and society in different ways depending on how that information is represented. We should not assume that this is a entirely positive development: inequalities of power persists in new media and information networks; information may not always be reliable; state regulation remains relevant; and the need for local infrastructure can limit its effectiveness in, for example, developing countries.[92]

There are, therefore, diverse theoretical and disciplinary backgrounds being brought to bear on the application for ICT for environmental regulation, but as yet little agreement on theoretical approaches or research methods and very little significant literature, despite the importance of the topic. As Danziger and others point out, however, 'neither the lack of public scrutiny nor the subtle and indirect nature of computer effects negates the importance of this revolutionary change in the technology of modern organisations.'[93] Much of this change escapes popular, political, or academic attention, although they are just as important as other, more visible, aspects of official policy-making, as '[t]echnologies ... constitute part of a society's core political infrastructure', and if we do not pay attention to them, they can damage the social and political fabric.[94]

The use of digital computer technology in public administration is inherently complex, dynamic, and cross disciplinary, bringing together aspects of science, information systems, information technology, engineering, organizational and social dynamics, and law. The general topic of this thesis, which is the interaction between these new digital technologies and the rule of law,[95] is almost untouched.[96] Those

[92]Mol, 'Environmental Governance in the Information Age' (n 91) 501-07.

[93]Danziger and others (n 39) 2.

[94]Sclove, 'Making Technology Democratic' (n 51) 88.

[95]For an early example, see Mowshowitz (n 38) 184–6.

[96]For examples of instances where the topic has gained academic attention, see Laudon, *Dossier Society* (n 39); Kraemer and King, 'Computers and the Constitution' (n 39); Citron, 'Technological Due Process' (n 57); Les Metcalfe and Sue Richards, *Improving Public Management* (Sage 1990) 61; Citron, 'Open Code Governance' (n 57).

who write critically on the impact of ICT on the state focus on the public sphere and how it can foster better debate,[97] or on the new tools that it offers.[98] Writers on e-government seem to focus on making government more efficient,[99] which is a laudable goal, but either ignore or are unaware of the possible impacts of ICT on basic rights and procedures.[100] Those who write about ICT and the rule of law have tended to focus on privacy issues.[101] From the information systems discipline, those who write with an awareness of issues of power and politics tend to focus on the context of individual commercial firms.[102] The key problem arising from this point of view is that adopting a commercial perspective on e-government or the use of geographical data may undermine the legitimacy of democracy.[103] Those who call for 'a bold role' for IS in sustainability[104] seem to be focused on business applications, and the research agenda that is developing within the information systems discipline appears to be commercially-oriented[105] and often solely focused on energy informatics.[106]

In June 2013, I convened an international interdisciplinary workshop on the

[97] See, for example, Robins and Webster (n 43) 102–8.

[98] See, for example, Hood and Margetts (n 46) 184–203.

[99] See, for example, John Taylor and others, 'Innovation in Public Service Delivery' in William H Dutton (ed), *Information and Communication Technologies: Visions and Realities* (Oxford University Press Oxford 1996).

[100] See, for example, William D Eggers, *Government 2.0: Using Technology to Improve Education, Cut Red Tape, Reduce Gridlock, and Enhance Democracy* (Rowman and Littlefield 2007) which has no mention of 'rule of law', 'rights' or 'human rights' in its index.

[101] For example, see David Burnham, *The Rise of the Computer State. The Threat to Our Freedoms, Our Ethics and Our Democratic Process* (Random House 1983) which contains a chapter entitled 'The Rule of Law' but is primarily concerned with surveillance.

[102] See, for example, David Knights and Fergus Murray, *Managers Divided: Organisation Politics and Information Technology Management* (Wiley 1994).

[103] Bernd Carsten Stahl, 'The Ethical Problem of Framing E-Government in Terms of E-Commerce' (2005) 3(2) The Electronic Journal of e-Government 77; Yola Georgiadou and Jantien Stoter, 'Studying the Use of Geo-Information in Government—A Conceptual Framework' (2010) 34(1) Computers, Environment and Urban Systems 70.

[104] Viet Dao, Ian Langella, and Jerry Carbo, 'From Green to Sustainability: Information Technology and an Integrated Sustainability Framework' (2011) 20(1) The Journal of Strategic Information Systems 63.

[105] Nigel P Melville, 'Information Systems Innovation for Environmental Sustainability' (2010) 34(1) MIS Quarterly 1.

[106] Richard T Watson, Marie-Claude Boudreau, and Adela J Chen, 'Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community' (2010) 34(1) MIS Quarterly 23.

general topic of 'Information and Communications Technology for Environmental Regulation: Developing a Research Agenda'[107] and although the event attracted over 50 speakers from a variety of disciplines and from around the globe, for the most part, the presentations did not deal directly with my particular focus, the impact of ICT on the rule of law in environmental regulation. The majority of the discussions focused on specific technical aspects of this topic; very few dealt directly with the interaction between ICT and power relationships.[108] Even less looked at the impact of these technologies on legal processes and legal rights. This indicates a pressing need to explore this specific issue further at this point.

1.3.3 A Perspective Informed by Practice: The Realities of Invisible Transitions

Lived experience can often be a useful way of developing research and theories in information systems.[109] My professional career as a systems analyst and programmer working on the design, development, and implementation of information systems in commercial, institutional, and governmental contexts has led me to realise that there is often a significant difference between the initial vision of the initiator(s) of such projects and the final reality in practice. My experience as a researcher in a busy appeals court, observing litigation at close quarters, has also brought an understanding of the contingent, unpredictable, and un-designed articulation of legislation in practice. I observed at close quarters how cases could turn on minor details, the importance of procedure, and how judges were constrained from giving the results that seemed 'just' by the structure of court rules or the pleadings

[107] ICT4ER, 'Information and Communications Technology for Environmental Regulation: Developing a Research Agenda' (2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

[108] An exception is Holly Doremus, 'Institutional Architecture and Information Flow' (*Information and Communications Technology for Environmental Regulation: Developing a Research Agenda*, Galway, 2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

[109] Kosheek Sewchurran and Irwin Brown, 'Toward an Approach to Generate Forward-Looking Theories Using Systems Concepts' in Mike Chiasson and others (eds), *Researching the Future in Information Systems* (Springer 2011).

put before them. Interactions with visitors without legal training, particularly children, brought home to me how most people think of the law as being about crime, not realizing or noticing the extent to which they are enmeshed in both long-lasting and evanescent legal relationships throughout their day, how various legal regimes control many aspects of their lives, or the extent of the rights which they have but do not know about or know how to exercise.

This awareness of the invisible and often hidden webs of government interwoven into the increasingly digital, global, and fast-moving economy was one of the factors that motivated me to work on changing paradigms of state intervention. I could see the creation of new regulatory agencies at arm's length from mainline government departments, the development of public-private partnerships, and the use of contract law as a means for regulators to manage relationships with enterprises. I therefore looked at research on 'new governance',[110] which highlights how attention must be paid to non-traditional forms of control and regulation. The use of ICT is an example of new governance being applied to environmental regulation. This research explores what seems on the surface to be a very technical and ideologically neutral topic—the use of high technology to make bureaucracy more efficient—and aims through the integration of disciplines other than the law to illuminate the political, ethical, and legal choices that underpin the choice, implementation, and application of these new technologies in the field. As Bellamy points out, these are significant decisions:

> The specification of information resources and the configuration of information flows represent, and therefore help to reproduce, the structural categories, procedural rules, normative conventions, and operating criteria that govern institutional life. Another way of putting this is to say that IS help to define and regulate the political 'games' that are played in institutions. They allocate roles, define key relationships, and

[110] Gráinne de Búrca and Joanne Scott, 'Introduction: New Governance, Law and Constitutionalism' in Gráinne de Búrca and Joanne Scott (eds), *Law and New Governance in the EU and the US* (Hart Publishing 2006) 2.

shape behaviour.[111]

While my initial focus was to take stock of the adoption of ICT by regulators, and suggest how that adoption might lead to greater efficiency, the real motivation became to explore the way in which these new systems can reconfigure relationships of power and control. While the impact of ICT in certain industrial sectors or social contexts is well documented (if not always completely understood), the implementation of new technologies by government can have more subtle and unnoticed impacts on citizens' rights. Cox points out that '[t]echnology is altering the relationship between the governed and the government, and between governments.'[112] This thesis seeks to explore the detail of those alterations in one particular domain, that of ER, and raise questions about them from the perspective of the rule of law.

Legal systems develop in complex and challenging ways; with the addition of the accelerating effect of ICT and the unevenly distributed understanding of its impacts, the enthusiastic adoption of these new technologies can have many practical outcomes, with significant implications for ordinary citizens and the elaboration of their rights in practice. It is this perspective of coalface experience which informs my research and brings to life Sassen's reminder to be conscious of the interconnectedness of human and technological choices:

> Looking at electronic space as embedded [in both the technical features and standards of the hardware, and in actual social structures and power dynamics] allows us to go beyond the common duality between utopian and dystopian understandings of the Internet and electronic space generally.[113]

Supporting this approach of connecting the electronic and the physical, and examining the change as it occurs, in the preface to her groundbreaking study on

[111] Christine Bellamy, 'The Politics of Public Information Systems' in G David Garson (ed), *Handbook of Public Information Systems* (2nd edn, Marcel Dekker, Inc 2000) 92.

[112] Noel Cox, 'The Relationship Between Law, Government, Business and Technology' (2006) 8 Duquesne Business Law Journal 31, 49.

[113] Saskia Sassen, 'Towards a Sociology of Information Technology' (2002) 50(3) Current Sociology 365, 368.

the impact of ICT in the workplace, Shosana Zuboff talks about how in 1978 she struggled to 'grasp how everyday life had been altered by the profound material change in the means and method of production'[114] brought about by the Industrial Revolution. Other work brought her into contact with clerical workers who felt disenfranchised by the then-new information technology that was being imposed in their offices. A flash of insight made her realise that

> ... the people I had been interviewing were on the edge of a historical transformation of immense proportions, as important as that which had been experienced by the eighteenth- and nineteenth-century workers ... I saw that a world of sensibilities and expectations was being irretrievably displaced by a new world, one I did not yet understand.[115]

Similar changes are clearly underway in the world of law, regulation, and government. As Kraemer and King predicted many years ago,[116] John Morison claims that 'government is being transformed, and will further change radically, in line with developments in information and communication technology associated with the Web 2.0 phenomenon'.[117] These viewpoints, arguments, and ideas from history, sociology, and politics, as well as from law, suggest strongly that now is the time to research the area, before the information revolution has come and gone,[118] leaving behind it the radically reconfigured landscape which Zuboff found so difficult to explore in the context of the transformation of work.[119]

The danger is that, unless one moves quickly to explore a change, the reconfiguration erases the memory of what was there before and the ability to understand and influence the nature of the changes that are occurring. Computers in public administration will become 'part of the furniture' and not deemed worthy of in-

[114] Zuboff, *In the Age of the Smart Machine* (n 3) xi.
[115] ibid, xiii.
[116] Kraemer and King, 'Computers and the Constitution' (n 39).
[117] John Morison, 'Gov 2.0: Towards a User Generated State?' (2010) 73(4) Modern Law Review 551, 551.
[118] Hood and Margetts (n 46) 13–4.
[119] Zuboff, *In the Age of the Smart Machine* (n 3) xi.

vestigation by scholars,[120] any more than pen and paper, the printing press or the abacus, although those were undoubtedly also significant advances in technology in their time, bringing with them changes in social and economic relationships of power.[121]

Explaining my research to other scholars, even those already engaged in sophisticated consideration of the interconnection between science, law, and environmental protection, often elicited puzzlement that a lawyer should care about such commonplace devices in mundane contexts.[122] However, as Maniatopoulos points out, 'ongoing socio-technical configurations shape the application of electronic government. ... [E]-government is more than the passive application of new technologies.'[123] Weizenbaum warns us that

> [t]he computer becomes an indispensable component of any structure once it is so thoroughly integrated with the structure, so enmeshed in various vital substructures, that it can no longer be factored out without fatally impairing the whole structure.[124]

ICT will, in time, be as invisible a technological tool in the bureaucratic and industrial workplace as the alphabet or electricity,[125] masking the extent to which it is the product of deliberate design choices and still contains hidden possibilities.[126] When the practices that grow around it become institutionalized, it will be taken for granted.[127] This process is well underway, and needs to be researched before it

[120] Åke Grönlund, 'Electronic Government' in Ari-Veikko Anttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007) 640; Jon Agar, *The Government Machine* (MIT Press 2003) 1.

[121] See, for example, Jane Barker and Hazel Downing, 'Word Processing and the Transformation of the Patriarchal Relations of Control in the Office' (1981) 2 Education and the State 229.

[122] cf Dutton and Kraemer (n 39) xii.

[123] Gregory Maniatopoulos, 'E-Government Movements of Organizational Change: A Social Shaping Approach' in *4th International Critical Management Studies Conference: Critique and Inclusivity: Opening the Agenda* (2005).

[124] Joseph Weizenbaum, *Computer Power and Human Reason: From Judgment to Calculation* (Penguin 1984) 28.

[125] Erik Davis, 'Information Everywhere' in Alison Scammell (ed), *I in the Sky: Visions of the Information Future* (Fitzroy Dearborn 2000) 39–40.

[126] Jannis Kallinikos, *Governing Through Technology: Information Artefacts and Social Practice* (Palgrave Macmillan 2011) 35.

[127] Barbara Czarniawksa, 'How Institutions Are Inscribed in Technical Objects and What it May

has left its mark too deeply to be visible.[128] Of course, a comprehensive survey and exploration of ICT in government administration generally would be an enormous undertaking; this project sets out only to explore this issue in the specific and more limited context of environmental regulation.

1.3.4 ICT and the Distribution of Power: A Hidden and Misunderstood Transformation

The implementation of ICT in public administration is anything but simple, and much can go wrong. Bellamy presents a case study of the 'Coordination of Computerization in the Criminal Justice System' (CCCJS) project, which she says remains 'fragmented and cumbrous' after 10 years of significant investment. She claims that this occurred because the project was seen as primarily technological and focused on automation and production, rather than 'informating' (generating new and useful information and perspectives, which could result in radical transformation), and a failure to obtain political support because of an uneven distribution of costs and benefits.[129]

In addition, there are constitutional reasons why the institutional structure of the criminal justice system is not optimised for efficiency: the UK police force is decentralised into separate forces, there is a distinction between the police and the Crown Prosecution Service, and again between the Lord Chancellor's Department and the Home Office. This compartmentalization is seen as providing safeguards against the concentration of power while protecting individual rights.[130]

Bellamy reminds us that 'IS are deeply implicated in struggles for organiza-

Mean in the Case of the Internet' in Francesco Contini and Giovan Francesco Lanzara (eds), *ICT and Innovation in the Public Sector: European Studies in the Making of E-Government* (Palgrave Macmillan 2009) 53.

[128] Howard Veregin, 'Computer Innovation and Adoption in Geography: A Critique of Conventional Technological Models' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 91.

[129] Bellamy (n 111) 88–9.

[130] Bellamy and Taylor (n 33) 61.

tional control',[131] and therefore

> ... viewing information simply as a commodity is to overlook important dimensions of the politics of information. Along with material control, semantic control is important in opening up restricting capabilities for exploiting information: control over its form, specification, and interpretation can be as important as physical ownership or rights of access. The legal profession, for example, restricts the full understanding of legal documents to those people who understand its conventions. As these conventions come to be laid down in the standard format of computerized IS, so they become more heavily protected from challenge and change.[132]

Morison, writing in 2010 on 'the Web 2.0 phenomenon', which he explains as an 'evolution of computing towards a second generation of web design and development allowing new levels of interconnectivity and interactivity',[133] claims that we also see the implementation of what he calls 'Gov 2.0', centered around the use of 'interactivity, user generated content and qualitatively new levels and forms of information'[134] by government. This, he says, is 'less eye-catching than Labour's constitutional reform package ... [but] more far-reaching and radical. ... This is a large-scale, new political project and it is producing a new technology for governing.'[135]

This transformation may challenge the ideals underpinning the rule of law in a number of ways. Bowker and Star claim that ICT hides 'the arguments, decisions and uncertainties and processual nature of decision-making ... Thus values, opinions, and rhetoric are frozen into codes, electronic thresholds and computer applications.'[136] Despite the characteristics of speed, flexibility, and responsiveness which

[131] Bellamy (n 111) 90.
[132] ibid, 91.
[133] Morison, 'Gov 2.0' (n 117) 551.
[134] ibid, 551.
[135] ibid, 551–2.
[136] Geoffrey Bowker and Susan Leigh Star, 'Knowledge and Infrastructure in International Information Management: Problems of Classification and Coding' in Lisa Bud-Frierman (ed), *Information Acumen: The Understanding and Use of Knowledge in Modern Business* (Routledge 1994) 187.

are often ascribed to modern ICT, the reality is often much more prosaic. Software development is notoriously difficult,[137] with many high-profile failed public sector projects,[138] and systems may, in fact, become 'encrusted ... with earlier ways of thinking',[139] too costly to modify, and a barrier to change.[140] This fossilization of policy in ICT goes beyond what would already take place in a non-technocratic bureaucracy because modifications to ICT are generally not possible in the short term; shortcomings in the system are too expensive to work around, even on a small-scale; and the costs, complexity, and difficulty of ICT have tended to grow over time. These difficulties make administrators reluctant to make minor changes to such systems; and many organizations outsource their ICT operations, which imposes additional barriers to change in the short term.[141]

This thesis therefore explores the constitutional issues and implications for the rule of law and governance frameworks of the increasing use of ICT by regulators both to manage their internal processes and to communicate with and regulate external stakeholders and policymakers for environmental protection purposes. While an understanding of the rule of law begins with legal theory, a full understanding of the impact of ICT on this foundational principle requires the exploration of issues outside the purview of traditional legal research and the use of methodologies other than straightforward legal analysis. This thesis begins by setting out some fundamental contexts, such as the interaction between the rule of law and ICT, the role of scientific models, and the power of information in environment regulation, together with background on the development of regulatory theory, environmental regulation, and the practical applications of ICT for that purpose.

It is important to stress that this research is not simply about the role of com-

[137] See, for example, Lauren Ruth Weiner, *Digital Woes* (Addison-Wesley 1993).

[138] See, for example, Michael Moran, *The British Regulatory State: High Modernism and Hyper-Innovation* (Oxford University Press 2003) 178–9; Agar, *The Government Machine* (n 120) 375–9.

[139] Bellamy and Taylor (n 33) 156.

[140] Dunleavy and others, *Digital Era Governance* (n 18) 25.

[141] ibid, 26–7.

puting devices, fixed or mobile, but provides a window through which larger questions about the role of information, the regulatory system, and society in general can be explored. Nor should it be seen as a simple exploration of the 'digital divide', which is itself a problematic concept because it implies a simple bipolar split between those who have and have not, a direct causation between lack of access to technology and favourable outcomes, and excludes other factors which may be quite significant in determining social outcomes, when the reality is more complex and not so binary.[142]

1.3.5 ICT and Individual Rights: An Indian Example

An example of the less obvious ways in which information technology can impact on individual rights is the digitization of land registries in Tamil Nadu. While the original project was initiated with admirable aims of efficiency, transparency, and modernization,[143] and some studies of this project have labelled it a success,[144] the outcomes for those whom the system was supposed to benefit were not all positive. After the introduction of the new digital system, only its records were valid evidence of title; other records no longer had any legal status.[145] This largely disenfranchised members of the Dalit caste, who relied on less formal titles to their land, and small local developers (who relied on their specialised knowledge) were supplanted by large firms who could rely on open government data and land registry databases in order to identify sites for development on a much wider scale.[146]

Therefore, without forethought and attention to detail, a move towards the in-

[142]Mark Warschauer, *Technology and Social Inclusion: Rethinking the Digital Divide* (MIT Press 2004) 6–8.

[143]Solomon Benjamin and others, 'Bhoomi: "E-Governance", or, an Anti-Politics Machine Necessary to Globalize Bangalore?' (2007) ⟨http://casumm.files.wordpress.com/2008/09/bhoomi-e-governance.pdf⟩ accessed 19 May 2014, 6–7.

[144]Subhash Bhatnagar, *E-Government: From Vision to Implementation—A Practical Guide with Case Studies* (Sage 2004) 97–109.

[145]Bhuvaneswari Raman, 'The Rhetoric of Transparency and Its Reality: Transparent Territories, Opaque Power and Empowerment' (2012) 8(2) *Journal of Community Informatics*.

[146]Tom Slee, 'Seeing Like a Geek' (2012) ⟨http://crookedtimber.org/2012/06/25/seeing-like-a-geek/⟩ accessed 19 May 2014.

creasing use of ICT (or the replacement of existing paper-based systems with ICT entirely) may bring about consequences that are not immediately obvious to an observer who perceives the technologies being a neutral or deterministic intervention. Instead, the outcomes may reinforce existing bias and further marginalize the powerless.[147]

Of course, these consequences may be intended or unintended by the designers and developers of the system, and in the particular Indian example outlined above, there are concerns regarding the corruption of the process.[148] It is this which is most significant: as one report on that system says

> ... [p]ower does not disappear, but is re-organized and reinforced in a complex dynamic. ... It is naïve to assume that computers and well-designed software, or the rigorous training of support staff driven by a well-meaning project champion can address such structural political issues.[149]

Similarly, in a case study of the rural land reform project in the Kiepersol area in post-apartheid South Africa, Harris and others highlight how Geographic Information Systems (GIS) underpin programmes of social control, the importance of the selective availability of such data, and how GIS is likely to 'reinforce traditional market-based and technicist approaches to policy formulation', which is inherently undemocratic.[150] Writing of e-governance initiatives in the UK, Schafer provides both a positive and cynical analysis of the changes underway there, highlighting connections between e-government policies and managerialism.[151]

---

[147] Kevin Donovan, 'Seeing Like a Slum: Towards Open, Deliberative Development' (2012) 13(1) Georgetown Journal of International Affairs 97, 98.

[148] Benjamin and others (n 143) 5.

[149] ibid, 25–6.

[150] Trevor M Harris and others, 'Pursuing Social Goals Through Participatory GIS: Redressing South Africa's Historical Political Ecology' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 217.

[151] Burkhard Schafer, 'E-Governance in the United Kingdom' in JEJ Prins (ed), *Designing e-Government* (2nd edn, Kluwer Law 2007) 182.

1.3.6 Contribution and Constraints

This thesis makes three contributions to existing knowledge: drawing a clear connection, beyond the existing scholarship around privacy, between the significant increase in the use of ICT by government agencies and concerns for the proper operation of the rule of law; the identification of a new field of study, which I label 'e-regulation' and which I define as the use of ICT by regulators and those who deal with them, such as regulated entities, NGOs, and ordinary citizens, as an integral part of the process of measurement, assessment, and feedback which is central to regulation; and the analysis of semi-structured interviews in order to build a conceptual model of how practitioners view the use of ICT for ER.

It is important to highlight that this is an exploratory study which seeks to illuminate topics, issues, and questions which have been barely explored in the legal literature to date. This absence of fundamental groundwork creates a need to spend significant time setting out a context for the empirical findings. As has been discussed,[152] many basic concepts and theoretical frameworks must be 'imported' from other disciplines, such as information systems (particularly e-government research), science and technology studies, and sociology. This is the focus of Part II.

In addition to this academic constraint, the empirical research was necessarily limited by the practical difficulties in obtaining consent from suitable interviewees. I needed to speak to individuals with very specific and specialised experience, roles, and skills. These generally do not work in positions that deal with the public to any great extent. They are busy people and not easy to contact from the outside. They were difficult to establish contact with and often initially very hesitant about saying very much 'on the record'. Some added additional caveats to consent forms to underline that they were speaking only in a personal capacity; others only signed

[152] See Section 1.2.2.

when I confirmed that their manager had also agreed to be interviewed.

In sum, then, these two constraints—a lack of an existing foundation and the difficulty of the fieldwork—impose certain idiosyncrasies of structure on the thesis. In order for legal scholars to properly appreciate the significance and value of the empirical findings, their exposition is deliberately delayed to Part III, following somewhat the model of the work of Richardson and others.[153] Part II instead presents a review of literature from information systems, environmental regulatory theory, and information technology in order to properly frame the sociological 'heart' of the fieldwork in a such way that lawyers can properly appreciate its value.

1.4 Developing a Research Question

1.4.1 Inital Approach

There is therefore a connection between ICT and power. It took time for this to become clear to me. This thesis had as its starting point a general inquiry: can the use of ICT for environmental regulation lead to better environmental outcomes? However, as with much qualitative research,[154] the detail of how this question was to be explored became clear through the research process rather than in advance of it. At the outset, as noted above, there seemed to be little work done on how to improve the effectiveness of the applications of ICT, and this seemed a logical area of focus—particularly the use of rapid feedback to change individual behaviour. It became clear that this was attracting significant attention as the potential of 'smart grids' and other large-scale ICT driven applications became more widely understood and displayed significant potential to either save or make money.[155]

When I began, there were already some studies on the use of direct feed-

[153] Richardson, Ogus, and Burrows (n 14).

[154] Joseph A Maxwell, *Qualitative Research Design: An Interactive Approach* (Sage 1996) 53.

[155] See, for example, the OECD Technology Foresight Forum 2010, on 'Smart ICTs and Green Growth' at http://www.oecd.org/site/stitff/.

back through in-room monitors to reduce energy consumption,[156] feedback through mobile devices to encourage fitness activities,[157] the use of pervasive and persuasive technology to encourage more sustainable behaviour,[158] and the role of the smart grid in energy demand.[159] During the duration of the project, I became aware of research on the use of real-time displays of energy, water, and gas usage to change consumer behaviour,[160] including the use of mobile devices,[161] comparative feedback,[162] and gamification,[163] together with research on 'smart trans-

[156]Sarah Darby, 'The effectiveness of feedback on energy consumption: A Review for Defra of the literature on metering, billing and direct displays' (2006) ⟨http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf⟩ accessed 19 May 2014.

[157]Sunny Consolvo, James A Landay, and David W McDonald, 'Designing for Behavior Change in Everyday Life' (2009) 405 Computer 100.

[158]Marcus Foth and others, 'Pervasive Computing and Environmental Sustainability: Two Conference Workshops' (2009) 8(1) IEEE Pervasive Computing 78; Allison Woodruff and Jennifer Mankoff, 'Environmental Sustainability' (2009) 8(1) IEEE Pervasive Computing 18.

[159]Clark W Gellings, *The Smart Grid: Enabling Energy Efficiency and Demand Response* (Fairmont Press 2009).

[160]Christoffer A Björkskog and others, 'Energylife: Pervasive Energy Awareness for Households' in *Proceedings of the 12th ACM International Conference Adjunct Papers on Ubiquitous Computing* (Association for Computing Machinery 2010); Stacey Kuznetsov and Eric Paulos, 'Upstream: Motivating Water Conservation With Low-Cost Water Flow Sensing and Persuasive Displays' in Elizabeth Mynatt and others (eds), *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2010); Gaetano Aurelio Lanzarone and Antonella Zanzi, 'Monitoring Gas and Water Consumption Through ICTs for Improved User Awareness' (2010) 13(1) Information, Communication and Society 121; Vasughi Sundramoorthy and others, 'DEHEMS: A User-Driven Domestic Energy Monitoring System' in *Internet of Things* (IEEE 2010); Yolande Strengers, 'Designing Eco-Feedback Systems for Everyday Life' in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2011); Yolande Strengers, 'Negotiating Everyday Life: The Role of Energy and Water Consumption Feedback' (2011) 11(3) Journal of Consumer Culture 319; James Colley and others, 'Exploring Energy Monitoring in the Wild' (2011) ⟨http://de2011.computing.dundee.ac.uk/wp-content/uploads/2011/10/Exploring-energy-monitoring-in-the-wild.pdf⟩ accessed 27 August 2014; Felix Reitberger, 'Energy Awareness Through Ubiquitous Computing in Modern Households' in Doris Hausen and others (eds), *Ubiquitous Computing* (University of Munich Department of Computer Science Media Informatics Group 2011); Thomas Rist and others, 'Creating Awareness for Efficient Energy Use in Smart Homes' in Gerhild Feuerstein and Walter Ritter (eds), *Intelligent Wohnen. Zusammenfassung der Beiträge zum Usability Day IX* (Pabst 2011); Yolande Strengers, 'Peak Electricity Demand and Social Practice Theories: Reframing the Role of Change Agents in the Energy Sector' (2012) 44 Energy Policy 226.

[161]Anna Spagnolli and others, 'Eco-Feedback on the Go: Motivating Energy Awareness' (2011) 44(5) Computer 38.

[162]Petromil Petkov and others, 'Motivating Domestic Energy Conservation Through Comparative, Community-Based Feedback in Mobile and Social Media' in Marcus Foth, Jesper Kjeldskov, and Jeni Paay (eds), *Proceedings of the 5th International Conference on Communities and Technologies* (Association for Computing Machinery 2011); Andrew Vande Moere and others, 'Comparative Feedback in the Street: Exposing Residential Energy Consumption on House Façades' in *Human-Computer Interaction–interact 2011* (Springer 2011).

[163]Luciano Gamberini and others, 'Tailoring Feedback to Users' Actions in a Persuasive Game for

port'[164] and calls for 'an information strategy for environmental sustainability' on ethical grounds.[165] Yolande Strengers' critical review of industry initiatives and research studies that attempt to reduce energy use concludes that the effectiveness of feedback is limited.[166] Perhaps the most amusing research was the development of 'erratic applicances', which behaved in unpredictable ways as energy demand peaked.[167] More recent examples in this general area include large-scale experiments involving environmental campaigning,[168] peer comparison,[169] work on smart meters,[170] the use of public displays to regulate energy consumption,[171] projects targeting schoolchildren,[172] the development of 'serious games'[173] and social games.[174] Much of this work is located within the disciplines of information systems and human-computer interaction and was significantly more advanced and sophisticated than what was feasible for me given my level of skill, the time avail-

Household Electricity Conservation' in Magnus Bang and Eva L Ragnemalm (eds), *Persuasive Technology. Design for Health and Safety* (Springer 2012); Alenka Poplin, 'Playful Public Participation in Urban Planning: A Case Study for Online Serious Games' (2012) 36(3) Computers, Environment and Urban Systems 195.

[164]Owen Waygood and others, 'Developing an Online Tool for Behavioural Change in Urban Transport' (2011) ⟨http://www.carbonaware.eu/fileadmin/user_upload/Publications/ECEEE_online.pdf⟩ accessed 19 May 2014.

[165]Richard T Watson and others, 'An Information Strategy for Environmental Sustainability' (2012) 55(7) Communications of the ACM 28.

[166]Yolande Strengers, *Smart Energy Technologies in Everyday Life: Smart Utopia?* (Palgrave Macmillan 2013) 74.

[167]Anders Ernevi, Samuel Palm, and Johan Redström, 'Erratic Appliances and Energy Awareness' (2007) 20(1) Knowledge Technology and Policy 71.

[168]Alan Chamberlain and others, 'Understanding Mass Participatory Pervasive Computing Systems for Environmental Campaigns' (2014) 18(7) Personal Ubiquituous Computing 1775.

[169]Ian Ayres, Sophie Raseman, and Alice Shih, 'Evidence From Two Large Field Experiments That Peer Comparison Feedback Can Reduce Residential Energy Usage' (2013) 29(5) Journal of Law, Economics, and Organization 992.

[170]Jacqueline Corbett, 'Using Information Systems to Improve Energy Efficiency: Do Smart Meters Make a Difference?' (2013) 15(5) Information Systems Frontiers 747.

[171]Nina Valkanova and others, 'Reveal-it!: The Impact of a Social Visualization Projection on Public Awareness and Discourse' in Wendy E Mackay, Stephen Brewster, and Susanne Bødker (eds), *SIGCHI Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2013).

[172]Wai-Ming To, Andy WL Chung, and Linda SL Lai, 'Creating Green Awareness Using IT: The Case of Hong Kong' [2013] IT Professional 44.

[173]Joshua G Tanenbaum, Alissa N Antle, and John Robinson, 'Three Perspectives on Behavior Change for Serious Games' in *Proceedings of the 2013 ACM Annual Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2013).

[174]Dave Owen, 'Mapping, Modeling, and the Fragmentation of Environmental Law' [2013] Utah Law Review 219.

able to me, and other resources.

1.4.2 A Change of Direction

It also became clear that the field was very broad, with a very wide range of topics which could be included within the broad rubric of 'ICT for ER'. For example, the relatively discreet topic of the use of satellite imagery for that purpose could generate a substantial study by itself.[175] There was therefore a need to focus my research and to avoid duplicating what had already been carried out in order to produce a feasible project. From semi-structured interviews with practitioners, I realized that the implementation of ICT for ER was already making and would continue to make a significant difference to the power relationships both within regulators and in the interaction with the regulatory community and society (such as NGOs). It was also very difficult to gain access to research sites or data for behavioural studies, with one large public body that was initially receptive later unwilling to grant access to a database of building energy use, claiming commercial sensitivity.

It therefore seemed more important, if not urgent, to move from a focus on the 'engineering' questions of how best to influence and manage human behaviour and to consider in detail the impact of ICT on the rule of law. This concept seemed the best guiding principle, as it was both most directly implicated by shifts to systems that would obscure the workings of the rules from general visibility and, as I will explain,[176] had the flexibility and loose boundaries to encompass important related questions such as due process and natural justice.

However, it rapidly became clear that this was new ground for those studying regulation. Striking out into unexplored territory means that there are no signposts or maps. The material that I began to read from information systems scholars is

[175] See, for example, Atsuyo Ito, *Legal Aspects of Satellite Remote Sensing* (Martinus Nijhoff Publishers 2011).

[176] See Section 2.2.3.

about the workplace, the marketplace, and social life. These seemed to me to be very different contexts to the operation of government and I was hesitant to re-use insights from other studies or the more theoretical work that has emerged around (for example) ICT in copyright law or innovation policy. Much of that does not transfer.

In addition, I sought a critical understanding of why ICT in ER matters, but I am reluctant to make broad statements about the consequences of technology as it is difficult to properly ground these without significant data and observation. The principal challenge is to balance the desire to make a real contribution by identifying a new field of study and giving it an initial shape which enables me and others to follow up on this thesis with further studies, with the need to be rigorous and not overstep what I can reliably conclude based on a necessarily limited empirical investigation and very little preceding scholarship.

1.4.3 Finding a Central Focus

The fundamental concern of this research became the need to unpack the 'mythology of information'[177] and bring 'a richer understanding of the social in relation to governance'[178] to the particular context of environmental regulation, focusing on questions of power, authority, and legitimacy, particularly as these relate to environmental regulation. The central research question therefore became:

> *Does the increased use of ICT in environmental regulation redistribute power (whether express or implicit) within that system, and does this raise rule of law issues?*

This question would be difficult, if not impossible, to answer using traditional doctrinal analysis of legislation and case law. For the most part, these new technologies

[177] Geoffrey Bowker, 'Information Mythology and Infrastructure' in Lisa Bud-Frierman (ed), *Information Acumen: The Understanding and Use of Knowledge in Modern Business* (Routledge 1994).

[178] John Clarke, 'Governance Puzzles' in Leslie Budd and Lisa Harris (eds), *E-Governance: Managing or Governing?* (2009) 48.

have left little traces on the statute book to date. Although policymakers and legislators are now beginning to deliberately embed an awareness of these new tools in legislation, much of the use made of them by regulators and the general public has happened without explicit legal authority to do so. There is nothing untoward about this in principle but nonetheless, it means that in order to fully trace these technologies, it was necessary to speak to individuals who are actually involved in the processes of regulation.[179]

Amongst the issues that surround this question are:

- How are the traditional mechanisms by which government exercises its dominion over its citizens and the commercial activity that they engage in altered by the adoption of these new technologies?
- How is the internal functioning of a regulator changed by the use of ICT?
- Do these new tools bring new affordances and also new challenges?
- If ICT alters the balance of transparency surrounding a regulator, does this affect the way in which it is perceived by the regulated community?
- Do these tools bring new opportunities for non-governmental organizations?
- How do these reconfigured relationships affect the power of the individual citizen, particularly as regards their ability and capacity to interact with the policy process?

The shift to polycentric conceptions of governance has meant that the centrality of government control has been obscured.[180] In this, I am following Mashaw's claim that

[179] Julie E Cohen, *Configuring the Networked Self: Law, Code, and the Play of Everyday Practice* (Yale University Press 2012) 185.

[180] See Section 4.4.3.

> [i]f a set of external controls called administrative law no longer comforts us as we seek to manage our love-hate relationship with bureaucracy, perhaps we can see more clearly what needs to be done by turning to look inside the bureau, while retaining a normative perspective.[181]

My focus is deliberately internal, on the bureaucratic process and on the mundane. There is already a significant literature on the role of media and ICT in the democratic process and encouraging public participation. Except where this impinges directly on regulatory endeavours, I do not consider these issues.

1.5 Summary of Findings

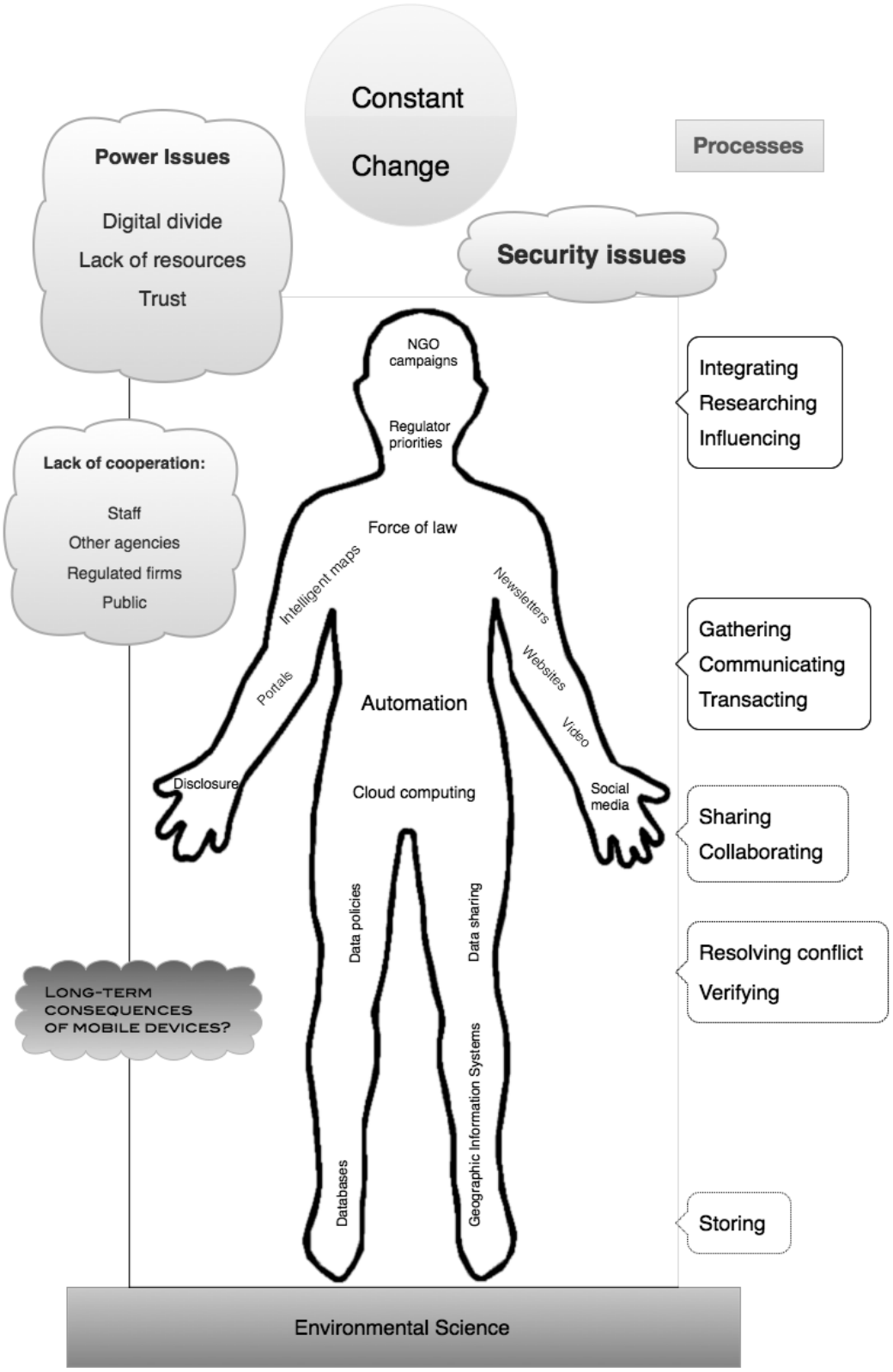
The most significant insight which this thesis has to offer is an understanding of the different aspects of the role of ICT in environmental regulation as perceived by those working in the process—how it acts as a basis for this activity, how it is in fact used and how regulators and others make decisions on how to prioritise their activities. It also outlines some of the issues and difficulties that arise in practice for regulators that seek to take advantage of new technologies. This is best explained in the form of a diagram, which is briefly explained here and considered in more detail, using the image of a 'body' of findings, in Chapter 8.[182]

The use of ICT in environmental regulation stands on environmental science, rooted in databases and Geographic Information Systems (GIS), and moves forward through the sharing of data and the development of policies to facilitate that sharing. It derives its strength from the force of law, the use of automation and the power of cloud computing. Its main means of taking action is the use of intelligent maps and portals, combined with social media and information dissemination (websites, newsletters, and other media, such as video). Decisions and choices are made through a process of prioritization within regulators, which is also influenced

[181] Jerry L Mashaw, *Bureaucratic Justice: Managing Social Security Disability Claims* (Yale University Press 1983) 15.

[182] See Section 8.6.

Figure 1.1: ICT in Environmental Regulation: A Network of Power



by NGO campaigns.

This takes place within an environment of constant change. A very significant issue in these power relationships is trust between management and staff, regulators, and regulated, agencies and the citizen, and between government agencies. Finally, the use of ICT does not always proceed without complications: cooperation from staff, regulated entities and other agencies cannot be taken for granted; there are security issues; and it is not clear what the long-term consequences of the proliferation of mobile computing devices will be.

1.6 Thesis Outline

The thesis proceeds as follows. Chapter 2, which concludes this part, outlines the issues which the widespread use of ICT in bureaucratic and regulatory processes raises for the operation of the rule of law. This includes a definition of the rule of law and a sketch of its essential elements, focusing on substantive or 'thick' conceptions. This chapter highlights the absence of any significant academic work on the connections between ICT and the rule of law and the advantages and difficulties which this new development raises.

Chapter 3 opens the contributions of the thesis by defining information systems, e-government, e-governance and e-regulation. I define the last of these in a way which is new in the literature, as 'the use of ICT by regulators and those who deal with them, such as regulated entities, NGOs and ordinary citizens, as an integral part of the process of measurement, assessment and feedback which is central to regulation.'

Chapter 4 defines 'regulation', outlines the significant theoretical perspectives on it and discusses the historical development of environmental regulation. Chapter 5 comprises brief histories of the development of both ICT and the application of ICT for environmental regulation, concluding with some speculation as to how

this technology might develop in the future. Chapter 6 builds on this by exploring the issues that surround the use of scientific models and schemes of regulation by disclosure.

Chapter 7 considers some significant theoretical frameworks for understanding the development and application of technology: the Technology Enactment Framework, 'Information Ecology' perspectives, the relationship between ICT and power (including Foucauldian governmentality theory), and sociological theories of technology development, particularly Actor-Network Theory. Finally, it outlines what is meant by 'critical realism' and how this informs the thesis.

Chapter 8 explains the approach that was taken to the analysis of the interviews, including the practical and theoretical challenges which they raised; the need to be inventive yet rigorous; and the use of Thematic Network Analysis as a method for disassembling and re-assembling the texts. It presents the conclusions from this analysis, represented first in a graphical form which is then further explained by extracts from the interviews. In addition, the ways in which controversies develop and are settled in the use of ICT for environmental regulation are explored. Finally, the 'network of power' diagram presented briefly above[183] is explored in more detail.

The thesis concludes with Chapter 9, which discusses the need to take the protection of the rule of law in the development of bureaucratic and regulatory ICT seriously. It provides a number of practical suggestions that can assist in achieving this, such as open source code, fostering 'digital literacy' amongst policymakers and regulators, and the adoption of reflective modes of governance that are based on design criteria which clearly include consideration of values in the process of developing technical solutions.

[183] See Section 1.5.

Chapter 2

ICT and the Rule of Law

2.1 The Importance of 'Information'

In this chapter, I will examine how regulation and ICT intersect at the most basic level: in the decision-making process. The aim of this chapter is to explain how the use of ICT by regulators may quietly erode aspects of the rule of law. As such, this chapter provides an important contextual backdrop to the empirical research and resulting analysis. I begin by setting out the theoretical and academic understandings of 'information'. I then explore the connections between ICT and the rule of law. These can be positive as well as negative: ICT can be a valuable support for access to the laws and for transparency in the court system. However, the often unnoticed and unexamined biases that can creep into the development of software and databases can damage this important principle, shifting the locus of decision-making away from those who are formally assigned this power by statute into the control of system designers and developers, whose work is unexaminable and unchallengeable by (and often entirely hidden from) the ordinary people whose lives it affects.

2.1.1 Defining 'Information'

An initial inquiry is necessary in order to clarify a core concept. Information is a word that is very often used, both in daily speech and in regulatory and legal

discourse, but without a simple definition.[1] The confusion is heightened by the way in which the word is used to mean both 'data' and 'knowledge'.[2] Despite this lack of clarity, information is fundamental to environmental regulation both explicitly and implicitly, as will be discussed,[3] and it is essential to define it clearly without 'forsak[ing] science for a land of mysticism'.[4] I first explore the definitions given by researchers before looking more closely at the sources and types of information with which the thesis is most concerned.

From a technological perspective, the classic work on information theory is by Shannon. Writing in the 1940s as an electronic engineer and leaving aside the social aspects of transmitting data, he framed the 'fundamental problem of communication [as] reproducing at one point either exactly or approximately a message selected at another point.' He ignored the issue of 'meaning', saying that '[t]hese semantic aspects of communication are irrelevant to the engineering problem'.[5] Shannon thus approached the problem from a mathematical perspective: for him, an exact transmission of nonsense is as successful as an exact transmission of recognisable words.

Approaching the topic from a perspective closer to regulation, that of cybernetics (the study of feedback mechanisms in technical and social systems), Weiner continues to use mathematical language:

> One of the simplest, most unitary forms of information is the recording of choice between two equally probable simple alternatives, one or the other is bound to happen—a choice, for example, between heads and tails in the tossing of a coin. We shall call a single choice of this sort a decision.[6]

---

[1] GG Scarrott, 'The Nature of Information' (1989) 32(3) The Computer Journal 262.

[2] Thomas H Davenport, *Information Ecology: Mastering the Information and Knowledge Environment* (Oxford University Press 1997) 8.

[3] See Section 2.1.2.

[4] RK Stamper, 'Information: Mystical Fluid or a Subject for Scientific Inquiry' (1985) 28(3) The Computer Journal 195.

[5] Claude Shannon, 'A Mathematical Theory of Communication' (1948) 27(3) Bell System Technical Journal 379, 379.

[6] Norbert Weiner, *Cybernetics or Control and Communication in the Animal and the Machine* (MIT Press 1948) 61.

This definition highlights another important issue, which is that the measurement and recording of information itself embodies choices, sometimes from a wide range of possibilities. This exercise of discretion by scientists and engineers is not always made explicit.

Another influential definition, and perhaps more useful for this chapter, is that offered by the cyberneticist Bateson: 'The technical term "information" may be succinctly defined as *any difference which makes a difference in some later event*. This definition is fundamental for all analysis of cybernetic systems and organization.'[7] Scarrott similarly points out the importance of context and consequences in understanding the term:

> 'Information' in its most fundamental sense can be defined only in the context of an 'Organised System' (OS). An organised system is an assembly of interdependent components whose physical activities are controlled so that they complement one another and thereby create a coherent whole. Information is that which is exchanged between the components to effect control within an organised system.[8]

Therefore, the definition of 'information' that I will adopt in this thesis is that of Losee:

> Information is always informative about something, being a component of the output or result of the process. This 'aboutness' or representation is the result of a process or function producing the representation of the input, which might, in turn, be the output of another function and represent its input, and so forth.[9]

This definition best suits our purposes because it highlights the way in which information is used in ongoing, interconnected activities, such as regulation.

---

[7] Gregory Bateson, *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (University of Chicago Press 1972) 381 (emphasis in original).

[8] Scarrott (n 1) 265 (emphasis omitted).

[9] Robert M Losee, 'A Discipline Independent Definition of Information' (1997) 48(3) Journal of the American Society for Information Science and Technology 254, 258.

2.1.2 Information in the Regulatory Process

Regulation is fundamentally about feedback processes: the regulator is concerned with changing behaviour (whether by individuals or by firms), over time, and therefore '[i]nformation is the lifeblood of regulatory policy.'[10] Regulatory activity is focused on gathering, working with and acting on information in order to quantify and control risk; as Sparrow says, '[t]he whole operational structure is intensely analytical.'[11] In order to calibrate and adjust its work effectively, the regulator must have information about the current state of affairs, the policy goals that are to be achieved, and how individual behaviour is changing in response to policy initiatives. In addition, regulated entities and the general public require information in order to engage with the process.[12] This does not mean that all participants in the regulatory process have equal access to knowledge. Their capacity to process information and convert it into something which is genuinely useful to them will vary widely.[13]

Much of this information is, of course, represented in numerical form. According to Rose, numbers serve four roles in government: allocating power, acting as diagnostic tools, enabling and assessing modern forms of government, and allowing the exercise of power.[14] Quantification in statistical form also enables standardization,[15] and through extensive and detailed measurement, the modern state can observe and govern across large distances.[16] This allows it to create and re-create abstractions of reality which can easily be manipulated and are then translated back

[10]Cary Coglianese, Richard J Zeckhauser, and Edward Parson, 'Seeking Truth for Power: Informational Strategy and Regulatory Policy Making' (2004) 89 Minnesota Law Review 277.

[11]Malcolm K Sparrow, *The Regulatory Craft: Controlling Risks, Solving Problems, and Managing Compliance* (Brookings Institute Press 2000) 261.

[12]Douglas A Kysar and James Salzman, 'Foreword: Making Sense of Information for Environmental Protection' (2008) 86 Texas Law Review 1347, 1347–8.

[13]Anthony Ogus, 'Regulation Revisited' [2009] Public Law 332, 346.

[14]Nikolas Rose, *Powers of Freedom: Reframing Political Thought* (Cambridge University Press 1999) 197–8.

[15]ibid, 207.

[16]ibid, 211.

into reality as plans for action and means of control.[17]

Without proper safeguards, the regulatory system is susceptible to 'information capture': 'excessive use of information and related information costs as a means of gaining control over regulatory decisionmaking in informal rulemakings.'[18] Indeed, mathematics and modelling seem to have slowly captured the regulatory system. When numbers are used to drive decision-making, 'they transform the thing being measured—segregation, hunger, poverty—into its statistical indicator and displace political disputes into technical disputes about methods.'[19] For example, debates about the social problems of unemployment and poverty move to discussing how the unemployment rate and poverty line are calculated,[20] losing sight of the underlying human issues.

2.1.3 Information in Environmental Regulation

Information may be a key aspect of the environmental regulation (ER) process, but despite being an essential input, it is often flawed or incomplete.[21] Although regulators rely on a wide and changing range of information in order to quantify and reduce pollution, information-gathering requirements are usually an afterthought in regulatory schemes and lead to large volumes of *data* but little *information*.[22] In addition, technological constraints often limit the capacity, scope, and effectiveness of environmental regulation.[23] However, information-forcing regulation can provide

[17] Peter Miller and Nikolas Rose, *Governing the Present* (Polity Press 2008) 32.

[18] Wendy Wagner, Elizabeth Fisher, and Pasky Pascual, 'Misunderstanding Models in Environmental and Public Health Regulation' (2010) 18 New York University Environmental Law Journal 293, 1325.

[19] Rose, *Powers of Freedom* (n 14) 205.

[20] Alain Desrosières, *The Politics of Large Numbers: A History of Statistical Reasoning* (Harvard University Press 1998) 332.

[21] Holly Doremus, 'Scientific and Political Integrity in Environmental Policy' (2008) 86 Texas Law Review 1600.

[22] Bradley C Karkkainen, 'Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?' (2001) 89 Georgetown Law Journal 257, 283–85.

[23] Daniel H Cole, *Pollution and Property: Comparing Ownership Institutions for Environmental Protection* (Cambridge University Press 2002) 67–84.

more flexible regulatory systems that preserve accountability.[24]

The environment is often understood through information; indeed, it can be conceptualised as a web of information.[25] The availability of a wide range and depth of 'information', particularly numerical data, regarding the environment, together with ready access to digital computer technology to process this, opens up the appealing vista identified by Professor Esty,[26] of computers extending the span of human decision-making and control beyond what was already achieved during the Industrial Revolution.[27]

However, although measurement is fundamental to many environmental regimes, it is often imprecise.[28] The process of standardising measurement on a national or global basis is anything but straightforward.[29] It is very difficult to estimate the resulting costs with a great degree of precision, and difficulties of method make it difficult to produce useful numerical figures.[30]

Environmental regulatory regimes must therefore be designed around limitations in information. This can take three different forms: uncertain information ('scientific and technical questions that are unlikely to have immediate or even short-term answers'[31]), imperfect information ('available, or nearly so, only it lies with certain parties who are disinclined to share it'[32]) and emergent information

[24]Bradley C Karkkainen, 'Information-Forcing Environmental Regulation' (2005) 33 Florida State University Law Review 861.

[25]Jim Chen, 'Webs of Life: Biodiversity Conservation as a Species of Information Policy' (2004) 89 Iowa Law Review 495.

[26]Daniel C Esty, 'Environmental Protection in the Information Age' (2004) 79 New York University Law Review 115.

[27]See Section 1.3.2.

[28]Judith Jones, 'Regulatory Design for Scientific Uncertainty: Acknowledging the Diversity of Approaches in Environmental Regulation and Public Administration' (2007) 19(3) Journal of Environmental Law 347, 348–9.

[29]Theodore M Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton University Press 1995) 21–32.

[30]Richard Macrory, 'Regulating in a Risky Environment' in Richard Macrory (ed), *Regulation, Enforcement and Governance in Environmental Law* (Hart Publishing 2010) 158.

[31]Wendy E Wagner, 'Stormy Regulation: The Problems That Result When Stormwater (and Other) Regulatory Programs Neglect to Account for Limitations in Scientific and Technical Information' (2006) 9 Chapman Law Review 191, 194–5.

[32]ibid, 195.

(where 'scientific research or information ... has not been fully vetted or accepted by the scientific community'[33]). Failing to take these information gaps into account can lead to regulatory failure.[34]

Regulators can attempt to strengthen their response to inadequate information in a number of different ways: acknowledging the uncertainty (through, for example, the precautionary principle); shifting the burden of proving that an activity is unsafe to a particular party (usually the applicant for permission); establishing legal standards that require 'sound science' (such as the Data Quality Act); a focus on the consequences of a worst-case scenario; working towards a consensus between regulators and the regulated; developing simple standards-based approaches to estimate and avoid harm; and adaptive eco-system management.[35]

However, one significant response is to gather, store, and combine more and more information through ICT. This thesis takes as its primary focus the relationship between this common strategy, the rule of law, and the use of ICT in ER. As this connection may seem initially obscure, it merits some explanation: first, how I see links between these two; second, my understanding and preferred perspective on the rule of law; and finally, what issues I propose to explore from a theoretical perspective before moving on to analyse the results of the qualitative interviews.

The focus of this thesis has developed from a recognition that although '[i]nformation is the foundation of all governing'[36] and numbers are a fundamental technology of government,[37] there is very little academic discussion of the interactions between ICT and the fundamentals of legal theory.[38] This is despite claims

[33] ibid, 196.
[34] ibid, 197.
[35] Jones (n 28) 352–63.
[36] Viktor Mayer-Schönberger and David Lazer, 'From Electronic Government to Information Government' in Viktor Mayer-Schönberger and David Lazer (eds), *Governance and Information Technology: From Electronic Government to Information Government* (MIT Press 2007).
[37] Nikolas Rose, 'Governing By Numbers: Figuring Out Democracy' (1991) 16(7) Accounting, Organizations and Society 673.
[38] Keith Culver, 'How the New ICTs Matter to the Theory of Law' (2004) 17 Canadian Journal of Law and Jurisprudence 255, 255.

that the informatization of society may be a significant transformation with important consequences for basic notions.[39] So-called 'cyberlawyers' rely more on the social sciences than the law in their research and rarely venture into the significant questions of jurisprudence.[40] Those who do focus on the regulation of commercial transactions[41] rather than how ICT is used in government and the constitutional issues which this raises. In this thesis, I explore one such issue, that the rule of technology could replace the rule of law,[42] raising fundamental questions for 'our concept of law'[43] and the associated meanings of legality and the rule of law.

2.2 The Rule of Law in the Context of 'Ambient Law'

It is therefore necessary to consider what is meant by the rule of law, attempt to identify its essential elements, and explore what connections exist between this high principle and the seemingly mundane tools of the bureaucrat. What follows is not an attempt to provide a comprehensive literature review on the rule of law. That would be a significant project in itself. Instead, I will briefly consider the fundamental requirements of the rule of law, outline the various different perspectives on how that core is elaborated, and attempt to enumerate some of the essential elements of the rule of law, arriving at a conception that best fits with the concerns that animate my research.

[39] Mark Bovens and Eugène Loos, 'The Digital Constitutional State: Democracy and Law in the Information Society' (2002) 7(4) Information Polity 185.

[40] Andrew Murray, 'Looking Back At the Law of the Horse: Why Cyberlaw and the Rule of Law Are Important' (2013) 10(3) SCRIPTed, 314–5.

[41] Chris Reed, 'How to Make Bad Law: Lessons From Cyberspace' (2010) 73(6) Modern Law Review 903.

[42] Roger Brownsword and Karen Yeung, 'Regulating Technologies: Tools, Targets and Thematics' in Roger Brownsword and Karen Yeung (eds), *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing 2008) 6.

[43] Roger Brownsword, 'Lost in Translation: Legality, Regulatory Margins, and Technological Management' (2011) 26 Berkeley Technology Law Journal 1321, 1323.

2.2.1 The Core Idea of the Rule Of Law

The rule of law is difficult to define clearly.[44] As Rose notes, the 'meaning of the Rule of Law is not self-evident and ... the phrase has been used both in different ways and without indicating its content.'[45] Craig also points out that 'there is considerable diversity of opinion as to the meaning of the rule of law and the consequences that do and should follow from breach of the concept.'[46] According to Lord Bingham, '[t]he core of the existing principle is ... that all persons and authorities within the state, whether public or private, should be bound by and entitled to the benefit of laws publicly and prospectively promulgated and publicly administered in the courts.'[47] Craig states the same idea in shorter but perhaps more open terms: '[a] core idea of the rule of law to which all would subscribe is that the government must be able to point to some basis for its action that is regarded as valid by the relevant legal system.'[48]

2.2.2 Principal Conceptions of the Rule of Law

Beyond the fundamental notion that there are rules, and the rules are followed, there are different ways of conceptualising the rule of law, perhaps best understood as being on a continuum from formal to substantive. To further complicate matters, the categorizations adopted by various theorists differ.[49] Fletcher puts forward a simple framework of two versions of the rule of law: a narrow one of governance by and adherence to rules; and the second a wider, principles-based approach to the admin-

[44] Laurent Pech, 'The Rule of Law as a Guiding Principle of the European Union's External Action' (2011) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1944865⟩ accessed 19 May 2014, 7.

[45] Jonathan Rose, 'The Rule of Law in the Western World: An Overview' (2004) 35(4) Journal of Social Philosophy 457, 458.

[46] Select Committee on the Constitution, *Relations Between the Executive, the Judiciary and Parliament: Report With Evidence, 6th Report of Session 2006-07* (HL 2006, 151-I) 97.

[47] Lord Bingham, 'The Rule of Law' (2007) 66(1) Cambridge Law Journal 67, 69.

[48] Select Committee on the Constitution (n 46) 98.

[49] Brian Z Tamanaha, *On the Rule of Law: History, Politics, Theory* (Cambridge University Press 2004) 91.

istration of justice.[50] Fuller calls these 'procedural' and 'substantive' versions,[51] which may also be known as 'thin' or 'thick'.[52] Thin or procedural perspectives require proper legal authority, expect clear boundaries between acceptable and unacceptable behaviour, and frown on retrospective rule-making. Substantive or thick perspectives build on these to also demand that the law support particular human rights.[53]

Fallon describes four different models of the rule of law, which he says are 'ideal types' to which various scholars adhere to to a greater or lesser extent:[54] historicist,[55] formalist,[56] legal process,[57] and substantive.[58] He states that there are three purposes or values which the rule of law should serve: protecting people from the rule of the strong; providing a mechanism by which individuals can determine in advance the legality of their choices of action; and guaranteeing against arbitrary decisions by officials.[59] Tamahana identifies six significant variations on the concept, with each successive iteration incorporating the previous conception: rule-by-law,[60] formal legality,[61] democracy and legality,[62] individual rights,[63] and the right of dignity and social welfare.[64]

The narrow perspective is, according to Rose, 'procedural in nature, focusing

[50]George P Fletcher, *Basic Concepts of Legal Thought* (Oxford University Press 1996) 11.
[51]Lon L Fuller, *The Morality of Law* (2nd edn, Yale University Press 1969) 96.
[52]Pech, 'The Rule of Law as a Guiding Principle' (n 44) 8.
[53]Paul Craig, 'Formal and Substantive Conceptions of the Rule of Law: An Analytical Framework' [1997] Public Law 467, 467.
[54]Richard H Fallon Jr, '"The Rule of Law" as a Concept in Constitutional Discourse' (1997) 97 Columbia Law Review 1, 5.
[55]'... rule by norms laid down by legitimate lawmaking authorities prior to their application to particular cases' ibid, 11.
[56]'... a clear prescription that exists prior to its application and that determines appropriate conduct or legal outcomes.' ibid, 14.
[57]ibid, 18.
[58]'... the intelligibility of law as a morally authoritative guide to human conduct.' ibid, 21.
[59]ibid, 7–8.
[60]Tamanaha (n 49) 92.
[61]ibid, 93.
[62]ibid, 99–101.
[63]ibid, 102.
[64]ibid, 112.

on the prevention of arbitrary governmental action and the protection of individual rights.'[65] Perhaps the most formalist theorist of the rule of law is Raz.[66] For him, 'this means [both] that people should obey the law and be ruled by it ... [and] that the government shall be ruled by the law and subject to it.'[67] His conception of the rule of law includes notions of openness, stability, and availability of the law; and that it can act as a guide for the behaviour of the subjects of the law.[68]

Another formalist theorist is Dicey. He saw the rule of law as having three elements:

> ... the absolute supremacy or predominance of regular law as opposed to the influence of arbitrary power, ... [excluding] the existence of arbitrariness, of prerogative, or even of wide discretionary authority on the part of the government. ...
>
> ... Equality before the law, or the equal subjection of all classes to the ordinary law of the land administered by the ordinary Law Courts ...
>
> ... the law of the constitution, the rules which in foreign countries naturally form part of a constitutional code, are not the source but the consequence of the rights of individuals, as defined and enforced by the Courts...[69]

However, '[t]he rule of law in the sense articulated here could be met by regimes whose laws were morally objectionable, provided that they complied with the formal precepts of the rule of law.'[70] It has been noted that ' [i]t is quite possible that the political and legal systems of Nazi Germany could be consistent with the Rule of Law.'[71] Although there are examples of formalist approaches that have not slipped into authoritarianism, such as the United Kingdom, the existence or application of the rule of law is not by itself sufficient in order to ensure good ad-

[65] Rose, 'The Rule of Law in the Western World' (n 45) 459.

[66] Craig (n 53) 68.

[67] Joseph Raz, 'The Rule of Law and Its Virtue' in *The Authority of Law: Essays on Law and Morality* (Clarendon 1979) 212.

[68] ibid, 213–4.

[69] Albert Venn Dicey, *The Law of the Constitution* (MAssociation for Computing Machineryillan 1924) 198–9.

[70] Select Committee on the Constitution (n 46) 99.

[71] Rose, 'The Rule of Law in the Western World' (n 45) 460.

ministration or the protection of the rights of the citizen—Aristotle saw no conflict between the rule of law and the institution of slavery.[72] Unger highlighted that the creation of neutral rules is impossible, as the process which creates them cannot itself be free from bias. It is impossible for a society which is not initially equal to create a power structure which is neutral.[73] (The problems of creating neutral rules become particularly salient when encoded in software.)

Therefore, other advocates of the rule of law see it as not simply providing a set of procedures to be followed, but also as embodying certain fundamental and inviolable values, and laying down important limits for the freedom of action of the state as a whole and the individuals working within that machinery. This requires compliance with notions of 'good administration', is partly procedural and partly substantive in focus, and may incorporate some or all of the following principles: 'legality, procedural propriety, participation, fundamental rights, openness, rationality, relevancy, propriety of purpose, reasonableness, equality, legitimate expectations, legal certainty and proportionality.'[74] According to Craig, there are three dominant modern meanings, each of which builds on the previous:[75] lawful authority,[76] a guide for conduct,[77] and accountable government.[78] The third, and broadest, understanding of the rule seems to find favour with the European Court of Justice.[79]

2.2.3 Responding to 'Ambient Law' with a Substantive Rule of Law

In order to identify and assess the impacts which the widespread adoption of ICT by public administration in the field of environmental regulation is having on the rule

[72]Judith N Shklar, 'Political Theory and the Rule of Law' in Allan Hutchinson and Patrick Monahan (eds), *The Rule of Law: Ideal or Ideology* (Carswell 1987) 2.

[73]Roberto Mangabeira Unger, *Law in Modern Society* (The Free Press 1977) 178–181.

[74]Select Committee on the Constitution (n 46) 101.

[75]ibid, 98.

[76]ibid, 98.

[77]ibid, 99.

[78]ibid, 101.

[79]Laurent Pech, '"A Union Founded on the Rule Of Law": Meaning and Reality of the Rule Of Law as a Constitutional Principle of EU Law' (2010) 6 European Constitutional Law Review 359, 373.

of law, it would be useful to have a detailed list of the most significant components of the rule of law in practice. However, despite the Venice Commission's optimistic claim that 'it seems that a consensus can now be found for the necessary elements of the rule of law',[80] the reality is that different scholars put forward quite different lists of the essentials.[81] In addition, as Fallon warns:

> The Rule of Law is best conceived as comprising multiple strands, including values and considerations to which each of the four competing ideal types calls attention. It is a mistake to think of particular criteria as necessary in all contexts for the Rule of Law. Rather, we should recognize that the strands of the Rule of Law are complexly interwoven, and we should begin to consider which values or criteria are presumptively primary under which conditions.[82]

However, there is agreement around core issues.[83] Notions of clarity, stability, and impartiality are essential to formalist readings of the rule of law. Those who take a substantive perspective would also support these underpinnings, but would augment them with progressive ideas that seek to support and implement rights-based notions of protection for individuals. In the particular context of ICT and environmental regulation, the choice between these two broad approaches is significant for the remainder of the thesis. It is arguable that adopting a formalist understanding of the rule of law would truncate my work sharply, as the use of technology either does not need any legislative approval or obtains it where necessary.

I argue that even those who take a narrow view of the rule of law should be concerned about the implications of ICT for impartiality for reasons that I will explain shortly. However, a focus only on compliance with formal and positive law is grounded in a misunderstanding of decision-making and discretion in practice, where 'legal rules [are] ... just one set of norms competing with others that derive

[80] European Commission for Democracy through the Law, *Report on the Rule of Law* (2011) 9.

[81] Fuller, *The Morality of Law* (n 51) 46–91; Raz (n 67) 214–219; Fallon (n 54) 7–8; Bingham (n 47) 69–81; European Commission for Democracy through the Law (n 80) 9.

[82] Fallon (n 54) 6 (emphasis removed).

[83] Leighton McDonald, 'The Rule of Law in the "New Regulatory State"' (2004) 33 Common Law World Review 197, 203.

from other systems'.[84] This research has roots in the challenges for law and legal theory of the development of 'ambient law', or legal norms embodied in technology with Ambient Intelligence.[85]

As will be discussed in detail in chapter 5, ICT is being used in public administration, and particularly environmental regulation, to an ever-increasing extent. This is a process that is likely to accentuate and accelerate with time. Some consideration of an extreme example will help to highlight how this might prevent the attainment of these ideals now and in the future. Bullinga predicts, perhaps with some hyperbole (and certainly with an overoptimistic faith in the capacity of software developers to produce error-free code), a future of omnipresent and ambient technology with a significant regulatory dimension:

> Permits and licenses will be embedded in smart cars, trains, buildings, doors, and devices. Laws will automatically download and distribute themselves into objects in our physical environment, and everything will regularly be updated, just as software is now automatically updated in your desktop computer.
>
> ...
>
> In the future, all rules and laws will be incorporated into expert systems and chips embedded in cars, appliances, doors, and buildings—that is, our physical environment. No longer will police officers and other government personnel be the only law enforcement. Our physical environment will enforce the law as well.
>
> ...
>
> Automatic law enforcement will be used for environmental regulations, traffic and safety laws, bookkeeping rules, and all social security issues involving proof of identity.[86]

In a similar (although less far-fetched) fashion, Gil-Garcia paints an appealing picture of a 'smart State', in which

[84] Julia Black, 'New Institutionalism and Naturalism in Socio-Legal Analysis: Institutionalist Approaches to Regulatory Decision Making' (1997) 19(1) Law and Policy 51, 52.

[85] Mireille Hildebrandt and Bert-Jaap Koops, 'A Vision of Ambient Law' (*Future of Identity in Information Society*, 2007) ⟨http://www.fidis.net/resources/fidis-deliverables/profiling/d79-a-vision-of-ambient-law/⟩ accessed 27 August 2014.

[86] Marcel Bullinga, 'Intelligent Government: Invisible, Automatic, Everywhere' [2004] The Futurist 32, 32–4.

> [g]overnments would ... use sensors and HD cameras to obtain information about air quality, electric power consumption, public safety, road conditions, and emergency preparedness, among many other policy domains. Citizens would be helping government to identify problems and to develop solutions in a crowd-sourced fashion.[87]

The scenarios above are no doubt pleasing for those charged with the implementation of regulation but are as unrealistic as the over-enthusiastic claims that electricity would remove 'disease and strife'.[88] Very few of these ideas are yet embodied in real devices.[89] They are probably never fully attainable[90] because of technical, financial, and privacy constraints.[91] Gil-Garcia acknowledges that

> ... reaching the situation described above will not be easy and will require important changes in the silo structure of government, well-established institutional arrangements, and the pervasive organizational culture that together limit the incentives for collaboration and information sharing.[92]

Hildebrandt and Koops, two leading theorists in this area, are clear in their preference for a substantive perspective on the rule of law, claiming that '[t]he procedural legitimacy of Ambient Law requires more than the mere promulgation of techno-norms by a legitimate public law-making body.'[93] Following this, and taking cognisance of the disconnect between formalist notions and the reality of modern

---

[87] J Ramon Gil-Garcia, 'Towards a Smart State? Inter-Agency Collaboration, Information Integration, and Beyond' (2012) 17(3) Information Polity 269, 275.

[88] Nicholas G Carr, *The Big Switch: Rewiring the World, From Edison to Google* (WW Norton and Company 2008) 88–9.

[89] Antoinette Rouvroy, 'Technology, Virtuality and Utopia: Governmentality in an Age of Autonomnic Computing' in Mireille Hildebrandt and Antoinette Rouvroy (eds), *The Philosophy of Law Meets the Philosophy of Technology* (Routledge 2011) 120.

[90] Jim Dator, 'Communication Technologies and the Future of Courts and Law' in Sam Muller and others (eds), *The Law of the Future and the Future of Law: Volume II* (Torkel Opsahl Academic EPublisher 2012).

[91] Mari-Klara Oja, 'Electronic Government in the Age of Ubiquitous Computing' (Master of Science in Digital Media thesis, University of Lübeck 2008).

[92] Gil-Garcia (n 87) 276.

[93] Mireille Hildebrandt and Bert-Jaap Koops, 'The Challenges of Ambient Law and Legal Protection in the Profiling Era' (2010) 73(3) Modern Law Review 428, 456.

governing,[94] and the need to examine closely the exercise of discretion,[95] I adopt the 'thick' conception put forward by Allan, who rejects

> ... any rigid distinction between procedure in substance, as artificial and unworkable, [and explains the rule of law as] ... a set of closely interrelated principles that together make up the core of the doctrine or theory of constitutionalism ... [including] the procedural ideal of 'natural justice' or due process, if it is to provide real protection against arbitrary power, [which] must be accompanied by the equally fundamental ideal of equality... The latter ideal imposes substantive constraints on governmental power, ensuring that all citizens are treated alike in certain crucial respects.[96]

According to Allan, the legitimacy of the rule of law rests on the consent of the citizen.[97] For consent to be real, there must be transparency as to rules, particularly those embedded in software and databases.

2.3 The Rule of Law and ICT

Embodying those ideals of natural justice and equality in e-regulation requires considerable effort. Hildebrandt and Koops argue that 'the way in which a legal rule is translated and inscribed in a technology is a separate activity that should be assessed in its own right.'[98] Constructing a theory of the rule of law that can usefully be applied for this purpose is not an easy task.

It is clear that the rule of law must underly the regulatory system and that its application to the regulatory process has significant implications for institutional design and operational procedures.[99] According to Salambier, effective regulation requires the advance promulgation and publication of rules to all who might be

[94] Kenneth Culp Davis, *Discretionary Justice: A Preliminary Inquiry* (University of Illinois Press 1971) 33.

[95] ibid, 215.

[96] Trevor RS Allan, *Constitutional Justice: A Liberal Theory of the Rule of Law* (Oxford University Press 2001) 1–2.

[97] ibid, 6.

[98] Hildebrandt and Koops, 'The Challenges of Ambient Law' (n 93) 456.

[99] Julia Black, 'Talking About Regulation' [1998] Public Law 77, 95.

concerned with them, limiting the discretion of bureaucrats, ensuring that the rules are practical, understandable, and consistent, and guaranteeing uniform enforcement.[100] It is questionable whether this is possible, given the (perhaps irreversible) shift from primary legislation that states clear rules to the delegation of significant discretion to regulatory agencies.[101] Predictability sometimes has to be sacrificed in order to achieve necessary flexibility.[102]

However, a regulatory system that operates in an untransparent, inconsistent way does not comply with the rule of law, and 'there are numerous subtle and quiet ways to scuttle regulatory protections even while the laws embodying those protections remain in force.'[103] The importance of this issue is highlighted by the explicit protection of a right to 'administrative justice' in the recent Constitution of South Africa.[104] Nonetheless, there is a dearth of literature addressing this issue,[105] and while there are some writings that explore the connections between rights and regulation,[106] these do not address questions of discretion, due process, or natural justice.[107]

The focus of scholarly writing on the rule of law is firmly on the courtroom, on the formal hearing, and on the functioning of the police power of the state. However, as Bell points out, 'discretion is the centrepiece of the institutional edifice to which

[100] J Paul Salembier, 'Designing Regulatory Systems: A Template for Regulatory Rule-making—Part I' (2002) 23(3) Statute Law Review 165, 172–3.

[101] Peter L Strauss, 'Legislative Theory and the Rule of Law: Some Comments on Rubin' (1989) 89 Columbia Law Review 427.

[102] DJ Galligan, *Discretionary Powers: A Legal Study of Official Discretion* (Oxford University Press 1990) 152–61.

[103] William Buzbee and others, *Regulatory Underkill: The Bush Administration's Insidious Dismantling of Public Health and Environmental Protections* (Center for Progressive Regulation 2005) 1.

[104] See generally Rosemary Lyster, 'The Effect of a Constitutionally Protected Right to Just Administrative Action' in Michael Harris and Martin Partington (eds), *Administrative Justice in the 21st Century* (Hart Publishing 1999).

[105] McDonald (n 83) 197.

[106] Bronwen Morgan, *The Intersection of Rights and Regulation: New Directions in Sociolegal Scholarship* (Ashgate Publishing 2007); Karen Yeung, 'Better Regulation, Administrative Sanctions and Constitutional Values' (2013) 33(2) Legal Studies 312.

[107] Black, 'New Institutionalism and Naturalism' (n 84) 53.

the legal rules play a subservient role of setting the boundaries'.[108] The majority of the dealings that ordinary citizens will have with the law and the various arms and agencies of government will take place in the context of routine administrative procedures.[109] Transgressions of the rules are often regulatory offences rather than 'true crimes'. A focus on the very small proportion of litigation that gives rise to written judgments is itself missing a great deal of the reality of the legal system, as many prosecutions will be withdrawn and many civil suits settled before they ever come to a full trial. The number of instances of litigation is surely only a small fraction of the number of legal disputes that arise daily between individuals, businesses, and the state. The number of minor instances where the government acts in a way that infringes on the rights of individuals, does not properly follow procedures or otherwise acts in contravention of the law, but the impact is so small that the citizen either does not notice or is deems it unworthy of challenge, must be even larger, perhaps many multiples.[110] These issues are generally invisible to lawyers.[111]

2.3.1 The Rule of Law and the Mundane Work of Regulators

This somewhat misplaced focus on obvious and easily traceable interactions probably arises for the same reason as the lack of attention placed on the development of ICT in the bureaucratic process: the mundane nature of the administrative process seems boring, trivial, and confusing to the legal scholar. Indeed, it often is, but this should make it a focus of close attention.[112] As Agar points out in his discussion of the use of decryption techniques and technologies in Britain during the Second

[108]John Bell, 'Discretionary Decision-Making: A Jurisprudential View' in Keith Hawkins (ed), *The Uses of Discretion* (Clarendon Press 1992) 102.

[109]Denis James Galligan, *Due Process and Fair Procedures: A Study of Administrative Procedures* (Clarendon Press 1996) 291.

[110]Terence G Ison, '"Administrative Justice", Is It Such a Good Idea?' in Michael Harris and Martin Partington (eds), *Administrative Justice in the 21st Century* (Hart Publishing 1999) 23.

[111]Jon Bing, 'Code, Access and Control' in Mathias Klang and Andrew Murray (eds), *Human Rights in the Digital Age* (Glasshouse Press 2005) 205.

[112]Miller and Rose, *Governing the Present* (n 17) 63.

World War, the focus of attention is often on the unique and the unusual, not on the routine, the detail, or the repetitive;[113] this misses much of what is important about the work of government. One of the aims of this thesis is to properly contextualise the use of ICT in the regulatory process from the perspective of a rule of law analysis. The theories of the rule of law, whether thick or thin, already alluded to are of some assistance here. As a minimum, from a formalist perspective, the laws which are implemented by regulators must be clearly signalled in advance, the rules must be relatively stable and individuals are not punished in a retrospective fashion.

However, a more refined theory is needed in order to investigate more carefully the routine operations of the state,[114] what Davis calls 'discretionary justice'.[115] In the same way as sociologists have begun to examine 'mundane governance',[116] lawyers need to examine what Miller and Rose call the 'apparently humble and mundane mechanisms which appear to make it possible to govern'.[117]

The citizen interacts with the processes of environmental regulation in a wide variety of ways: ensuring that waste is properly sorted and disposed of; applying for planning permission, submitting comments in a planning process, participating in an oral hearing; complying with licensing requirements in their capacity as an employee; complaining about pollution as a member of a community group or environmental NGO; and perhaps even being prosecuted for some breach of the myriad of statutes that seek to protect the world around us. It is here that the rule of law is put into operation in both a mundane and highly significant way: '[t]he real test of procedures and of notions of fairness is how people are treated in these contexts,

[113] Jon Agar, *The Government Machine* (MIT Press 2003) 207.

[114] Eoin Carolan, *The New Separation of Powers: A Theory for the Modern State* (Oxford University Press 2009) 255.

[115] '... initiating, investigating, prosecuting, negotiating, settling, contracting, planning, recommending, supervising' Davis, *Discretionary Justice* (n 94) 22.

[116] Steve Woolgar and Daniel Neyland, *Mundane Governance: Ontology and Accountability* (Oxford University Press 2013).

[117] Peter Miller and Nikolas Rose, 'Governing Economic Life' (1990) 19(1) Economy and Society 1, 8.

which are often complex, disorganized, and hidden from the outside eye.'[118]

2.3.2 Protecting Fairness in the Routine Work of Government

Regulators often have broad discretion, which makes it difficult to ascertain whether or not they are acting within the boundaries of their legal powers. This discretion is inevitable but need not threaten the need for certainty and stability in the law.[119] Such discretion may be legitimate and desirable as it is not possible for the legislature to anticipate all the issues that may arise in the work of a particular regulator.[120] A certain amount of 'fuzziness' may, in fact, be beneficial, as it allows the regulators and the regulated to deal with each other informally.[121] Accountability may also be difficult: regulators are often independent, so as to protect them from political influence, but this can also mean that they are not easily amenable to democratic scrutiny. There is need for careful attention to transparency in regulatory decisions and procedural fairness. It may not be possible to uphold all of these values to the same extent simultaneously, and we should not expect regulators to do so, but should instead require that they adhere to general principles rather than to strict rules. However, the requirement that there is legal authority for the decisions is paramount and must always be respected.[122] Above all, they must offer due process to those affected by their decisions,[123] to avoid 'regulatory arbitrariness'.[124]

Courts in a variety of common law jurisdictions, including those without written constitutions, have required adherence to fair procedures in administrative agencies and processes.[125] Galligan draws a contrast between 'the administrator me-

[118]Galligan, *Due Process and Fair Procedures* (n 109) 291.
[119]Peter M Shane, 'The Rule of Law and the Inevitability of Discretion' (2013) 36 Harvard Journal of Law and Public Policy 21.
[120]Davis, *Discretionary Justice* (n 94) 25; McDonald (n 83) 214.
[121]Margit Cohn, 'Fuzzy Legality in Regulation: The Legislative Mandate Revisited' (2001) 23(4) Law and Policy 469, 482.
[122]Karen Yeung, *Securing Compliance: A Principled Approach* (Hart Publishing 2004) 37–45.
[123]Allan (n 96) 126.
[124]McDonald (n 83) 219.
[125]Carolan (n 114) 71–2.

chanically and bloodlessly applying clear and certain rules to certain facts'[126] and 'decision-making as an unruly social process by which human agents try to decide on a course of action on the basis of evidence and facts, norms and standards, values and beliefs.'[127] The challenge is to develop a theory of the 'mundane rule of law' that will both encapsulate and maximize the benefits from the first ideal,[128] which the computer can support very well, while taking proper account of the second reality, which is an inescapable consequence of the complexity of the modern world and the messy nature of human interaction.[129] The aim is 'the ideal of formal justice, ie unbiased, universalistic, prompt, and predictable decision making',[130] but with a 'sensible goal ... [of] development of a proper balance between rule and discretion.'[131] According to Sainsbury, decision processes should be 'accurate ... fair, ... impartial,' open, and accountable.[132]

Basic elements of the rule of law can come under pressure in the regulatory process, particularly as the scope and scale of the endeavour grows. The ideal of legality can suffer as decision-making is delegated and dispersed.[133] As Galligan underlines, protecting the ideals encapsulated in the rule of law is essential here:

> The primary value, from the point of view of the person subject to the decision, is that the case will be dealt with on the basis of standards laid down in advance. ... [T]he principle of treating people in accordance with their normative expectations is at the very foundation of fair treatment and procedural fairness[134]

While this must be defended, it is important to avoid this degenerating into '*legalism*, the mechanical application of rules without regard to their purpose, without

[126]Galligan, *Due Process and Fair Procedures* (n 109) 65.
[127]ibid, 65–6.
[128]Davis, *Discretionary Justice* (n 94) 3–4.
[129]Robert A Kagan, *Regulatory Justice: Implementing a Wage-Price Freeze* (Russell Sage Foundation 1978) 87.
[130]ibid, 86.
[131]Davis, *Discretionary Justice* (n 94) 42.
[132]Roy Sainsbury, 'Administrative Justice: Discretion and Procedure in Social Security Decision-Making' in Keith Hawkins (ed), *The Uses of Discretion* (Clarendon Press 1992) 305–6.
[133]Kagan (n 129) 85.
[134]Galligan, *Due Process and Fair Procedures* (n 109) 42.

regard for the fairness or substantive desirability of the results produced by applying the rules.'[135] Therefore, as regulatory powers increase, so should the protections of basic rights.[136] However, Lipsky highlights how difficult it can be to ensure that individuals working at the coalface of the public service do not make decisions in irrational, unfounded, or biased ways, as their existing prejudices are reinforced by subjective perceptions and self-fulfilling prophecies.[137] While his remarks relate to what he calls 'street-level bureaucrats', they undoubtedly also apply to those to those in backrooms and higher echelons of government.

The use of bureaucracy as a technique for wielding the increasing powers in an accurate and cost-effective manner will depend on a 'general decisional technique ... [of] information retrieval and processing'.[138] There are elements of this process that are key, and easily lost when decision-making is automated or significantly driven by software, such as respect,[139] independence,[140] or fairness and non-arbitrariness.[141]

2.3.3 Digital Decision-Making

It is certainly not the case that regulators, including environmental regulators, are allowing computers to make decisions for them. It is questionable whether any complex legal decision-making can be automated to this extent.[142] The issue I am

[135]Kagan (n 129) 92 (emphasis in original).

[136]Colin Scott, 'Regulatory Governance and the Challenge of Constitutionalism' in Dawn Oliver, Tony Prosser, and Richard Rawlings (eds), *The Regulatory State: Constiutional Implications* (EUI RSCAS 2010) 25.

[137]Michael Lipsky, *Street-Level Bureaucracy: Dilemmas of the Individual in Public Services* (Russell Sage Foundation 2010) 105–16.

[138]Jerry L Mashaw, *Bureaucratic Justice: Managing Social Security Disability Claims* (Yale University Press 1983) 26.

[139]Dawn Oliver, *Common Values and the Public-Private Divide* (Cambridge University Press 1999) 268.

[140]Galligan, *Due Process and Fair Procedures* (n 109) 440.

[141]ibid, 44.

[142]HMG Concannon, 'Using Information Technology to Assist Tribunal Decision-Making' (1996) 3(2) Journal of Social Security Law 59, 62; Neil Hutton, 'Sentencing, Rationality, and Computer Technology' [1995] Journal of Law and Society 549, 565; Jeanne Lee, 'The Era of the Computer Judge' (1995) 2 UCL Jurisprudence Review 249.

raising is not a distant dystopia of unquestioning control by machines, but the extent to which reliance on software may subtly and invisibly alter the regulatory process in ways that invisibly erode the protections encapsulated in the rule of law. There is significantly more ICT to be found in the offices and vehicles of regulators now than there was a decade ago, or a decade before that. If Zouridis is correct, and 'the major challenge the rule of law will face in the next decades is the movement from the rule of law as an abstract doctrine to the rule of law as real governmental practice',[143] there is a clear need to consider in detail how the tools which are used by modern bureaucrats affect the bringing to reality of the values which underpin this fundamental notion.

The widespread use of ICT as an element in a regulatory system raises important issues with regard to individual privacy and autonomy, as our every move may be tracked and automated systems may invisibly intervene in order to manipulate the information on which we base decisions or to mistakenly conclude that we have transgressed a rule that we have, in fact, observed.[144] Lanzara highlights that the final outcome may not be a utopia of complete cybernetic control, but one in which 'many government functions and mechanisms are inscribed in and delegated to the technology, which then "acts" as a regulatory regime with enforcement capabilities.'[145] Gil-Garcia acknowledges that this could lead to 'a new vision of a dangerously powerful government'.[146] Lawyers must therefore take this phenomenon seriously, but need assistance from other disciplines in order to surmount the challenges which it creates for this basic principle. In thinking through the implications of ICT in the operation of government, we must bear in mind that '[i]nformation

[143] Stavros Zouridis, 'The Rule of Law in the 21st Century: Bridging the Compliance Deficit' in Sam Muller and others (eds), *The Law of the Future and the Future of Law* (Torkel Opsahl Academic EPublisher 2011) 90.

[144] Hildebrandt and Koops, 'The Challenges of Ambient Law' (n 93).

[145] Giovan Francesco Lanzara, 'Building Digital Institutions: ICT and the Rise of Assemblages in Government' in Francesco Contini and Giovan Francesco Lanzara (eds), *ICT and Innovation in the Public Sector: European Studies in the Making of E-Government* (Palgrave Macmillan 2009) 37.

[146] Gil-Garcia (n 87) 276.

and communications capabilities have been fundamental to the state ... they have been indispensable prerequisites for administering and co-ordinating—maintaining the cohesion and integrity—of complex social structures.'[147] To return to Zouridis:

> A legal perspective on the rule of law ... will not guarantee a rule of law in the real practices within public authorities. First, it does not include the public authorities' state of compliance with law. Second, it does not include the use of law by public authorities. Public authorities usually possess substantial discretionary powers, and the use of these powers usually remains under the radar of legal scholars. Third, the legal perspective does not shed any light on the mechanisms that empirically guarantee the enforcement of the rule of law. ... In order to detect these regulatory, organizational, political, and administrative design issues, we need a broader public administration perspective on the rule of law.
>
> ... We urgently need a multidisciplinary perspective on the rule of law built with a combined body of knowledge of constitutional and administrative law and public administration theory.[148]

I would add information systems to the disciplines suggested by Zouridis, and draw heavily on that literature in this thesis. The outcomes of technological change are never deterministic. We must therefore pay close attention to the agendas of those who support and implement such processes.[149]

2.3.4 ICT as a Support for the Rule of Law

ICT may be both a support and an impediment to the rule of law. According to Richardson,

> ... today's advances in technology and communication have enormous potential to advance the rule of law.
>
> ...
>
> ICT offers considerable potential to improve the way courts operate in areas such as case filing and management, case allocation,

[147] Kevin Robins and Frank Webster, *Times of the Technoculture: From the Information Society to the Virtual Life* (Routledge 2004) 103.

[148] Zouridis (n 143) 96–104.

[149] Kenneth L Kraemer and William H Dutton, 'The Interests Served By Technological Reform: The Case of Computing' (1979) 69(4) Boston University Law Review 80, 81.

> record keeping, archiving, court management, statistical and fee systems, video links for witnesses and the recording of their testimony, the presentation of evidence and court reporting. ... It is, though, in the area of access to justice in which ICT has a particularly vital role to play. Incourt kiosks and websites that improve access to court information, legislation, court decisions and research, do much to enhance the transparency of the system and instil user confidence.[150]

Online capabilities also open possibilities for 'reputation-based governance', providing citizens with easy access to the information that they need to assess different proposals in a standardised fashion and thus making the State 'legible' to its citizens.[151] Nonetheless, despite the possible positive outcomes from the widespread use of ICT in legal and regulatory systems, details matter. What little initial research has been done indicates that the results can be 'very uneven and mixed',[152] and the Internet has proven to be both 'an instrument of bureaucratic control and of personal liberation, a conduit of communal ideals and of corporate profits.'[153] It is therefore necessary to spend some time considering how ICT can be a barrier to the effective implementation of the rule of law.

2.3.5 ICT Impeding the Rule of Law

A technocratic administration may in fact present serious challenges to the ideal of the rule of law. A common complaint regarding modern lawmaking is that it is labyrinthine, opaque, and not easily accessible to the public—what the legal futurist Susskind has referred to as 'hyper-regulation'.[154] This problem is likely to be accentuated, rather than ameliorated, by the use of ICT. ' "[T]ranslating" open legal

[150] Frank Richardson, 'The E-Justice Revolution' (2010) 64(5) International Bar News 37, 38–9.

[151] Lucio Picci, 'Reputation-Based Governance and Making States "Legible" to Their Citizens' in Hassan Masum and Mark Tovey (eds), *The Reputation Society: How Online Opinions Are Reshaping the Offline World* (MIT Press 2011).

[152] Dieter Zinnbauer, 'False Dawn, Window Dressing or Taking Integrity to the Next Level? Governments Using ICTs for Integrity and Accountability: Some Thoughts on an Emerging Research and Advocacy Agenda' (2012) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2166277⟩ accessed 19 May 2014, 11.

[153] Carr (n 88) 110.

[154] Richard Susskind, *The Future of Law: Facing the Challenges of Information Technology* (Clarendon Press 1998) 12–8.

norms into rigid technical code' is by no means straightforward and requires careful and detailed consideration.[155] In addition, elaborating the rule of law in practice is problematic because

> [a]ny normative theory of this kind has three basic components: conceptual, institutional, and axiological. Such a theory must be conceptualized and then institutionalized in rule making processes, in rules, in interpretive and applicational methodologies, and in processes of judicial and other enforcement.[156]

The third component of this requirement is challenging and yet receives little focused attention,[157] particularly in the context of modern 'machine bureaucracy', especially when those bureaucracies make many of their decisions through procedures strongly constrained by machines. As Davis highlights, discretion extends not only to 'substantive choices' but also to questions of procedure, method, forms, and so on.[158] A shift from paper-based methods of bureaucracy to computerized systems will change the way in which internal processes operate in a way that makes them significantly more opaque, less equitable, and less open to legal challenge. As Zouridis and Thaens explain,

> ... e-government transforms legal processes into administrative-technical processes. ... If individual situations are brought under the rule of law, legal reasoning is never completely unilinear (from general rule to individual situation). Legal decision-making proceeds from the general rule to the individual situation and back again, with each individual case testing the tenability of the rule as such and the justification for its application. Computers do not and cannot do this. Therefore, public administration practice does not try to automate legal reasoning. Instead, it transforms legal processes into administrative-technical processes. ... [This change] affects the openness of law quite fundamentally and raises some new issues with regard to democratic guarantees ...[159]

[155] Hildebrandt and Koops, 'The Challenges of Ambient Law' (n 93) 452–3.

[156] Robert S Summers, 'A Formal Theory of the Rule of Law' (1993) 6(2) Ratio Juris 127, 129.

[157] Summers devotes less than a page to this element of his framework: ibid, 129.

[158] Davis, *Discretionary Justice* (n 94) 4.

[159] Stavros Zouridis and Marcel Thaens, 'E-Government: Towards a Public Administration Approach' (2003) 25(2) Asian Journal of Public Administration 159, 175 (citations omitted).

For example, expert systems are already used as a support for decision-making by some government agencies, despite their occasional errors.[160] These decision-making (and ultimately, enforcement) systems will not be amenable to straightforward examination or easy challenge by those affected.[161] An example that I will return to later in the thesis is the ways in which an unthinking over-reliance on models can lead to significant issues for environmental regulation.[162] This problem is worsened by the widespread adoption of ICT and the computerization of these scientific models in ways that are not easily amenable to public scrutiny, thus creating significant challenges for the operation of the rule of law. The use of complex computerized models in, for example, a risk-oriented approach to regulation may create the perception or reality of arbitrary decisions. The increased sophistication of the technological and scientific models that are deployed in environmental decision-making may disempower those suffering from economic and educational disadvantage, further exacerbating problems of inequality. This problem becomes all the more significant when considering, for example, the plight of an under-resourced local community group which is seeking to oppose pollution in its locality. Gaining access to information in the first instance may be a significant challenge; if that information is only usable with the aid of sophisticated computer hardware and software, an already disadvantaged group is further marginalised.[163] Another example which I will return to is schemes of regulation by disclosure[164] that do not make clear what behaviour is prohibited or disapproved of.

[160] Marga Groothuis, 'Applying ICTs in Juridical Decision Making By Government Agencies' in Ari-Veikko Annttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

[161] Adam Greenfield, *Everyware: The Dawning Age of Ubiquitous Computing* (New Riders Publishing 2006) 144–7.

[162] See further discussion in Section 6.2.

[163] Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976) 201.

[164] See further discussion in Section 6.3.

However, the scope of this thesis goes beyond these issues and considers more broadly the relationship between ICT on the regulatory process as a whole.[165] This stretches beyond the actual gathering, storing, and processing of information and into how the regulator interfaces with the regulated community and with the public. Decision-making processes are being supported or even implemented through software which is not available to the public, amenable to unskilled scrutiny, or accessible to the putative decision-makers themselves.[166] As Margetts says,

> [m]ost of us do not pretend to understand the computer on our desk—there is an element of magic and unpredictability about it. So digital government, relying on a myriad of computers and networks is uncertainty writ large. For those who do not use computers or the Internet, digital government is even more mysterious.[167]

It is difficult to hold software developers accountable for their work—there are 'many hands' involved in constructing computer-based systems,[168] bugs are seen as inevitable rather than preventable,[169] it is easy to shift blame from humans onto 'the computer',[170] and end-user licence agreements disclaim liability on the part of the manufacturer.[171]

Bingham states that it is important for the rule of law that '[t]here can, first of all, be no discretion as to the facts on which a decision-maker, official or judicial, proceeds.'[172] Computer systems may seem on the surface to be an ideal means of providing such independent, objective, and tightly-controlled fact-driven decision-makers, but processes of quantification and standardization inevitably involve the

[165] See Section 3.2.4.
[166] Danielle Keats Citron, 'Technological Due Process' (2008) 85 Washington University Law Review 1249, 1254–5.
[167] Helen Margetts, 'Transparency and Digital Government' in Christopher Hood and David Heald (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006) 200.
[168] Helen Nissenbaum, 'Accountability in a Computerized Society' (1996) 2 Science and Engineering Ethics 25, 28–32.
[169] ibid, 32–4.
[170] ibid, 34–5.
[171] ibid, 35–6.
[172] Bingham (n 47) 72.

loss of nuances of meaning.[173] As Bankowski says, when a computer makes decisions about legal issues, 'the actual person gets lost.'[174] In addition, computer systems are not valueless[175] or free from bias,[176] and may in fact embody the prejudgements of their creators in subtle and unchallengeable ways, and thus prove difficult to challenge to judicial review proceedings.[177] Bear in mind the system designer quoted by Zuboff, reflecting on the hard choices involved in agreeing on an algorithm to select the workload of a craftsperson:

> ... this process was completely undocumented. We have no record of what these issues were or why we made these decisions. When the people who made them leave, no one will know why we designed it this way.[178]

This experience is probably quite a common one. The use of computer technology necessarily involves sorting and classifying, and care must be taken to ensure that classifications are legally proper,[179] to be awake to

> ... the moral questions [that] arise when the categories of the powerful become the taken for granted; when policy decisions are layered into inaccessible technological structures; when one group's visibility comes at the expense of another's suffering.[180]

It is often very difficult to challenge an adjudication made by computer.[181] Computerized consistent implementation of rules removes the possibility of indi-

[173] Porter (n 29) 85.

[174] Zenon Bankowski, 'Law, Love and Computers' (1996) 1(1) Edinburgh Law Review 25, 40.

[175] Helen Nissenbaum, 'How Computer Systems Embody Values' (2001) 34(3) Computer 120.

[176] Batya Friedman and Helen Nissenbaum, 'Bias in Computer Systems' (1996) 14(3) ACM Transactions on Information Systems 330; Jay Kesan and Rajiv Shah, 'Deconstructing Code' (2004) 6 Yale Journal of Law and Technology 277.

[177] Citron, 'Technological Due Process' (n 166) 1261–3.

[178] Shoshana Zuboff, *In the Age of the Smart Machine: The Future of Work and Power* (Basic Books 1988) 330.

[179] Kent Greenawalt, *Law and Objectivity* (Oxford University Press 1992) 121.

[180] Geoffrey C Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (MIT Press 1999) 320.

[181] Bernd Carsten Stahl, 'When Does a Computer Speak The Truth? The Problem of IT and Validity Claims' in EH Wynn and others (eds), *Global and Organizational Discourse About Information Technology* (Springer 2003) 102.

vidual discretion.[182] 'Closed' systems, with source code not available to the public, render opaque the fact-gathering and decision-making processes for which they are used, thus reducing the accountability of public officials and reducing the possibility of effective input from civil society and skilled professionals.[183]

The rule of law demands not only accurate application of rules but justifications of distinctions between individuals.[184] Development errors make regulatory schemes implemented through software deeply problematic from the perspective of legal theory because all such systems have four characteristics that make them potentially subversive of the rule of law:

> First, along the traditional continuum between rules and standards, software lies at the extreme rule-bound end. ...
>
> Second, software can regulate without transparency. ...
>
> Third, software rules cannot be ignored. Parties facing a decision made by software can, at best, take steps to undo what software has wrought. ...
>
> Fourth, software is more fragile than other systems of regulation. Hackers can turn its plasticity against it, and its automated operation means that unintended consequences are shielded from human review. Its immediacy also speeds up failures.[185]

For example, Parkin highlights how a seemingly simple requirement that the attendance of a recipient of welfare in New York City be positively recorded on a computer system by a caseworker tilts the system against individuals. Any 'non-attendance' results in a loss of benefits, and therefore if a caseworker forgets to record a meeting or a legitimate excuse, there are financial consequences for the recipient.[186] These minor shifts in the rules may have legitimate roots in clearly articulated and promulgated laws, in which case they are unobjectionable from a

[182] Citron, 'Technological Due Process' (n 166) 1253.

[183] Danielle Keats Citron, 'Open Code Governance' [2008] University of Chicago Legal Forum 355, 357.

[184] Allan (n 96) 2.

[185] James Grimmelmann, 'Regulation By Software' (2005) 114(7) Yale Law Journal 1721, 1723–4.

[186] Jason Parkin, 'Adaptable Due Process' (2012) 160 University of Pennsylvania Law Review 1309, 1357–8.

formal perspective, but they may also be due to misunderstandings or mistakes on the part of systems developers. Unthinking implementation of computer-based systems can have effects which fundamentally undermine the rule of law, natural justice and due process. Allan highlights how 'the wooden application of rules to inappropriate cases is often *unfair*';[187] the problem is multiplied when the application is algorithmic:

> Seemingly, algorithms could be a boon to due process because they formalize decisionmaking procedures. ... At the same time, algorithms may involve rules of such complexity that they defy attempts to trace their reasoning. Is this the perfect perversion of due process: the uniform application of an inarticulable rule?[188]

These problems with software design and development have no easy solutions:

> ... biases in computer systems can be difficult to identify let alone remedy because of the way the technology engages and extenuates them. Computer systems, for instance, are comparatively inexpensive to disseminate, and thus, once developed, a biased system has the potential for widespread impact. If the system becomes a standard in the field, the bias becomes pervasive. If the system is complex, and most are, biases can remain hidden in the code, difficult to pinpoint or explicate, and not necessarily disclosed to users or their clients. Furthermore, unlike in our dealings with biased individuals with whom a potential victim can negotiate, biased systems offer no equivalent means for appeal.[189]

The design of computer systems that reduce the possibility of human error requires effort.[190] While systems generally work well, results are not guaranteed.[191]

---

[187] Allan (n 96) 128 (emphasis in original).

[188] Solon Barocas, Sophie Hood, and Malte Ziewitz, 'Governing Algorithms: A Provocation Piece' (2013) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2245322⟩ accessed 27 August 2014, 8–9.

[189] Friedman and Nissenbaum (n 176) 331.

[190] Karl W Sandberg and Pan Yan, 'Human Factors in Public Information Systems' in Ari-Veikko Anttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

[191] Marga M Groothuis and Jörgen S Svensson, 'Expert System Support and Juridical Quality' in Joost Breuker, Ronald Leenes, and Radboud Winkels (eds), *Proceedings of Jurix* (Foundation for Legal Knowledge Based Systems 2000).

The legal basis of the systems may be incompletely documented, obscure or mistaken.[192] It is difficult to 'translate' from the natural language of statute to the formal and limited language of computer programming,[193] particularly when legislation has a deliberately open texture.[194] In the worst cases, programmers may make mistakes when developing systems that implement statutory or regulatory rules,[195] or policy-makers may avoid more effective schemes because they will be difficult to automate.[196] Identifying systemic or cognitive bias in decision-making is already difficult[197] without adding the impenetrability of computers. Databases may contain systematic errors because of biases in the ways in which they are constructed, such as the undercounting of particular racial or ethnic groups in a census, or the unequal willingness of different socio-economic groups to report problems to their local authority.[198] These biases will tend to be towards the 'knowable and measurable … as well as towards existing types of metrics.'[199] Helen Nissenbaum argues that the

> … conditions under which computer systems are commonly developed and deployed, coupled with popular conceptions about the nature, capacities, and limitations of computing, contribute in significant measure to an *obscuring* of lines of accountability.[200]

This problem is compounded by the fact that a legal review of such decisions would need to compare the source code to the law, something which will be outside the

[192]Dag Wiese Schartum, 'Dirt in the Machinery of Government—Legal Challenges Connected to Computerized Case Processing in Public Administration' (1994) 2 International Journal of Law and Information Technology 327, 336–41.

[193]Dag Wiese Schartum, 'Developing eGovernment Systems—Legal, Technological and Organizational Aspects' (2010) 56 Scandinavian Studies in Law 125, 132.

[194]ibid, 134.

[195]Citron, 'Technological Due Process' (n 166) 1268–71.

[196]ibid, 1255.

[197]Galligan, *Due Process and Fair Procedures* (n 109) 438.

[198]Jeffrey Alan Johnson, 'From Open Data to Information Justice' in *Midwest Political Science Association Annual Conference* (2013) 2–4.

[199]Kenneth A Bamberger, 'Technologies of Compliance: Risk and Regulation in a Digital Age' (2010) 88 Texas Law Review 669, 705.

[200]Nissenbaum, 'Accountability' (n 168) 26 (emphasis in original).

competence of most lawyers.[201] A prominent example of where this issue has come to the attention of the courts is in access to source code for breathalyzer devices.[202] However, it is important not to let the extravagant predictions of futurists carry us too far along with their enthusiasm. Paper and text will remain a significant element of the law for quite some time to come.[203] In addition, there may be nothing wrong with a less than rigid adherence to the rule of law.[204]

2.3.6 Digitizing the Rule of Law

ICT can seriously hamper the ability of administrators and regulators to gather and process the information that is necessary for their decision making. This claim may initially seem counter-intuitive—ICT seems to make it much easier to assemble and assimilate information—but once a dedicated information system is put in place, this will constrain what can and cannot be brought to the attention of the regulator. Of course, regulatory processes have long depended on the collection of structured data through forms, but a computer-based form is even less flexible as it is often impossible to ignore 'required fields' (even if they do not apply) or to add additional information in the margins.

ICT can also constrain the hearing of an individual's case. The computer system will often follow a fixed 'script', which enrols and constructs both administrator and citizen into a particular pattern of interaction. It can be difficult (although not impossible) to deviate from this. In practice, what is likely to happen is that, through force of habit, regulatory staff will simply follow familiar procedures without tak-

[201] Bing (n 111) 205.

[202] Charles Short, 'Guilt By Machine: The Problem of Source Code Discovery in Florida DUI Prosecutions' (2009) 61 Florida Law Review 177; Cheyenne L Palmer, 'DUIs and Apple Pie: A Survey of American Jurisprudence in DUI Prosecutions' (2010) 13 University of the District of Columbia David A. Clarke School of Law Law Review 407; David Liebow, 'DWI Source Code Motions After Underdahl' (2010) 11 Minnesota Journal of Law, Science and Technology 853; Aurora J Wilson, 'Discovery of Breathalyzer Source Code of DUI Prosecutions' (2011) 7 Washington Journal of Law Technology and the Arts 121.

[203] Peter M Tiersma, *Parchment, Paper, Pixels: Law and the Technologies of Communication* (University of Chicago Press 2010).

[204] Shane (n 119).

ing the time to consider if they are appropriate for the particular individual that they are dealing with.

ICT can significantly channel internal processes. This is not always inappropriate—indeed, properly applied business process re-engineering can go a long way towards improving the efficiency of a regulator—but can lead to inflexibility over time. ICT can also lead to bias within the system. This can sometimes be obvious but may also be quite insidious, difficult to identify and even more difficult to root out.

A conception of the rule of law in the context of e-regulation therefore must ensure adherence to the minimum requirements of formalist notions, particularly protecting legality while avoiding legalism; balance discretion, accountability, and transparency; and ensure respect for the individual, the independence of the decision-maker, including local knowledge, meanings, and understandings—what Scott calls *mētis*[205]—and the fairness of the process. It must also embrace openness, pay attention to design issues, and function in a flexible, consultative fashion in order to avoid hidden biases. While the upholding of the rule of law may make the design and implementation of a regulatory system more complex, it should lead to a better functioning system in the long run.[206] I will return to how these goals can be achieved in the concluding chapter.

[205] James C Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (Yale University Press 1998) 311-3.

[206] Salembier (n 100) 170.

Part II

Contextualising the Digital Regulator: Mapping the Ground for E-Regulation

Introduction to Part II

I have already explained why the use of ICT by regulators is an issue that merits close consideration by lawyers and legal theorists. In this part, I lay out the various strands of literature that I will use in order to scrutinize this significant change in the workings of government, and also provide essential historical background on the development of ICT and environmental regulation.

This part begins with the development and problematization of a new area of study, e-regulation, which I define as *the use of ICT by regulators and those who deal with them, such as regulated entities, NGOs, and ordinary citizens, as an integral part of the process of measurement, assessment, and feedback which is central to regulation*. As this notion is novel, I place it in context by discussing ideas of longer standing, such as e-government and e-governance. I then utilize this new focus to raise further questions about the consequences of the greater use of e-regulation for the rule of law, a fundamental element of modern democracies and one which may be challenged by ICT in subtle, invisible, and misunderstood ways.

I provide a brief history of the development of digital and electronic ICT, from its roots in the Second World War, through initial application in the backrooms of large enterprises and mainline government departments, to its now widespread and almost ubiquitous use in almost all forms of human endeavour. This is followed by a history of the use of ICT in environmental regulation, something which has developed almost coterminously with environmental law, and extends from the use of satellites in the 1970s to the present day. I also give a summary of the rise of 'regulation' as a field of study, including an overview of the major schools of regu-

latory theory, and a history of the somewhat inchoate shifts from the 'regulatory' to the 'post-regulatory' or 'de-centered' state, and perhaps back again in the aftermath of the financial crisis. The final element in this scene-setting is a consideration of the various 'generations' of environmental regulation.

This part concludes this focus on regulation in practice with significant questions on the use of information in the processes of environmental regulation: first, in the use of scientific and technical models; and second, in schemes of regulation by disclosure (also known as 'informational regulation').

Chapter 3

E-Regulation: Computing Like a State

As will be elaborated later in this thesis,[1] regulation is a relatively new field of study but one with a significant and developing literature. ICT is also a new field of study,[2] with an even more significant explosion of related scholarship. However, this newness should not blind us to the threads of the old that are woven through the changes that these phenomena bring.[3] ICT does not bring with it a new era completely disconnected from what went before;[4] instead, it represents a continuation of the existing political, social, and economic context, and its integration into the process of regulation must be understood through this lens. ICT should be seen as 'products of a social network embedded in social institutions.'[5] We must not lose sight of 'all the fuzzy stuff that lies around the edges—context, background, history, common knowledge, social resources'.[6]

Bellamy links this awareness of the social dimensions of adherence to rules to 'new institutionalism', which 'regards institutions as self-renewing social media that host specific kinds of discourses, support particular kinds of meanings, and thus

---

[1] See Section 4.2.

[2] See Section 5.2.

[3] Monroe E Price, 'The Newness of New Technology' (2000) 22 Cardozo Law Review 1885, 1888.

[4] On this point, see generally David Edgerton, *The Shock of the Old: Technology and Global History Since 1900* (Profile Books 2008).

[5] Chrisanthi Avgerou, *Information Systems and Global Diversity* (Oxford University Press 2002) 30.

[6] John Seely Brown and Paul Duguid, *The Social Life of Information* (Harvard Business School Press 2000) 1.

shape human identities or loyalties ... ways of thinking, valuing, and knowing'.[7] She highlights how

> [i]nformation systems not only reveal the fields of influence—the domains—of powerful groups, but in so doing reflect, legitimate, and reproduce their discourses, validate their ways of seeing and thinking, and give tangible force to their influence in organizational life.[8]

This need to bear in mind the context within which regulation operates, together with the self-recreating aspects of regulatory practices, connects to regulatory space[9] and systems theory perspectives on the study of regulation.[10] In order to provide the context which is therefore necessary, this chapter explores the shift towards the use of ICT in regulation generally, a phenomenon which I label *e-regulation*, what values and perspectives are likely to be embedded in that shift, and the concerns which this new phenomenon raises. This chapter lays out the foundations for this concept.

3.1 Why Study Computerization in Regulation?

ICT may have unanticipated and undesired effects which are difficult to undo, becoming part of the infrastructure in a way that is very difficult and expensive to remove, unlike paper-based systems. The focus of study in this domain to date has been on the interface between the individual and the state. It has largely approached this from the perspective of the efficient access of services (the citizen as consumer).[11] It has tended to view government action as a single-step decision-making event rather than an ongoing engagement (or game). There has been little

[7] Christine Bellamy, 'The Politics of Public Information Systems' in G David Garson (ed), *Handbook of Public Information Systems* (2nd edn, Marcel Dekker, Inc 2000) 90.

[8] ibid, 93.

[9] See Section 4.3.3.

[10] See Section 4.3.3.

[11] Viktor Mayer-Schönberger and David Lazer, 'From Electronic Government to Information Government' in Viktor Mayer-Schönberger and David Lazer (eds), *Governance and Information Technology: From Electronic Government to Information Government* (MIT Press 2007) 2–3.

examination of the internal workings of the system and particularly not at processes that are information-intensive feedback loops.

Joerges and Czamiawska argue that it is not possible to adequately study organizations or institutions without considering the role of technology.[12] We should not assume that ICT will simply be like a lubricant which is applied to an old bicycle chain to make it run more smoothly, or a replacement for that chain. It is more like replacing a push-bike with a motorcycle, opening new possibilities but bringing with it new complications and skills requirements.

According to Bellamy and Taylor, there are

> ... two sides of a continuing debate about the significance of 'computerization' for organizational change. On the one hand, there is the view that its main purpose is to save money by shedding labour. ... On the other hand, however, ... the impact of computers on organizations could be more complex because it opens up the possibility that ICTs could permit new kinds of processes and services to be developed.[13]

As I will discuss,[14] '[g]overnment has been, and still remains, the single largest collector, user, holder and producer of information. Information is a central resource for all staff levels and for all activities ...'[15] Although it should therefore be clear that the adoption of ICT is likely to have a significant transformative effect on regulatory bureacracies, the consequences of these new technologies and their broad deployment has been little explored in the academic literature. However, before attempting to fill this lacuna, some definitions are required.

---

[12] Bernward Joerges and Barbara Czarniawska, 'The Question of Technology, or How Organizations Inscribe the World' (1998) 19(3) Organization Studies 363.

[13] Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) 33–4.

[14] See Section 2.1.2.

[15] Richard Heeks, 'Reinventing Government in the Information Age' in Richard Heeks (ed), *Reinventing Government in the Information Age: International Practice in IT-Enabled Public Sector Reform* (Routledge 1999) 16.

3.2 Defining Basic Terms: The Is and Es of a Digital State

Five terms must be clarified at this point: *information systems* (IS), *information infrastructures* (II), *e-government*, *e-governance* and *e-regulation*.

3.2.1 Information Systems and Infrastructures

An IS is not simply technology but the result of 'the mutually transformational interactions'[16] between tools and people. Heeks provides a definition of information systems that highlights the overall human and social context, something which is very important for the remainder of this discussion:

> *Information systems* ... can be defined as systems of human and technical components that accept, store, process, output and transmit information. They may be based on any combination of human endeavours, paper-based methods and IT [(information technology)]. ...
>
> Thus:
>
> - IT on its own does not do anything useful: in order to do anything, it must become part of an information system;
> - information systems do not necessarily involve computers and telecommunications equipment;
> - even when they do, information systems are much more than just IT because they involve people and their actions.[17]

Hanseth and Monteiro underline that information *systems* are being replaced by 'information *infrastructures*'.[18] These have six key aspects: they are designed to support a wide range of activities,[19] shared by a wide community in an undivisible fashion,[20] open for new connections (whether from humans or technology),[21] are socio-technical networks 'encompass[ing] technological components, humans,

[16] Allen S Lee, 'Thinking About Social Theory and Philosophy for Information Systems' in *Social Theory and Philosophy for Information Systems* (John Wiley and Sons 2004) 11.

[17] Heeks (n 15) 15.

[18] Ole Hanseth and Eric Monteiro, 'Understanding Information Infrastructure' (1998) ⟨http://heim.ifi.uio.no/oleha/Publications/bok.pdf⟩ accessed 27 August 2014, 4 (emphasis in original).

[19] ibid, 41.

[20] ibid, 41.

[21] ibid, 42.

organizations, and institutions,',[22] 'connected and interrelated, constituting *ecologies of networks*',[23] and do not develop from scratch but 'through extending and improving the *installed base*.'[24] They argue that '[u]nderstanding information infrastructures requires a holistic perspective—an infrastructure is more than the individual components.'[25] I would also argue that in understanding ICT in ER requires an awareness that these new systems have institutional consequences: they become 'institutional information infrastructures'.

3.2.2 E-Government

The focus of this thesis is on the use of ICT within the processes of regulation. This can be understood as a sub-set of the broader topic of e-government, sometimes known as 'digital government'.[26] Defining these terms completely is not possible,[27] but one possible interpretation is

> ... the use of modern information and communication technologies, especially Internet and web technology, by a public organization to support or redefine the existing and/or future (information, communication and transaction) relations with 'stakeholders' in the internal and external environment in order to create added value.[28]

According to Bekkers and Homburg, e-government is a policy tool that came to prominence in the early years of this century as the result of the confluence of a number of contextual factors: the crisis of representative democracy; demands for more responsive public service delivery; the spread of 'business process de-

[22] ibid, 43.
[23] ibid, 44 (emphasis in original).
[24] ibid, 47 (emphasis in original).
[25] ibid, 4.
[26] Hans J Scholl, 'Electronic Government: A Study Domain Past Its Infancy' in Hans J Scholl (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010) 11.
[27] Scott P Robertson and Ravi K Vatrapu, 'Digital Government' (2010) 44(1) Annual Review of Information Science and Technology 317.
[28] Victor Bekkers and Vincent Homburg, 'E-Government as an Information Ecology: Backgrounds and Concepts' in VJJM Bekkers and VMF Homburg (eds), *Information Ecology of E-Government: E-Government as Institutional and Technological Innovation in Public Administration* (IOS Press 2005) 6.

sign' approaches from the private to the public sector; the shift from government to governance; calls for greater responsibility and accountability in the public sector; and the development of connectivity through network technology.[29] More recently, some scholars have claimed that e-government is more about information flow than storage and a new phenomenon of 'iGovernment' is developing.[30]

It is important to note that this thesis focuses on specific aspects of e-government, not on the whole. E-government comprises a number of different facets, some of which get more attention than others. Lenk lists four perspectives—the interface with the citizen, the re-organization of processes, cooperation and collaboration, and information and knowledge assets[31]—while LaVigne writes about e-services, e-commerce, e-democracy, and e-management.[32] My focus is on processes and knowledge. While the other elements are also obviously important, their focus is on the external relationship between the organization and the public at large and on the behaviour of bureaucratic organizations in relationships with individual citizens. While these evolving dynamics are not completely understood, they are relatively well-studied and theorised. This research instead examines internal, technical, and under-explored topics.

3.2.3 E-Governance

A related concept, which is often represented as either supporting or supplanting e-government, is e-governance. Distinguishing and defining this latter concept is not easy, but an initial definition is 'the facilitation of governance through ICT and related tools'.[33] However, both scholars and practitioners use e-democracy, e-

[29] Bekkers and Homburg, 'E-Government as an Information Ecology' (n 28) 1–4.

[30] JEJ Prins, Dennis Broeders, and HM Griffioen, 'iGovernment: A New Perspective on the Future of Government Digitisation' (2012) 28(3) Computer Law and Security Review 273, 278.

[31] K Lenk and Roland Traunmüller, 'Broadening the Concept of Electronic Government' in JEJ Prins (ed), *Designing e-Government* (2nd edn, Kluwer 2007) 10.

[32] Mark LaVigne, 'Electronic Government: A Vision of a Future That is Already Here' (2002) 52 Syracuse Law Review 1243, 1245–6.

[33] Jamal Shahin and Matthias Finger, 'The Operationalisation of e-Governance' in Tomasz Janowski and Theresa A Pardo (eds), *Proceedings of the 2nd International Conference on The-*

government and e-governance in loose, sometimes synonymous and interchangeable ways.[34] Marche and McNiven claim that

> ... e-government is the provision of routine government information and transactions using electronic means, most notably those using Internet technologies, whether delivered at home, at work, or through public kiosks. E-governance is a technology-mediated relationship between citizens and their governments from the perspective of potential electronic deliberation over civic communication, over policy evolution, and in democratic expressions of citizen will.[35]

E-governance includes ideas such as electronic consultation.[36] It contains a greater awareness of 'confrontational and open-ended'[37] relationships, of the tensions that arise in the practice of government in action, and 'the active useage of the ICTs for such collective problem solving.'[38] An important secondary theme is what might be called 'e-controllership':[39] managing and standardising the tools and technologies that are used for e-government.[40]

Finger and Pécoud identify three different interpretations of the word: a new public management perspective of 'satisfying the citizen/customer by means of delivering the services through the internet', where the state is seen as the principal actor and citizens as passive; a focus on 'processes and interactions', with the state

ory and Practice of Electronic Governance (ICEGOV '08) (Association for Computing Machinery 2008) 24.

[34]Matthias Finger and Thomas Langenberg, 'Electronic Governance' in Ari-Veikko Anttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007); Åke Grönlund, 'Electronic Government' in Ari-Veikko Anttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

[35]Sunny Marche and James McNiven, 'E-Government and E-Governance: The Future Isn't What it Used to be' (2003) 20(1) Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration 74, 75.

[36]Rowena Cullen, 'Defining Transformation: An E-Government or E-Governance Paradigm?' in Hans J Scholl (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010) 58.

[37]Gianluca Misuraca, 'Futuring E-Government: Governance and Policy Implications for Designing an ICT-Enabled Knowledge Society' in Tomasz Janowski (ed), *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance (ICEGOV '09)* (Association for Computing Machinery 2009) 86.

[38]Finger and Langenberg (n 34) 629.

[39]Cullen (n 36) 58.

[40]Misuraca (n 37) 86.

remaining at the centre; and finally, as 'a set of tools in the hands of government, or rather in the hands of the administration', which is somewhat deterministic but does consider the role of values in government.[41] They put forward instead

> ... a dynamic concept, which implies the growing use of the NICTs for the three State's main functions (e.g. e-Government, e-regulation and e-democracy), increasingly involving non-state actors at levels other than the national one ...[42]

and call for research into how ICT will (or will not) transform government in the future.[43] E-governance has potential in improving environmental democracy.[44] However, delivery in Europe is not proving easy.[45] Overly technological perspectives often do not bring about desirable outcomes such as democratization of greater efficiencies; it is therefore important to take a holistic and social approach to the implementation of ICT-enabled reform programmes.[46] Rossel and Finger highlight some of the tensions that exist in the elaboration of e-governance initiatives: between efficiency and bureaucracy, transparency and control, empowerment and disempowerment, centralization and distributed provision, commercialization and regulation, and finally between community and anomie.[47]

---

[41] Matthias Finger and Gaëlle Pécoud, 'From E-Government to E-Governance? Towards a Model of E-Governance' (2003) 1(1) Electronic Journal of e-Government 1, 6–7.

[42] ibid, 6.

[43] ibid, 9.

[44] Lalanath de Silva, 'Environmental E-Governance' in Thomas Janowski and Theresa A Pardo (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (icegov '08)* (Association for Computing Machinery 2008).

[45] Leslie Budd, 'The Limits of Post-Lisbon Governance in the EU' in Leslie Budd and Lisa Harris (eds), *E-Governance: Managing or Governing?* (Routledge 2008).

[46] KBC Saxena, 'Towards Excellence in E-Governance' (*CEXIM Working Paper Series*, 2005) ⟨http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan045361.pdf⟩ accessed 27 August 2014.

[47] Pierre Rossel and Matthias Finger, 'Conceptualizing E-Governance' in Thomas Janowski and Theresa A Pardo (eds), *Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance (icegov '07)* (Association for Computing Machinery 2007) 405.

3.2.4 E-Regulation

What is considerably less studied than either e-government or e-governance and has little associated theory is the use of ICT *within* the operations of regulators and those who deal with them, such as NGOs, as an integral part of the process of measurement, assessment, and feedback which is central to regulation, something which I label '*e-regulation*'. E-government research has tended to focus on the public face of government and on service delivery,[48] not on the use of ICT within the regulatory process.

For example, Hernon and Cullen put forward what they call a 'generalized model of e-government'[49] which mentions 'e-compliance',[50] which is only one aspect of regulation. Henman adopts Perri 6's model of e-government,[51] enumerating as the elements of government activity e-democracy, e-service provision, e-management (which is solely about allocating internal government resources), and e-governance,[52] omitting any mention of regulatory activity. One definition of e-regulation used in the literature is 'the use and application of the NICTs to supervising—or rather regulating—the [outsourced or] autonomised services',[53] but this takes a very narrow view of the purpose and application of regulation, similar to the narrow views of regulations already discussed.[54]

I put forward a more encompassing definition, which is *the use of ICT by regulators and those who deal with them, such as regulated entities, NGOs, and ordinary citizens, as an integral part of the process of measurement, assessment, and*

[48]Frank Bannister and Regina Connolly, 'Forward to the Past: Lessons for the Future of E-Government from the Story so Far' (2012) 17(3) Information Polity 211.

[49]Peter Hernon and Rowena Cullen, 'E-Government: Transforming Government' in Peter Hernon, Rowena Cullen, and Harold C Relyea (eds), *Comparative Perspectives on E-Government: Serving Today and Building for Tomorrow* (Scarecrow Press 2006) 5.

[50]ibid, 8.

[51]Perri 6, *E-Governance: Styles of Political Judgement in the Information Age Polity* (Palgrave Macmillan 2004) 15–7.

[52]Paul Henman, *Governing Electronically: E-Government and the Reconfiguration of Public Administration, Policy, and Power* (Palgrave Macmillan 2010) 8.

[53]Finger and Pécoud (n 41) 5.

[54]See Section 4.1.

feedback which is central to regulation. It has a number of significant features: its focus is on internal government processes; it relies on the wide availability of ICT inside and outside government to be economically and legally feasible; its fundamental ideological perspective is modernising; and it has important consequences for government operations and structures, but also for citizens and for basic constitutional values (a point which I will expand on in Chapter 2). This thesis will use the terms e-government and e-regulation to mean two distinct but closely related phenomena. It is important to bear in mind that e-government encapsulates or includes e-regulation, which is a subset of the former concept. As there is very little literature on e-regulation, and previous use of the term seems to focus on Internet regulation,[55] many of the authors cited in the following discussion will refer to e-government[56] but much of what they say also applies to e-regulation.

My definition connects with the concept of governmentality[57] by building on Rose and Miller's identification of the use of *inscription devices* and *centres of calculation* as key technologies of government, enabling action at a distance.[58] While their discussion focuses on the pre-digital uses of observation, measurement, and calculation as tools for control, the development of ICT allows this type of enterprise to be conducted on a much wider scale and at a much more rapid pace, thereby increasing the potential of governmentality approaches. This is a nascent form of activity, only recently beginning to become possible with the development of increasingly inexpensive, portable, and powerful ICT tools. The focus is generally on individual or small-group regulatory decision-makers in ongoing interactions with large groups of citizens or regulated firms. It is a topic which has received very little academic attention to date, largely because of the focus of efforts to expand and

[55]For example, Shalini Venturelli, 'Inventing E-Regulation in the US, EU and East Asia: Conflicting Social Visions of the Internet and the Information Society' (2001) 19(2) Telematics and Informatics 69.

[56]See Section 3.2.2.

[57]See Section 7.3.

[58]Nikolas Rose and Peter Miller, 'Political Power Beyond the State: Problematics of Government' (2010) 43(2) British Journal of Sociology 173, 185–7.

improve e-government has been on the external interface between the citizen and the state—the 'customer services' element—while largely ignoring 'the executive, strategic, and supporting parts of public organisations.'[59] This lack of examination obscures how the resulting dichotomous situation—both more flexible in its capacities and less malleable in its infrastructure—has significant consequences for regulation:

> The computational rendition of reality has far-reaching implications in the sense of recapturing a growing proportion of the physical and cognitive landscape of contemporary life into the medium of permutable and recombinable information.[60]

E-regulation is part of what Bannister calls 'deep e-government', which he claims has four distinctive elements:

- It 'takes place in the core of central administration, its immediate agencies, and local/regional government';[61]
- it is transformative but not as much as is sometimes claimed, and 'has tended to be used to reinforce existing power structures and relationships';[62]
- 'it enhances the delivery of public sector values';[63] and
- '[c]entral governments ... must be concerned with issues such as equity, access, fairness, accountability, and so on.'[64]

E-regulation has much in common with 'Digital Era Governance' (DEG), which signifies

[59] Stavros Zouridis and Marcel Thaens, 'Reflections on the Anatomy of E-Government' in VJJM Bekkers and VMF Homburg (eds), *Information Ecology of E-Government: E-Government as Institutional and Technological Innovation in Public Administration* (IOS Press 2005) 28.

[60] Jannis Kallinikos, *The Consequences of Information: Institutional Implications of Technological Change* (Edward Elgar Publishing 2006) 6.

[61] Frank Bannister, 'Deep E-Government: Beneath the Carapace' in Hans J Scholl (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010) 39.

[62] ibid, 39.

[63] ibid, 41.

[64] ibid, 41.

> ... a whole complex of changes, which have IT and information-handling changes at their centre, but which have spread much more widely and take place in many more dimensions simultaneously than was the case with previous IT influences ... [It is] now the most general, pervasive, and structurally distinctive influence on how governance arrangements are changing in advanced industrial states. ...[65]

According to Dunleavy and others, DEG can be broken into three main themes:

Reintegration A response to the problems with new public management (NPM), this involves reassembling 'many of the elements that NPM separated out into distinct corporate hierarchies'.[66] This is made up of seven elements: the roll-back of agencification and fragmentation (through mergers, re-assimilations, culls, and the reimposition of cooperative community-based structures); joined up governance; re-governmentalization ('the re-absorption into the public sector of activities that had previously been outsourced to the private sector'); re-establishing or re-strengthening central processes; radically squeezing production costs; re-engineering back-office functions and service delivery chains; procurement concentration and specialization; the development of shared services; and the simplification of networks and the creation of 'small worlds' (focused boutique agencies that do not duplicate the functions of others).[67]

Needs-based Holism This involves '[c]reating larger and more encompassing administrative blocs ... [through] ... "end to end" re-engineering processes, stripping out necessary steps, compliance costs, checks and forms [and] developing a more "agile" government that can respond speedily and flexibly to changes in the social environment'.[68] Its main components are interactive information seeking and giving (which is fundamental to what follows); client

[65] Patrick Dunleavy and others, *Digital Era Governance: IT Corporations, the State and E-Government* (Oxford University Press 2008) 225.
[66] ibid, 227.
[67] ibid, 227–33.
[68] ibid, 227.

based or needs-based reorganization; one-stop provision, ask-once processes; data warehousing; end-to-end service re-engineering; agile government processes; and sustainability.[69]

Digitization Changes Changes to IT become 'genuinely transformative', at the extreme 'moving towards a situation where the agency "*becomes* its website"'.[70] The main components of this theme are electronic service delivery and e-government; web-based utility computing; new forms of automated processes; radical disintermediation; active channel-streaming and customer segmentation; mandated channel reduction; facilitating isocratic (citizen-managed) administration; and moving towards open book government.[71]

Dunleavy and others question whether these observed changes indicate a fundamental re-orientation in the organizational structures of government or a cynical ritual of responding to political fashions.[72] However, Kallinikos claims that as a result of ICT, we are seeing 'the transformation of the organizational order of modernity'.[73] Digital era changes have already trigged numerous significant shifts—a large-scale switchover to email in internal and external communications; the increasing importance of websites and intranets in organizational information networks; the development of electronic services for different client groups; the growth of electronic procurement systems; a fundamental transition from paper-based to electronic record-keeping and so on.[74] There are clear connections between e-government, modernization, and public sector reform, which focus around concerns for economic efficiency; integration and interconnection; and science, tech-

[69] ibid, 233–7.
[70] ibid, 228 (emphasis in original).
[71] ibid, 237–42.
[72] ibid, 242.
[73] Kallinikos, *The Consequences of Information* (n 60) 16.
[74] Dunleavy and others, *Digital Era Governance* (n 65) 225.

nology, and expertise.[75] This is often driven by the state,[76] and rests on ICT.[77] According to Lanzara, '[w]e can reasonably speak of ICT-mediated and supported institutional arrangements',[78] and the

> ... regulatory and enforcing capacities of public administration are thus likely to be equally embodied into formal laws and regulations *and* into technical standards and devices brought about by the technology, while the share of the latter is continually growing.[79]

This new development raises concerns regarding the the level of control which the state may be able to exercise over individual citizens, or that the technology itself may end up with an excessive level of control over the machinery of government.[80] In addition, Bowker and Star point out that classification schemes can be read as 'political and cultural productions', and that their architectures have moral consequences.[81] I would argue that a similar analysis should also apply to the deployment of sensor devices, the development of algorithms, and the use of models in the regulatory process.

3.3 ICT and Regulation

3.3.1 Ubiquitous but Under-Studied

It is difficult to discuss, analyse, or critique e-regulation in detail. We cannot simply reuse the experience and knowledge gained from the extensive study of the application of ICT in the business world in order to understand its application in

[75] Helen Margetts and Patrick Dunleavy, 'The Second Wave of Digital-Era Governance: A Quasi-Paradigm for Government on the Web' (2013) 371 Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 26–7.

[76] ibid, 32–3.

[77] ibid, 37–8.

[78] Giovan Francesco Lanzara, 'Building Digital Institutions: ICT and the Rise of Assemblages in Government' in Francesco Contini and Giovan Francesco Lanzara (eds), *ICT and Innovation in the Public Sector: European Studies in the Making of E-Government* (Palgrave Macmillan 2009) 12.

[79] ibid, 12.

[80] Margetts and Dunleavy (n 75) 39.

[81] Geoffrey C Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (MIT Press 1999) 324.

the public sector.[82] Writing in the context of local government, and reflecting on the experience of Atlanta, Georgia, in introducing a 'scorecard' or 'dashboard' for performance, Edwards and Clayton Thomas point to three significant differences between public bodies and commercial entities: the lack of the common, straightforward metric of profitability; the lack of a common culture across units within an organization; and the reality that managers may be reluctant to reveal negative information to the public.[83]

There is a dearth of specific literature and a lack of empirical studies. Although ICT has become widespread and probably ubiquitous in the offices of government and regulators, in contrast to its application in business, there is very little study of what drives or constrains it in the public service nor a developed understanding of its consequences.[84]

For example, Diez and McIntosh could find very few empirical studies of the impact of Geographic Information Systems (GIS) use by local governments. Their study of the use of decision and information support tools by desertification policy and management organizations (including government ministries, research institutions, and non-governmental organizations) concluded that these factors can be different to those which are most prominent in the commercial context. The process was driven by the mandate of the organization, the potential uses to which the information might be put, the need for more detailed information, and the system attributes. The impacts included changes in execution and performance of work, organizational structure and financial investment. Although many interviewees pointed to greater levels of effectiveness and efficiency, this cannot be assumed to follow from the implementation of ICT tools, with other organizational factors, such as

[82] Stuart Bretschneider, 'Management Information Systems in Public and Private Organizations: An Empirical Test' [1990] Public Administration Review 536.

[83] David Edwards and John Clayton Thomas, 'Developing a Municipal Performance-Measurement System: Reflections on the Atlanta Dashboard' (2005) 65(3) The Reflective Practitioner 369, 370–1.

[84] Karl Löfgren, 'The Governance of E-Government' (2007) 22(3) Public Policy and Administration 335, 336.

management processes, preventing a full realization of possible gains. More positively, ICT tools were connected to higher levels of stakeholder participation. Many pointed to the new need to establish new units to manage and use the new technology, mirroring experience in the business world.[85]

3.3.2 E-Regulation is not a Binary Process

The role of ICT in public administration tends to be seen in very black and white terms, but the reality is that the two tend to interact with each other in ways that bring both benefits and drawbacks for the state and the citizen. Bellamy and Taylor claim that ICTs have two interrelated qualities that lead to such contradictory perspectives on their impact on society and governance: first, informatization, as defined by Zuboff,[86] the distinctive foundation for innovation which ICT provides, as it brings the possibility of reflexivity, which can in turn lead to additional changes in chosen directions; and second, the new capacity for communicating information across traditional organizational boundaries and through newly constituted networks, thereby opening up new possibilities for greater efficiency but also significant surveillance.[87]

Based on a study of the development of ICT in the Canadian federal government, Kernaghan and Gunraj argue that ICT brings with it three major predispositions:

1. the acquisition of specialised skills and substantial capital investment;

2. improving efficiency by streamlining the management of information; and

3. the sharing and dissemination of information.[88]

[85]Esther Diez and Brian S McIntosh, 'Organisational Drivers for, Constraints on and Impacts of Decision and Information Support Tool Use in Desertification Policy and Management' (2011) 26(3) Environmental Modelling and Software 317.

[86]Shoshana Zuboff, *In the Age of the Smart Machine: The Future of Work and Power* (Basic Books 1988) 10.

[87]Bellamy and Taylor (n 13) 26–8.

[88]Kenneth Kernaghan and Justin Gunraj, 'Integrating Information Technology Into Public Admin-

This brings with it moves from independent action to collective action; from the departmental form of organization to non-departmental forms; and from hierarchy and central control to decentralization of authority and control.[89] However, the newly computerized systems must be operated according to procedures defined in advance and protected from unusual or unforeseen inputs.[90] Nonetheless, the resulting '[c]omputational descriptions of reality' that reside in databases and algorithms are very malleable and can be transferred from context to context or combined with other information in order to make possible new and much broader perspectives of control.[91] When they are used in an interconnected environment, they may create the potential for significant social change.[92] The resulting collection, combination, and re-combination of information through sophisticated software gives rises to still more information, which can no longer be adequately processed and explored manually and therefore must be dealt with through automated means, but also demands constant updating.[93]

According to Bekkers, ICT has two broad impacts on organizational boundaries: they move and their nature changes. In the first category, he includes situations where a central organization colonises others, such as a requirement of compliance with Electronic Data Interchange standards by those who must communicate with it; where an organization is penetrated by its external environment, for example through an electronic public consultation process; and where organizations are integrated, as often occurs in the health sector. In the second category are circumstances where boundaries are blurred, such as a data connection between a prosecutor's office and the local police; where boundaries are fixed, such as the use of a tightly controlled intranet; or a combination of these two scenarios, which

istration: Conceptual and Practical Considerations' (2004) 47(4) Canadian Public Administration 525, 531.

[89] ibid, 542.

[90] Kallinikos, *The Consequences of Information* (n 60) 22.

[91] ibid, 26.

[92] ibid, 38.

[93] ibid, 68–9.

he calls controlled transparency and which includes limited bi-directional access to internal data, such as between universities and state-funded student loan services. These shifts in boundaries can lead to difficulties in clearly assigning responsibility and accountability, controlling individual private data and preserving low-level decision-making discretion.[94]

3.3.3 Cheaper, More, Quicker, Better, New: The Benefits of E-Regulation

In broad terms, the five main advantages of ICT for the reform of public administration have been outlined by Heeks as:

- *Cheaper*: producing the same outputs at lower total cost.
- *More*: producing more outputs at the same total cost.
- *Quicker*: producing the same outputs of the same total cost in less time.
- *Better*: produce the same outputs at the same total cost in the same time, but to a higher quality standard.
- *For the first time*: producing new outputs.[95]

Drawing on these, e-government advocates claim significant benefits: a radical transformation in the openness and accessibility of bureaucratic processes; reduced transaction costs; integration of ordinary citizens into public decision-making; and greater protection of individual rights through stronger privacy protections.[96] In the context of an increasingly dynamic and globalised economic environment (itself partly the product of the development of ICT), these can bring significant practical advantages. Markets are not static; the individual actors adapt and evolve. Policy must change in response;[97] this is particularly important in environmental regula-

[94] VJJM Bekkers, 'Information and Communication Technology and the Redefinition of the Functional and Normative Boundaries of Government' in Oscar van Heffen, Walter JM Kickert, and Jacques Thomassen (eds), *Governance in Modern Society: Effects, Change and Formation of Government Institutions* (Kluwer Academic Publishers 2000).

[95] Heeks (n 15) 18.

[96] Alexei Pavlichev and G David Garson, *Digital Government: Principles and Best Practices* (IGI Global 2004) 2–3.

[97] Richard S Whitt, 'Adaptive Policymaking: Evolving and Applying Emergent Solutions for US Communications Policy' (2009) 61 Federal Communications Law Journal 483, 489–05.

tion.[98] ICT can play a very important role in this, facilitating greater transparency and accountability[99] and shorter response times.[100] Information can come to the regulator more rapidly, and in turn be made available to the public more quickly, in a form that is more easily processed, understood, and acted upon.

ICT allows more detailed tracking and detection of human activity, particularly regulatory breaches through, for example, speed cameras. Regulation can be targeted more closely at particular segments of the population. Enforcement can be improved and made more efficient through, for example, remote sensing.[101] Digital technology may 'de-centre' government (and governance) but also permits the more precise observation of the populace and more focused interventions.[102]

Associated with this is the possibility of a more iterative regulatory process. ICT can more quickly highlight the occurrence of harms, particularly those caused by small-scale activity which only becomes damaging when aggregated. Regulatory innovations can be tried for short periods of time, in particular markets or in specific geographic areas. The results of these 'experiments' can be analysed and used as the basis for revisions in the future, allowing for a more rapid evolution of best practice.[103]

With regard to the external, democratic context, the greater availability of information can lead to a more informed public and a better deliberative process,[104]

---

[98] JB Ruhl, 'Regulation by Adaptive Management—Is It Possible?' (2005) 7 Minnesota Journal of Law, Science and Technology 21.

[99] Daniel C Esty, 'Environmental Protection in the Information Age' (2004) 79 New York University Law Review 115, 167–70.

[100] KA Taipale, 'Information Technology as Agent of Change In Environmental Policy' (*Center for Advanced Studies in Science and Technology Policy Working Paper*, 2003) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=712161⟩ accessed 19 May 2014, 67.

[101] Kenneth J Markowitz, 'Legal Challenges and Market Rewards to the Use and Acceptance of Remote Sensing and Digital Information as Evidence' (2002) 12 Duke Environmental Law and Policy Forum 219.

[102] Christopher C Hood and Helen Z Margetts, *The Tools of Government in the Digital Age* (Palgrave Macmillan 2007) 185–203.

[103] Esty (n 99) 162–64.

[104] Beth S Noveck, *Wiki Government: How Technology Can Make Government Better, Democracy Stronger, and Citizens More Powerful* (Brookings Institution Press 2009) 108–09.

thereby allowing for an evolutionary approach to law reform[105] and a more inclusive law-making process. Electronic communications offers an opportunity to improve the consultation process surrounding administrative rulemaking.[106] This is not without its costs and risks and is best used on a trial basis at this early stage.[107] By itself, more information will not promote democracy: empowering citizens to contribute to the rule-making process does not mean that they will,[108] and e-democracy projects may fail.[109]

ICT can also enable greater citizen participation in environmental monitoring, either through access to baseline data or direct involvement in systems development, implementation, and management.[110] However, this can be limited by issues of access, cost, ease of use, or lack of broader institutional supports and frameworks.[111] This gives the regulator the possibility of reacting much more quickly to anomalous events, of processing routine applications in a speedier way, and of opening its processes to NGO input in a more streamlined fashion. In the context of tighter public finances, this creates opportunities to structure ER in new ways, for example, the development of 'environmental collaborative monitoring networks', in which individual citizen volunteers 'crowd-source' information on environmental quality.[112] In order to assist with this, the state should consider how it can better ensure the quality of the environmental data which it makes available, provide material re-

[105]Noveck (n 104) 185.

[106]Thomas C Beierle, 'Discussing the Rules: Electronic Rulemaking and Democratic Deliberation.' (*Resources for the Future Discussion Paper*, 2003) ⟨http://purl.umn.edu/10681⟩ accessed 19 May 2014; Cary Coglianese, 'Information Technology and Regulatory Policy: New Directions for Digital Government Research' (2004) 22(1) Social Science Computer Review 85.

[107]Stuart Minor Benjamin, 'Evaluating E-Rulemaking: Public Participation and Public Institutions' (2006) 55 Duke Law Journal 893.

[108]Cary Coglianese, 'Weak Democracy, Strong Information: The Role of Information Technology in the Rulemaking Process' in Viktor Mayer-Schönberger and David Lazer (eds), *From Electronic Government to Information Government: Governing in the 21st Century* (MIT Press 2007) 116.

[109]Åke Grönlund, 'The Rise and Fall (?) of Participatory Electronic Information Infrastructures' in Viktor Mayer-Schönberger and David Lazer (eds), *Governance and Information Technology: From Electronic Government to Information Government* (MIT Press 2007).

[110]Cristina Gouveia and Alexandra Fonseca, 'New Approaches to Environmental Monitoring: The Use of ICT to Explore Volunteered Geographic Information' (2008) 72(3-4) GeoJournal 185, 186.

[111]ibid, 190.

[112]ibid.

sources and training for local NGOs, and perhaps even offer bounties for citizens who discover pollution control violations.[113]

3.3.4 Querying the 'March of Progress'

However, e-regulation can also have negative impacts. ICT can remove discretion from individual decision-makers and place it with systems analysts, developers, and senior management.[114] The role of frontline staff changes from that of 'street-level bureaucrat' to a much more limited 'screen-level bureaucrat'.[115] Even if individuals retain discretion, the increasing monitoring, accountability, and transparency which ICT can provide may motivate them to follow rules strictly rather than flexibly, in a way that is detrimental to the rights of particular citizens.[116] ICT can accentuate existing imbalances of power and distort the political and regulatory processes. The important differences between the public and private sector, alluded to above, must be borne in mind in order to avoid the inappropriate application of models that are successful in other, different domains.[117] In the public sector, many of the potential savings (such as disintermediation or reduced transaction costs) and potential new income streams (such as commissions and fees, advertising) do not apply.[118] The processes of public administration are not linear, manufacturing operations.[119] In addition, it is difficult to identify a direct relationship between investment in ICT

[113]Christine Overdevest and Brian Mayer, 'Harnessing the Power of Information Through Community Monitoring: Insights From Social Science' (2008) 86 Texas Law Review 1493, 1520–23.

[114]Mark Bovens and Stavros Zouridis, 'From Street-Level to System-Level Bureaucracies: How Information and Communication Technology is Transforming Administrative Discretion and Constitutional Control' (2002) 62(2) Public Administration Review 174.

[115]James E Swiss, 'Information Technology as a Facilitator of Results-Based Management in Government' in G David Garson (ed), *Public Information Technology: Policy and Management Issues* (IGI Global 2003) 183.

[116]Christopher Corbett, 'The Future of Digital Government' in Alexei Pavlichev and G David Garson (eds), *Digital Government: Principles and Best Practices* (IGI Global 2004) 362–3.

[117]Kim Viborg Andersen, 'Reengineering Public Sector Organisations Using Information Technology' in Richard Heeks (ed), *Reinventing Government in the Information Age: International Practice in IT-enabled Public Sector Reform* (Routledge 1999) 323.

[118]Maria A Wimmer, 'European Development towards Online One-stop Government: The "eGOV" Project' in *International Conference on Electronic Commerce* (Vienna, Austria, 2001).

[119]Lenk and Traunmüller (n 31) 13.

and prosperity; just-in-time methods are not always appropriate; and clearly identifying the customer is difficult.[120] It is therefore important to study the limitations of e-government and e-regulation.

De-Mythologising E-Government Reforms

According to Bekkers, e-government is based on four grounding myths (by which he means 'a double-edged sword ... [both] seductive tales containing promises unfulfilled or even unfulfillable ... [and] a source of inspiration that actors can use to enact social reality'[121]):

1. A New and Better Government—'ICTs are seen as helping the realization, with little effort, of administrative machinery that is responsive, client oriented, and cohesive.'[122]

2. Technological Progress and Instrumentality—'... a strong belief and trust in the potential of ICTs. Optimism prevails in the descriptions of the progress the information society and Internet technology will bring. Things that were previously unthinkable will now happen.'[123]

3. Rational Information Planning—'The path forward is presented as a question of setting goals, formulating action plans, allocating budgets, and identifying clear roles and responsibilities.'[124]

4. Citizen as Empowered Consumer—'... an online environment will allow individuals to to [sic] customize their online channel with government, to make it more useful, familiar, convenient, and in many instances transparent.'[125]

---

[120] Pavlichev and Garson (n 96) 10–11.
[121] Victor Bekkers and Vincent Homburg, 'The Myths of E-Government: Looking Beyond the Assumptions of a New and Better Government' (2007) 23(5) The Information Society 373, 375.
[122] ibid, 375.
[123] ibid, 378.
[124] ibid, 379.
[125] ibid, 379.

Underlying each of these myths is an unspoken assumption that ICT is 'an essentially autonomous entity (as something "neutral" in character), with inevitable determining impacts or effects on the socio- economic life and society as a whole',[126] which gives rise to a fundamental misconception regarding the notions of 'progress' that these tools are seen as embodying:

> The ideas of technological determinism are particularly prevalent in the public rhetoric of e-government reform which assumes that paths of technological change are inevitable and by their very nature necessitate particular social changes ... [T]hey assume that these technologies by themselves are effective and reliable vehicles for achieving organizational change. However, the casual simplicity offered by such a perspective fails to acknowledge the complexity of organizational, political, and social factors that shape the adoption, design and use of the e-government project.[127]

The Challenges of Formalising Practices and Knowledge

The legal decision-making process is not a simple or linear system, easily amenable to modelling through computerized logic and expert systems.[128] In addition, administrative, bureaucratic, and regulatory skills depend on knowledge which is held in individual minds and is difficult to extract and store in a strucutured retrieval system. Administration is therefore not easily re-structured or made 'efficient' in a Taylorist fashion, and building a good 'institutional memory' requires more than a static database.[129] However, if ICT does take hold as part of the institutional framework of an organization, it can become a rigid element in that architecture.[130]

---

[126]Gregory Maniatopoulos, 'E-Government Movements of Organizational Change: A Social Shaping Approach' in *4th International Critical Management Studies Conference: Critique and Inclusivity: Opening the Agenda* (2005) 3.

[127]ibid, 3.

[128]Paul Alpar and Sebastian Olbrich, 'Legal Requirements and Modelling of Processes in E-Government' (2005) 3(3) Electronic Journal of E-Government 107.

[129]Lenk and Traunmüller (n 31) 17–18.

[130]Wanda J Orlikowski, 'The Duality of Technology: Rethinking the Concept of Technology in Organizations' (1992) 3(3) Organization Science 398, 409.

ICT As a Brake on Reform

ICT-based innovation does not automatically bring with it democratization.[131] As ICT becomes an increasingly significant component in the regulatory process, the practical challenges involved in re-developing installed infrastructural systems can significantly slow down internal institutional, organizational, and procedural change[132] while further disempowering those external actors who were already excluded from the process by educational or financial disadvantage.[133] ICT-based reform efforts can fail because individuals fear losing their jobs, are unwilling to change their work cultures, lack clear leadership, are tired of failure, or simply do not have access to adequate infrastructure.[134] Those who operate and develop the technology may also be reluctant to embrace change that threatens their preeminence. In a Foucauldian ethnographic study, Davies and Mitchell study a government department, explaining how the discourses that regulate the adoption of ICT solutions in that organization prevent the technology from becoming a significant element in organizational change. In the case presented, that of a minerals industry regulator, the IT section prevents the progress of potentially destabilising proposals for change by ruling out more easy-to-learn options as 'not technically feasible' and controlling the institutional mechanisms that could see control of technology decision-making slipping from it.[135]

In particularly unhealthy situations, ICT can be implemented as a tool of central control, which is even more rigid in its application than the previous paper-based

[131]Richard Lum, 'The Disconnect Between Civic Hacking and Democracy' (2013) ⟨http://thethirdera.com/the-disconnect-between-civic-hacking-and-democracy/⟩ accessed 19 May 2014.

[132]Helen Margetts, 'The Automated State' (1995) 10 Public Policy and Administration 88, 93.

[133]Nick Hunn, 'Smart Metering is FCUKED' (2013) ⟨http://www.nickhunn.com/smart-metering-is-fcuked/⟩ accessed 19 May 2014.

[134]Mila Gasco, 'Civil Servants' Resistance Toward E-Government Development' in Ari-Veikko Anttiroiko and Matti Mälkiä (eds), *Encyclopedia of Digital Government* (Idea Group 2007) 192.

[135]Lynda Davies and Geoff Mitchell, 'The Dual Nature of the Impact of IT on Organizational Transformations' in Richard Baskerville and others (eds), *Proceedings of the IFIP WG8. 2 Working Conference on Information Technology and New Emergent Forms of Organizations: Transforming Organizations with Information Technology* (North-Holland Publishing Co 1994).

system. It may become an unsurmountable barrier to change, as it overly constrains options and imposes too high costs on reform efforts.[136] Despite the hype regarding the re-configurability of ICT,

> ... ministers cannot 'join-up' information at the flick of a switch. New IS systems still have to be hardwired, often at considerable financial cost. Datasets have to be reformatted, and administrative codes have to be reconfigured to allow this to occur.[137]

A holistic understanding of the consequences of ICT for reform efforts requires looking beyond changing the law to consider elements which lawyers may not immediately consider:

> In order to fully account for the complex dynamic patterns of ICT-based innovation in the public sector we must also consider the institutional and organisational components of the installed base, which comprise the existing institutional arrangements, the organisational routines and capabilities *and* the established legal codes and frameworks. Depending on the specific characteristics of the institutional installed base, new organisational configurations and capabilities and new ICT solutions can be fostered or hindered.[138]

Resistance to ICT-Driven Change

Decisions about the implementation and operation of ICT systems are ultimately political issues, and as ICT becomes more and more central to the operation of the modern organization, the political challenges in the successful execution of ICT strategies become more significant.[139] This thesis focuses on the sharing of information, internally and externally, and that can become an intensely political issue. With shared databases, it can be difficult to find individuals or departments who are willing to take responsibility for errors in data entry. If sharing is mandated from

[136] Lanzara (n 78) 19.
[137] Bellamy (n 7) 95.
[138] Lanzara (n 78) 18.
[139] Bruce Rocheleau, 'Politics, Accountability, and Governmental Information Systems' in G David Garson (ed), *Public Information Technology: Policy and Management Issues* (Idea Group Publishing 2003) 22-23.

higher-up in the hierarchy, it can be resisted by, for example, the provision of poor quality information. Failures will be attributed to quite different factors, depending on the perspective of the individual or the unit speaking.[140]

Allen and her colleagues present a detailed study of the implementation of an 'information strategy' for Fisheries and Oceans Canada (FOC). An organization like this, charged with managing a large, complex, and incompletely-understood natural resource, is an ideal case study for the purposes of this thesis as its work is very much driven by data, information, and knowledge. Social, economic, and environmental pressures require it to make decisions on whether or not to open fisheries in increasingly short times, sometime a matter of days or hours. The availability of ICTs have created a new context in which it must work collaboratively with a network of NGOs in order to maintain its legitimacy.[141]

FOC has therefore put in place an IT strategy focused on using data for greater effectiveness and efficiency. However, there is resistance to such efforts at the top levels of the organization, because of a lack of understanding, and a conception of IT as a cost rather than as an enabler of innovation limits the possibility of transformative change.[142] Externally, the government ministry involved focuses excessively on hard science, seen as something that can be transformed into data to be measured and manipulated through ICT,[143] and ignores the wider context:

> In an organization that mediates between an incomplete scientific understanding of the environment and human behaviour, the limits of science must be recognized. There needs to be space to appreciate the local, the contextual, and the tacit. Management in such contexts demands an iterative approach where managers acknowledge that objectives are moving targets and employ probabilistic models. IT can impact the formal and informal knowledge systems that have an important

[140] Rocheleau (n 139) 31–32.

[141] Barbara Allen and others, 'The Organizational Culture of Digital Government: Technology, Accountability and Shared Governance' in Alexei Pavlichev and G David Garson (eds), *Digital Government: Principles and Best Practices* (IGI Global 2004) 82.

[142] ibid, 86.

[143] ibid, 88–9.

> role to play in developing an adaptive approach but it is only one piece of the puzzle; the relationship between those with the technology and those with the knowledge and/or problem must also be nourished.[144]

In addition, FOC is excessively defensive about what data it is willing to release to the outside world, something which inhibits both its engagement with stakeholders and the development of informed citizens, something which is vital to the growth of e-government. A more integrated, holistic approach which acknowledges the social, the tacit, and the informal is required in order for ICT to be an effective part of a strategy for improving the functioning of regulatory bodies which rely on the skill and expertise of highly-trained and educated staff.[145] I will attempt to build a more contextually-aware model of ICT in Part III.

3.3.5 Need for a Broader Understanding

The consequences of widespread adoption of ICT are setting-specific. It is not a neutral tool but a political intervention into a dynamic system. The final result is not certain or predictable, and may consolidate rather than revolutionize the existing arrangements of routine and power.[146] There is therefore a need for an understanding of the broader context in which these efforts take place:

> ICT developments in the public sector should pay more attention to the complexity that is associated with their implementation, rather than focusing on best practices and universal strategies to prescribe how to successfully implement e-Government programmes. Outcomes of public sector reforms have in fact an impact on social and political dimensions that are not accounted for in private sector frameworks[.][147]

Zouridis and Thaens point out that no technology is socially, culturally, or ideologically neutral and claim that the ideology underlying e-government is one of

[144] ibid, 89.
[145] ibid, 90–93.
[146] Bekkers and Homburg, 'E-Government as an Information Ecology' (n 28) 9–10.
[147] Antonio Cordella and Federico Iannacci, 'Information systems in the public sector: The e-Government enactment framework' (2010) 19(1) Journal of Strategic Information Systems 52, 53.

information with a resulting bias to define all issues in those terms. This has a number of consequences: the solidification of power by creating stable definitions of data and structures of relationships; a rationalization of public policy; the transformation of legal processes into administrative-technical ones, with more automation, less individual discretion and no institutional learning; and citizenship becoming 'consumership'.[148]

Although electronic tools offer new possibilities for reinventing the process of democratic government, it can also exacerbate existing problems or create new ones by reinforcing social and educational divides or trivialising the political and electoral process. Individual citizens may be unable to properly inform themselves because they do not have the time, tools, or ability to engage with an increasingly digital bureacracy. Online debates may become unnecessarily and unhelpfully heated. If they can vote easily and often, they may do so without much thought or connection to long-term outcomes.[149]

A digital process may allow more comments to be submitted to a consultation process, but more comments are not necessarily better or more representative. Digital tools, by themselves, will not solve the barriers to widespread and useful public participation, such as lack of knowledge, education, or time. They may also damage the process by tilting the balance in favour of those who can submit rather than providing a mechanism for selecting the suggestions that best advance the public interest.[150]

---

[148]Zouridis and Thaens, 'The Anatomy of E-Government' (n 59) 28–31.

[149]Andrew Korac-Kakabadse and Nada Korac-Kakabadse, 'Information Technology's Impact on the Quality of Democracy: Re-Inventing the "Democratic Vessel"' in Richard Heeks (ed), *Reinventing Government in the Information Age: International Practice in it-Enabled Public Sector Reform* (Routledge 1999).

[150]Cary Coglianese, 'E-Rulemaking: Information Technology and the Regulatory Process' (2004) 56 Administrative Law Review 353.

3.3.6 Improving E-Regulation

These difficulties do not mean that we should abandon the application of ICT in environmental regulation, or elsewhere in the operation of government. ICT has the potential to make a significant contribution to improving administrative and regulatory processes, and thus the quality of life overall:

> In theory, everything that IT can do could be done by some other means. In practice, its ability to increase the speed and/or reduce the cost of information tasks means that it can do things that would not otherwise be contemplated. IT therefore does bring change and has three basic change potentials within reform:
>
> *Supplant*: automate existing human-executed processes which involve accepting, storing, processing, outputting or transmitting information. For example, the automation of existing clerical functions.
>
> *Support*: assist existing human-executed processes. For example, assisting existing processes of government decision-making, communication and decision in implementation. (This can also be seen as a potential to *empower* if IT assists the activity of citizens outside government.)
>
> *Innovate*: create new IT-executed processes or support new human-executed processes. For example, creating new methods of public service delivery.[151]

The application of ICT in government could be improved by flexible design which allows systems to cope with changing political preferences and to engage in institutional learning, taking into account the need to protect individual rights and privacy from an all-knowing state, and creating explicit capacity for self-reflection in the evolution of systems and processes.[152]

In addition, the potential for increased transparency provides the opportunity for significant improvements in the functioning of government. If regulatory data is made available to the public in electronic form, it can be combined with data from other sources, public or private, in new and interesting ways. For example, Scorecard collects together information from US government databases, and many

[151] Heeks (n 15) 17.

[152] Zouridis and Thaens, 'The Anatomy of E-Government' (n 59) 33–34.

other sources, to provide an easy-to-access (searchable by zipcode) source for the public to learn about environmental issues in their locality.[153] The Tropical Ecology and Monitoring Network gathers information about biodiversity in distributed sites, collects it using mobile technology and disseminates it globally.[154] This type of regulatory innovation should be encouraged: when data is made publicly available, it should be in open, documented formats or accessible through an Application Programming Interface which allows other services to re-use it. However, achieving these improvements will not be a straightforward process. There are significant obstacles in the way of using ICT for genuine progress.

3.4 The Need to 'Get It Right First Time'

Information and communications technology can bring about significant productivity improvements, but a tendency to cling to old practices in an inefficient way means that in business, it seems that the best way to implement new ICT-focused work practices is to start from scratch with a "greenfield" approach.[155] This is often not possible in the context of the public and civil service. However, it is very important to build the best system possible at the outset, as it can be very difficult to change it later.[156] Classifications, and systems to manage and manipulate them, become the foundations for perspectives on the world, incorporating important and irreversible relationships of power and knowledge.[157] The 'installed base' can take on a 'life of its own'[158] and information infrastructures can 'easily become irre-

[153] GoodGuide, 'Scorecard' (2014) ⟨http://www.scorecard.org⟩ accessed 27 August 2014.

[154] Conservation International, 'Tropical Ecology, Assessment and Monitoring Network' ⟨http://www.teamnetwork.org⟩ accessed 27 August 2014.

[155] Erik Brynjolfsson and Lorin M Hitt, 'Beyond Computation: Information Technology, Organizational Transformation and Business Performance' (2000) 14(4) Journal of Economic Perspectives 23, 27.

[156] Jannis Kallinikos, 'Farewell to Constructivism: Technology and Context-Embedded Action' in Chrisanthi Avgerou, Claudio Ciborra, and Frank Land (eds), *The Social Study of Information and Communication Technology: Innovation, Actors and Contexts* (Oxford University Press 2004).

[157] Geoffrey C Bowker, 'Biodiversity Datadiversity' (2000) 30(5) Social Studies of Science 643.

[158] Lanzara (n 78) 24.

versible as they grow… because everybody communicating has to use the same standard.'[159] Once choices and commitments are made, flexibility is lost and what seemed at the time to be minor details can emerge as significant consequences with the passage of time.[160]

The process of creating ICT systems that support government and regulatory activity is not straightforward, and can be hampered by a lack of understanding on both the legal and technical side. Some twenty years ago, Schartum highlighted the unfortunate absence of lawyers from project teams developing computer systems for government administration in Norway,[161] a situation doubtless repeated elsewhere. More recently, Meneklis and Douligeris present a detailed case study of the implementation of a pan-European egovernment project to provide enterprise services to municipalities in different jurisdictions, from which they conclude that

> … the difficulties which the project's consortium faced were mainly due to lack of experienced legal advisors for the municipalities, to different perspectives on concepts such as 'platform effectiveness' created by legal and technical viewpoints, to lack of experienced ICT consultants in some municipalities and most importantly to lack of compatibility between legal frameworks of participating municipalities.[162]

It is clear, therefore, that the implementation of an ICT system in a government context will begin to have an impact on legal processes and instruments; if the context is not properly understood and the system is not well-designed at the outset,

---

[159] Eric Monteiro and Ole Hanseth, 'Social Shaping of Information Infrastructure: On Being Specific About the Technology' in WJ Orlikowski and others (eds), *Information Technology and Changes in Organizational Work* (Chapman and Hall, London 1996) 338.

[160] Langdon Winner, 'Do Artifacts Have Politics?' in *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (University of Chicago Press 1986) 29.

[161] Dag Wiese Schartum, 'Dirt in the Machinery of Government—Legal Challenges Connected to Computerized Case Processing in Public Administration' (1994) 2 International Journal of Law and Information Technology 327, 346–7.

[162] Vassilis Meneklis and Christos Douligeris, 'Technological Integration: Evidence of Processes of Structuring in Governmental Organizations' in Tomasz Janowski and Theresa A Pardo (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (ICEGOV '08)* (Association for Computing Machinery 2008) 22 (citations omitted).

this is likely to degenerate into a destructive feedback cycle.[163]

Even if the effort is made to ensure that problems are correctly diagnosed, legal issues are comprehensively identified in advance, and a full picture of the social issues that arise are incorporated into the solutions, the use of ICT may nonetheless bring about deep transformations in the ways in which issues are identified and solved: '[t]he study of problems not amenable to automation may be abandoned, the study of others may be restructured for efficient data handling, and new problems may be adopted that focus explicitly on technical issues.'[164]

In a discussion of the implementation of ICT in the criminal investigation and prosecution process in the UK, Cordella and Iannacci make two important points about the stickiness of e-government reform and the potential which that reform has for changing the legal landscape, sometimes without it being noticed:

> First, the fact that technology can be a carrier of e-Government aims in a context where e-Government policies are shifting and transient may imply that that the technology chosen and designed by e-Government reforms may have a long-term impact that outlives the very aims that have initially informed the reform. ...
>
> Second, these long-lasting effects are part of the forces which are 'capable of triggering dynamics whose unintended and unanticipated consequences may nevertheless follow a contextual logic' ... so that create [sic] a legacy which is part of the e-Government architecture and therefore of the policies which are associated with it. ... Changes in the organization of the public sector can change the nature of the services provided by public administrations and therefore have profound effects on the enforcement of the fundamental principles that govern the action of democratic States ...[165]

Morison argues that the application of interactive Internet technologies and user-generated content to government dealings with citizens is a significant consti-

[163] Andrew Chadwick and Christopher May, 'Interaction between States and Citizens in the Age of the Internet: "e-Government" in the United States, Britain, and the European Union' (2003) 16(2) Governance 271, 273.

[164] Howard Veregin, 'Computer Innovation and Adoption in Geography: A Critique of Conventional Technological Models' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 97.

[165] Cordella and Iannacci (n 147) 64.

tutional change.[166] A similar argument could be made for the application of ICT within government, particularly regulatory bodies. Despite the resulting need for cross-disciplinary conversations and studies, lawyers, e-government scholars, and practitioners do not seem to work together that often. For example, Scholl does not include law in his list of 'core disciplines' in the field of electronic government.[167] It is vital to look beyond the undeniable advantages of ICT in the regulatory process, and the enthusiastic claims made by those who seek to bring forward reforms built around these new tools, and to look at the broader context, including the value and ethical choices to be made.[168] In order to fully explore the issues which this raises, it is necessary to consider the development of regulation in theory and practice, a task which is undertaken in the next chapter.

[166] John Morison, 'Gov 2.0: Towards a User Generated State?' (2010) 73(4) Modern Law Review 551, 564.

[167] Hans J Scholl, 'Electronic Government: Introduction to the Domain' in Hans J Scholl (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010) 3.

[168] Victor Bekkers, 'Is There a Future for E-Government? Looking beyond the explanitory emptiness of the e-government concept' (2011) ⟨https://www.scss.tcd.ie/disciplines/information_systems/egpa/docs/2011/Paper%20-%20Bekkers.pdf⟩ accessed 27 August 2014, 16.

Chapter 4

ICT and Environmental Regulation: Theoretical and Practical Foundations

This thesis is fundamentally concerned with the ways in which information and communications technology (ICT) alters processes of regulation in ways that are significant for lawyers. This chapter provides some context by explaining 'regulation' and briefly discussing the significant schools of regulatory theory as aspects of these will be applied later. It also outlines how regulation is applied in the modern context and the development of environmental regulation (ER).

4.1 Narrow and Broad Conceptions of Regulation

Regulation, broadly defined, is any mechanism to control human behaviour. Scholars have put forward a number of different definitions of regulation, highlighting different aspects of a multi-faceted topic.[1] One of the fundamental and often-cited definitions takes a broad perspective on what constitutes a regulatory system:

> ... [A]ny control system in art or nature must by definition contain a minimum of ... three components ... There must be some capacity for *standard-setting*, to allow a distinction to be made between more or less preferred states of the system. There must also be some capacity for *information-gathering* or monitoring to produce knowledge about current or changing states of the system. On top of that must be some

[1] Carol Harlow and Richard Rawlings, *Law and Administration* (Cambridge University Press 1997) 295.

> capacity for *behaviour-modification* to change the state of the system.[2]

Within this wide ambit, there are different points of view, moving from a narrow to a broad understanding:

> [There are] three broad types of definitions which have been identified in some of the main 'textbooks' on regulation. In the first, regulation is the promulgation of rules accompanied by mechanisms for monitoring and enforcement. The usual assumption is that government is the rule-maker, monitor, and enforcer, usually operating through a public agency. The second definition keeps to the government as the 'regulator' but broadens the techniques that may be described as 'regulation' to include any form of direct state intervention in the economy, whatever form that intervention might take. In the third definition, regulation includes all mechanisms of social control or influence affecting behaviour from whatever source, whether intentional or not.[3]

At one end of the continuum, writing from the perspective of the regulator, Connery and Hodnett rely on Stone's definition of regulation as 'a state imposed limitation on the discretion that may be exercised by individuals or organizations, which is supported by the threat of sanction'[4] and put forward the view that

> [r]egulation is the use of [the power to coerce] ... for the purpose of restricting the decisions of economic agents. Economic regulation typically refers to State-imposed restrictions on individuals' and firms' decisions on price, quantity, and entry and exit.[5]

This is the traditional 'centred' perspective on regulation as 'regulation by the state, which is often assumed to take a particular form, that is the use of legal rules backed by criminal sanctions: "command and control" (CAC) regulation'.[6]

Other authors have taken a standpoint beyond the positivist and economic. Selznick, for example, sees regulation as 'sustained and focused control exercised

[2]Christopher Hood, Henry Rothstein, and Robert Baldwin, *The Government of Risk: Understanding Risk Regulation Regimes* (Oxford University Press 2001) 23 (emphasis in original).

[3]Julia Black, 'Decentring Regulation: Understanding the Role of Regulation and Self Regulation in a "Post-Regulatory" World' (2002) 54 Current Legal Problems 103, 129 (citations omitted).

[4]Alan Stone, *Regulation and Its Alternatives* (Congressional Quarterly Press 1982) 10.

[5]Niamh Connery and David Hodnett, *Regulatory Law in Ireland* (Tottel Publishing 2009) 25.

[6]Black, 'Decentring Regulation' (n 3) 105.

by a public agency over activities that are valued by a community'.[7] Similarly, according to Ogus, regulation is the implementation mechanism for

> ... the collectivist system ... [in which] the state seeks to direct or encourage behaviour which (it is assumed) would not occur ... to correct perceived deficiencies in the market system in meeting collective or public interest goals ...[8]

Such regulation has three characteristics: 'the ideal of control by a superior'; being a part of public rather than private law (Ogus sees regulation as having no role in what he calls the 'market system'); and 'typically *centralized*.'[9]

It is important to note that these various understandings or perspectives on regulation see the state as central. In contrast, Baldwin and others put forward a more nuanced understanding, which recognises that attempts to control behaviour may emanate from different loci of power, and claims that regulation consists of:

> ... *a specific set of commands* ... [that] involves the promulgation of a binding set of rules to be applied by a body devoted to this purpose ...
>
> *deliberate state influence* ... [that] has a more broad sense ...[which] covers all state actions designed to influence industrial or social behaviour ...
>
> *all forms of social control or influence* ... [including] all mechanisms affecting behaviour—whether these be state-derived or from other sources (e.g. markets) ... [with] no requirement that the regulatory effects of a mechanism are deliberate or designed rather than merely incidental to other objectives.[10]

Given the particular focus of this research on the bureaucratic internals of the regulatory system, it is also appropriate to highlight a definition which draws attention to duality:

---

[7] Philip Selznick, 'Focusing Organizational Research on Regulation' in Roger G Noll (ed), *Regulatory Policy and the Social Sciences* (University of California Press Berkeley and Los Angeles 1985) 363.

[8] Anthony I Ogus, *Regulation: Legal Form and Economic Theory* (Hart Publishing 2004) 1–2.

[9] ibid, 1–2 (emphasis in original).

[10] Robert Baldwin, Martin Cave, and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 3 (emphasis in original).

> ... a [regulatory] system [is] composed of two types of rules:
>
> 1. A set of rules of conduct by which a state seeks to control the manner in which certain activities—usually economic activities—are carried out (hereinafter referred to as a regulatory regime); and
> 2. A set of rules or practices governing the manner in which these rules of conduct that constitute the regulatory regime are established (the regulatory process).[11]

Building on this, the definition of regulation used in this thesis is any means of social control and behaviour modification, whether coming directly or indirectly from the state or through limits imposed by private parties. In what follows, I will expand on this definition by highlighting the salient aspects of the most significant schools of thought on the topic, building towards a general picture that can be used as context for the specific discussion of the application of ICT for regulation in the following chapters.

4.2 The Rise of Regulation

In legal practice and scholarship, the word 'regulation' has developed a specific technical meaning: the frameworks of licensing, enforcement, and sanctions that are developed to manage economic activity in specific areas. These are often related to technically developed and advanced sectors, sometimes involving the opening of a market hitherto in the exclusive control of a government-owned monopoly, to competition from private firms. Regulation is often an attempt by the state to manage a market while not controlling it too tightly; to allow innovation and efficiency to progress while at the same time ensuring that certain social political and moral goals are achieved in a context of increasing globalization and destabilization of existing markets by innovative technology.

This is a technocratic approach to market governance. Regulatory schemes can involve the development of a complex matrix of rules and regulations and reports

[11] J Paul Salembier, 'Designing Regulatory Systems: A Template for Regulatory Rule-making—Part I' (2002) 23(3) Statute Law Review 165, 169.

which firms must comply with. This leads, in turn, to complaints from business and those who represent them about 'red tape' and, in response, the development by politicians of 'regulatory quality initiatives' and an overall 'better regulation' agenda. These debates, and their outcomes, make it a relatively young but rapidly developing and inherently interdisciplinary field of study. In addition to the rapidly-growing literature emerging from a legal perspective, economists, sociologists, and psychologists all contribute to an increasingly-detailed examination of the field.

As modern economies become more sophisticated and the pace of economic and technical change accelerates, the perceived need for more and more regulation has become more intense. In certain markets, such as financial services, there is a growing perception that business cannot be trusted. This is particularly underlined by recent economic events (the so-called 'credit crunch'), which undermined faith in the 'invisible hand' of the market as an infallible pointer towards economic progress. The increasing importance and volume of European legislation has led to an environment of hyper-regulation and great concern about the regulatory burden that this places on entrepreneurs, innovators, and businesses generally.

Technology is also an important element in the growth and expansion of regulation. First of all, new technology facilitates the creation of new markets, often with the potential to bring about rapid social and economic change. Governments seek to control or manage this process both because of the potential impact on livelihoods in incumbent industries and also because they are concerned about the moral implications of new developments such as the application of biotechnology for human reproduction. Technology also creates new opportunities and modes of regulation. For example, the new surveillance capacities provided by closed-circuit television and e-mail interception allows governments to oversee and intervene in the lives of individuals to a hitherto impossible extent.

4.3 Schools of Regulatory Theory

In this section, I adopt Morgan and Yeung's classification of regulatory theories into three broad categories. These are public interest theories, private interest theories, and institutionalist theories.[12]

4.3.1 Public Interest Theories

Public interest theories encompass welfare economics approaches, where regulation is seen as a means of correcting market failures; and political approaches, which give consideration to non-economic values, such as social or racial equality (priorities which are identified through political dialogue and deliberative processes). From a welfare approach, regulation is focused on dealing with economic issues, such as market failures, misbehaving monopolies, abusive behaviour or externalities (such as pollution).[13] In addition, a political approach sees regulation as having a role in resolving political issues, such as equality or environmental protection.[14]

4.3.2 Private Interest Theories

Private interest theories are more sceptical about the positive outcomes of regulation and are concerned about the phenomena of regulatory failure and regulatory capture. Political private interest theories see regulation as emerging from the lobbying efforts of interest groups. Economic private interest approaches, particularly public choice theory, see regulation as something that can be bought and sold in the political marketplace.

One example of a political private interest theory is neopluralism, which claims that interest groups compete with each other using political tools, such as votes, in

[12] Bronwen Morgan and Karen Yeung, *An Introduction to Law and Regulation: Text and Materials* (Cambridge University Press 2007) 16.

[13] Michael E Levine and Jennifer L Forrence, 'Regulatory Capture, Public Interest, and the Public Agenda: Toward a Synthesis' (1990) 6 Journal of Law, Economics, and Organization 167, 168.

[14] Cass R Sunstein, *After the Rights Revolution: Reconceiving the Regulatory State* (Harvard University Press 1993) 56–68.

order to persuade the state to produce outcomes that are favourable to their members, including supportive regulatory frameworks. This process continues to an equilibrium position in which some win and some lose.[15]

Public choice models, on the other hand, are more cynical about the final outcome, seeing this as more of a 'marketplace', with regulation as the commodity. However, the long-term outcomes are negative, as it is not possible to opt out of the 'market', bad regulations tend to last longer than poor purchases, and decision-making is collective rather than individual.[16]

4.3.3 Institutional Theories

Institutionalist theories are more diverse and complex. This group of theories includes at least three sub-theories. First, tripartism encompasses both public and private interest theories, but with a focus on the dynamics of negotiation, and argues for explicit provision to be made for public interest groups in that process. Second, regulatory space theories focus less on the actors and their interests and more on the unique political, social, and economic context within which regulation is negotiated. They give explicit recognition to the place of non-state actors in regulation. Finally, systems theory looks at the inter-relationships of regulatory systems and their tendency to follow existing patterns. This also has particular relevance to ICT, which operates simultaneously within technical, commercial, and social contexts and constraints. I explore these theories below in order to build a more sophisticated picture of the reality of regulation.

Tripartism, a model put forward by Ayres and Braithwaite, claims that regulation is not a once-and-for-all process but rather a game with multiple iterations, more than one side, and players who are on more than one side.[17] In addition to this

[15] Steven P Croley, 'Theories of Regulation: Incorporating the Administrative Process' (1998) 98 Columbia Law Review 1, 57–9.

[16] ibid, 34–8.

[17] Ian Ayres and John Braithwaite, *Responsive Regulation: Transcending the Deregulation Debate* (Oxford University Press 1992) 54–5.

descriptive element, the theory of tripartism also contains a normative argument—that the 'game' of regulation should have a third player, a public interest group to balance the process.[18] This proposal is not explored further in this thesis; what is important to take away from this theory is that regulation is an ongoing process.

Baldwin has argued that Ayres and Braithwaite's ideas of 'responsive regulation' should be combined with ideas from government-led initiatives for 'better regulation' in order to deliver 'smart regulation';[19] and writing with Black, that

> ... regulators have to be responsive not only to the compliance performance of the regulated, but in five further ways: to the firms' own operating and cognitive frameworks (their 'attitudinal settings'); to the broader institutional environment of the regulatory regime; to the different logics of regulatory tools and strategies; to the regime's own performance; and finally to changes in each of these elements.[20]

This underlines the importance of seeing regulated entities in as broad as context as is feasible.

One way of achieving this is through 'regulatory space' theories, particularly as proposed by Hancher and Moran, which provide an additional dimension, an awareness of the importance of context—the particular national setting, which will have distinctive political, legal, and cultural features. They also highlight that attention should be paid not only to those who are included in this 'space' but those who are not. As institutions regularize and routinize their relationships, the powerless are increasingly left out and behind and the issues that they want to raise cannot find an entry point.[21] This perspective is particularly important for this thesis, which deliberately focuses its attention on the routine, the fixed framework, and the algorithm, all of which significantly shape the overall space within which regulation is devised and elaborated.

[18] Ayres and Braithwaite (n 17) 56.

[19] Robert Baldwin, 'Is Better Regulation Smarter Regulation?' [2005] Public Law 485.

[20] Robert Baldwin and Julia Black, 'Really Responsive Regulation' (2008) 71 Modern Law Review 59, 61.

[21] L Hancher and M Moran, 'Organizing Regulatory Space' in Robert Baldwin, Colin Scott, and Christopher Hood (eds), *A Reader on Regulation* (Oxford University Press 1989) 153–5.

With this awareness of regulation as an ongoing process which must be seen in context, it becomes clear that regulatory systems will change and evolve in particular ways, often determined by their initial configuration, such that small differences between industries and regulatory institutions will lead to quite divergent, yet static, arrangements with the passage of time. This is the key insight of systems theory, put forward chiefly by Teubner and Luhmann, which highlights that '[w]e have ... to reformulate the hierarchical relation of regulation to a circular interaction between three self-referential systems (law, politics, regulated subsystems).'[22] Law interacts with other social subsystems by taking in new input (ideas, challenges, and programs) and re-formulating them in its own terms (legality/illegality) while remaining oblivious to (or resisting) efforts to force it to adopt external frames of reference.[23] If we think of a particular regulatory system in this way, as a self-enclosed, self-perpetuating whole, we realise that it will continue to replicate itself into the future, with only limited opportunity for meaningful change generated by external forces:

> This whole way of thinking ... [suggests that] one has to give up concepts of comprehensive social planning since they are utopian and unrealistic and replace them with more realistic models in which limited strategic knowledge is combined with social interaction, that is in our concept the interaction between the two black boxes [of law and politics, seen as closed self-referential systems] in order to reach guidance effects within one of the black-boxes.[24]

To summarise, 'regulation-in-action' is anything but simple: regulatory systems develop their own logics with time; they continue to affirm those logics (something called variously self-referential processes, autopoiesis or second-order-cybernetics); and change, particularly radical change, is difficult, if not impossible to produce. The initial conditions or starting context is very important, as are the

[22] Gunther Teubner, *Dilemmas of Law in the Welfare State* (Walter De Gruyter 1986) 310.

[23] Roger Cotterrell, 'Law in Social Theory and Social Theory in the Study of Law' in Austin Sarat (ed), *The Blackwell Companion to Law and Society* (Blackwell Publishing Ltd 2004) 22.

[24] Teubner, *Dilemmas of Law* (n 22) 320–1.

'rules of the game'. Because of this, it is naive to think that a regulatory initiative can solve a problem immediately, particularly if it is a large-scale issue, and a clear understanding of the frames, limits, and structures of regulatory processes are vitally important.

The above suggests that the application of ICT to regulation in practice is likely to be much more problematic than it seems at first glance. Inherent in the regulatory process is the fact that it is ongoing: a feedback loop of monitoring, intervention, and response which inevitably becomes a 'long game'. This, in turn, creates the possibility of capture and corruption and develops its own logic of salient issues, flashpoints, and exclusions. Adding ICT to this mix can create new possibilities which are either positive or negative from the point of view of the public interest: greater transparency and individual empowerment but also a faster feedback cycle and more exclusion of those without technical and scientific capacity.

4.4 Modern Regulation

The modern context for the study of regulation has a number of interesting features: the rise of 'governance' as an addition to, or replacement of, 'regulation' as a perspective to guide state intervention in the market; the concept of the 'regulatory', or even 'post-regulatory' state; New Public Management; and the related idea of a 'de-centred' state.

4.4.1 The 'Regulatory State'

Some twenty years ago, Majone identified how

> ... administrative regulation—economic and social regulation by means of agencies operating outside the line of hierarchical control or oversight by the central administration—is rapidly becoming the new frontier of public policy and public administration throughout the industrialized world.[25]

[25] Giandomenico Majone, 'The Rise of the Regulatory State in Europe' (1994) 17(3) West Euro-

In Europe, this is largely explained by budgetary constraints, the Commission expanding its remit, and pressure from multinationals for uniform rules.[26] Member states are willing to give this authority to the Commission because they know that direct inter-governmental efforts will not work well.[27] This gives rise to the modern 'Regulatory State', which Colin Scott defines as

> ... a complex set of changes in public management involving the separation of operational from regulatory activities in some policy areas (sometimes linked to privatization), a trend towards separating purchasers and providers of public services (through policies of contracting out and market testing) and towards separation of operational from policy tasks within government departments and the creation of executive agencies.[28]

This phenomenon has developed in different ways in different national contexts: in the US, by the state becoming involved in 'steering' the marketplace in the aftermath of the New Deal; in the UK, by the state withdrawing from the marketplace as it became more centralized; in Europe more broadly, from the efforts of the European Commission to complete the single market project, which has required member states to liberalise utility sectors and create independent agencies to ensure competition in newly-opened markets.[29] In light of the discussion of James Scott's pessimistic predictions as to the outcomes of rationalising, modernist reform initiatives,[30] it is important to note that Moran claims that these developments, at least in the UK, have their roots in high modernism, and links them to attempt to quantify, standardise, and centralise.[31] I have discussed the issues which these impulses create for the rule of law earlier in this thesis.[32]

---

pean Politics 77, 83.

[26] ibid, 88–9.

[27] ibid, 90.

[28] Colin Scott, 'Regulation in the Age of Governance: The Rise of the Post-Regulatory State' in Jacint Jordana and David Levi-Faur (eds), *The Politics of Regulation* (Edward Elgar 2004) 148.

[29] ibid, 148–9.

[30] See Section 7.4.3.

[31] Michael Moran, *The British Regulatory State: High Modernism and Hyper-Innovation* (Oxford University Press 2003) 11.

[32] See Section 2.3.

4.4.2 New Public Management

Closely related is the idea (or ideology) of so-called 'new public management' (NPM), which came to prominence in the 1980s and 1990s,[33] and made a significant difference to the practice of public administration.[34] It exchanges ideas with governance approaches but also somewhat contradicts it, as central control is one of its main principles.[35] It can particularly be connected with 'new governance' ideas,[36] which is a topic to which I will return later.[37]

NPM is a collection of ideas that have as their main focus the importation of private sector tools, such as efficiency, private sector approaches, privatization, and outsourcing, market-based mechanisms, and performance indicators[38] into the public service. These are in tension with the basic values of constitutional law.[39] The techniques used include reducing budgets, creating quasi-autonomous agencies from larger units, decentralization of management, procurement, performance management of staff (including pay and conditions), and a focus on 'quality'.[40] Scholars have identified four main models used in practice: efficiency; downsizing and decentralization; search for excellence; and a public service orientation.[41]

NPM has been criticized for unrealistic hype; not fully embracing the market; destabilizing existing structures and displacing public sector ethics; and creating

[33]Donald F Kettl, 'Public Administration At the Millennium: The State of the Field' (2000) 10(1) Journal of Public Administration Research and Theory 7, 25–27.

[34]Christopher Hood, 'A Public Management for All Seasons?' (1991) 69(1) Public Administration 3, 3.

[35]Erik Hans Klijn, 'New Public Management and Governance: A Comparison' in David Levi-Faur (ed), *The Oxford Handbook of Governance* (Oxford University Press 2012) 209–11.

[36]Kenneth W Abbott and Duncan Snidal, 'Strengthening International Regulation Through Transnational New Governance: Overcoming the Orchestration Deficit' (2009) 42 Vanderbilt Journal of Transnational Law 501.

[37]See Section 4.6.3.

[38]Klijn (n 35) 203–4.

[39]H Wade MacLauchlan, 'Public Service Law and the New Public Management' in Michael Taggart (ed), *The Province of Administrative Law* (Hart Publishing 1997) 118.

[40]Christopher Pollitt, 'Justification By Works or By Faith?: Evaluating the New Public Management' (1995) 1(2) Evaluation 133, 134.

[41]Ewan Ferlie and others, *The New Public Management in Action* (Oxford University Press 1996) 10–5.

opportunities for corruption, avoidance of hard work, and fragmented service delivery.[42] Its influence seems to have peaked in the middle of the last decade.[43] As the concept is difficult to define clearly and there is a lack of systematic studies, it is difficult to say if it made a significant difference in practice.[44]

The use of ICT in government follows pathways that are remarkably similar to NPM,[45] and the former may substantially support the latter,[46] particularly by facilitating the creation of more consumer-driven public services.[47] However, the strong links made between NPM and ICT in the early 1980s faded with time,[48] and while NPM may simply be a phase in the challenge which ICT creates for traditional, hierarchical bureaucracies,[49] it is likely to find it difficult to achieve its aims of re-orienting the public sector because of the inertia of institutions.[50] E-government[51] has continued the managerial reform approach of NPM.[52] Indeed, so-called 'digital era governance' may be supplanting NPM,[53] and entering into a 'second wave'.[54]

---

[42]Patrick Dunleavy and Christopher Hood, 'From Old Public Administration to New Public Management' (1994) 14(3) Public Money and Management 9, 10–2.

[43]Patrick Dunleavy and others, 'New Public Management is Dead—Long Live Digital-Era Governance' (2006) 16(3) Journal of Public Administration Research and Theory 467.

[44]Steven van de Walle and Gerhard Hammerschmid, 'The Impact of the New Public Management: Challenges for Coordination and Cohesion in European Public Sectors' (2011) 12(2) Administrative Culture 190.

[45]Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) 37.

[46]ibid, 37.

[47]ibid, 101.

[48]Patrick Dunleavy and others, *Digital Era Governance: IT Corporations, the State and E-Government* (Oxford University Press 2008) 96.

[49]Bellamy and Taylor (n 45) 150.

[50]ibid, 168–9.

[51]See Section 3.2.2.

[52]Matthias Finger, 'E-Gov and Public Sector Reform: What Roles for Government in E-Government?' in Thomas Janowski and Jim Davies (eds), *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance (icegov '09)* (Association for Computing Machinery 2009) 2.

[53]Dunleavy and others, 'New Public Management is Dead' (n 43); Dunleavy and others, *Digital Era Governance* (n 48) 3.

[54]Helen Margetts and Patrick Dunleavy, 'The Second Wave of Digital-Era Governance: A Quasi-Paradigm for Government on the Web' (2013) 371 Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences.

4.4.3 Move from 'Regulation' to 'Governance'

The word 'governance' has become increasingly current in recent years,[55] particularly in the wake of the so-called 'credit crunch' and the resulting financial crisis. This usage may simply be a passing fashion, but Lobel claims that we are seeing the emergence of a new model of management of the economy, a move away from the territorial, hierarchical, and controlling structures put in place in the 1930s and 1940s to a paradigm which is more global and pluralist but less interventionist.[56] There is no universally accepted definition of governance,[57] and it encompasses a number of different conceptions of control,[58] but it could be seen in general terms as 'effective co-ordination when power, information and resources are widely distributed.'[59] One possible definition is as

> ... a process of governing which departs from the traditional model where collectively binding decisions are taken by elected representatives within parliaments and implemented by bureaucrats within public administrations. ... [It] is often described as a process of co-ordination within networks ... [T]he core meaning of governance [is] steering and co-ordination of interdependent (usually collective) actors based on institutionalized rule systems.[60]

Although the word has a long history, the modern version was promulgated by the World Bank, to encompass the form of political regime, the process by which authority is exercised, and the capacity of the government to function. It is the promotion of democratic statehood and civil society.[61] In the field of environmen-

[55] Andrew Jordan, KW Wurzel, and Anthony Zito, 'The Rise of "New" Policy Instruments in Comparative Perspective: Has Governance Eclipsed Government?' (2005) 53(3) Political Studies 477.

[56] Orly Lobel, 'The Renew Deal: The Fall of Regulation and the Rise of Governance in Contemporary Legal Thought' (2004) 89 Minnesota Law Review 262, 344.

[57] Jordan, Wurzel, and Zito, 'Has Governance Eclipsed Government?' (n 55) 478.

[58] Reinhard Steurer, 'Disentangling Governance: A Synoptic View of Regulation By Government, Business and Civil Society' (2013) 46(4) Policy Sciences 387, 388.

[59] Gilles Paquet, 'Governance in the Face of Sabotage and Bricolage' (2001) 24(3) Canadian Parliamentary Review 11, 11.

[60] Oliver Treib, Holger Bähr, and Gerda Falkner, 'Modes of Governance: Towards a Conceptual Clarification' (2007) 14(1) Journal of European Public Policy 1, 3.

[61] Christoph Möllers, 'European Governance: Meaning and Value of a Concept' (2006) 43 Common Market Law Review 313, 314.

tal protection, it can be defined as 'attempts by governing bodies or combinations thereof to alleviate recognized environmental dilemmas.'[62] In environmental regulation, examples of such application include the Toxics Release Inventory,[63] the National Environmental Policy Act, and habitat conservation planning under the Endangered Species Act, with the granting of permits to those who submit satisfactory Habitat Conservation Plans.[64] These principles have obvious connections to the development of the 'network society',[65] with the US government making provision for electronic participation in its rule-making processes.[66] It is in this context that we see the development of governance models of environmental regulation, particularly informational regulation, a topic to which I will return in this chapter[67] and the next.[68] These approaches, sometimes called 'new governance', will either co-exist with, replace, or seek to displace traditional legal methods of regulation.[69]

4.4.4 The Development of the 'Post-Regulatory State'

It is possible to extrapolate from these observations regarding the ways in which regulation is changing in response to new economic, technological, and social realities (and also driven by political and academic fashions), and conclude that power no longer resides solely in the hands of the state (if it ever did):

> The post-regulatory state [examines] ... other bases of control than hierarchy in state law—notably the norms and practice of society and communities; the tendency towards rivalry and competition in organisational settings; and the capacity of design (for example of buildings

[62] Debra J Davidson and Scott Frickel, 'Understanding Environmental Governance: A Critical Review' (2004) 17(4) Organization and Environment 471.

[63] See Section 6.3.3.

[64] Lobel (n 56) 426–32.

[65] Manuel Castells, *The Rise of the Network Society: The Information Age: Economy, Society, and Culture* (John Wiley and Sons 2011).

[66] Lobel (n 56) 438–40.

[67] See Section 4.6.3.

[68] See Section 5.4.5.

[69] David M Trubek and Louise G Trubek, 'New Governance and Legal Regulation: Complementarity, Rivalry, and Transformation' (2006) 13 Columbia Journal of European Law 539.

or software) for controlling behaviour.[70]

This leads to a more complex and sophisticated picture of modern regulation, as something which is moving beyond the central control of the state, which does 'less rowing and more steering' and shares that work of steering.[71] Of course, the state has long engaged in the 'privatization' of certain functions, such as policing, through the offering of rewards.[72] It now also enlists private entities in regulation by, for example, requiring financial institutions to verify suspicious transactions or airlines to confirm the travel documents of international passengers; or through disclosure requirements[73] which help consumers to make 'better' choices (for example, energy requirements labelling).[74] However, this development should not be over-generalised; the state is re-asserting its pre-eminent role in the governance.[75] Closely associated with this idea of a post-regulatory state are John Morison's claim that there is 'a change in the site of government'[76] and Julia Black's suggestion that the state has become 'decentred', by which she means

> ... that governments do not, and the proposition that they should not, have a monopoly on regulation and that regulation is occurring with and between other social actors, for example large organizations, collective associations, technical committees, professions etc., all without the government's involvement or indeed formal approval...[77]

---

[70]Scott, 'Regulation in the Age of Governance' (n 28) 147.

[71]Leighton McDonald, 'The Rule of Law in the "New Regulatory State"' (2004) 33 Common Law World Review 197, 199.

[72]Peter N Grabosky, 'Beyond the Regulatory State' (1994) 27(2) Australian and New Zealand Journal of Criminology 192, 193.

[73]See Section 6.3.

[74]ibid, 193–5.

[75]Peer Zumbansen, 'Law After the Welfare State: Formalism, Functionalism, and the Ironic Turn of Reflexive Law' (2008) 56(3) American Journal of Comparative Law 769; Stephen Bell and Andrew Hindmoor, *Rethinking Governance: The Centrality of the State in Modern Society* (Cambridge University Press 2009).

[76]John Morison, 'Modernising Government and the E-Government Revolution: Technologies of Government and Technologies of Democracy' in Nicholas Bamforth and Peter Leyland (eds), *Public Law in a Multi-Layered Constitution* (Hart Publishing 2003) 166.

[77]Black, 'Decentring Regulation' (n 3) 104.

4.5 Contextualizing Regulation in the Early Twenty-First Century

The volume of writing on theoretical understandings of regulation, histories of its application in practice, and predictions as to how it might develop in the future is considerable. This thesis can only consider this literature in a cursory way, but the exposition above highlights a number of points which are important for the discussion that is to follow. Understandings of regulation can extend from a focus on the management of markets, largely through unilateral and traditional legal instruments, to a more holistic process which includes civil society and recognises the important role that non-traditional, non-legal interventions can have in managing and changing behaviour.

Academic writers have also underlined the importance of considering social values, political choices, and potential negative long-term consequences of regulatory decisions. In addition, a full understanding of regulation must be founded on an exploration of the specific context within which it operates, the power relationships within that context, and the self-reinforcing nature of human systems, which often become insular, isolated from each other, and resistant to change.

Finally, views on the importance of the state oscillate: has it moved into the background, or is it making a return in these post-crisis times? Perhaps, and perhaps not. The importance of regulation, the effectiveness of specific types of instruments and interventions, and the relative importance of the state changes with time and in specific markets or policy contexts. Nonetheless, the state is a very significant actor in the development and implementation of environmental regulation, and therefore the next section considers how this particular topic of social, political, and administrative concern has developed since the middle of the last century and how it is likely to develop in the near future.

4.6 Environmental Law and Regulation: Theory and Practice

While there have been environmental laws for decades, perhaps as far back as the nineteenth century,[78] 'environmental law' was not considered to be a distinct topic of interest or expertise by practitioners or academics until the late 1960s[79] or perhaps the early 1970s.[80] This section traces the development of environmental regulation (defined somewhat loosely as regulation concerned with protecting the environment) through the various 'generations' that different scholars have identified, so as to properly situate ICT-based approaches within an overall context. The division into generations is somewhat arbitrary; there is no definitive historical account and individual authors present slightly different taxonomies.[81] The classification should not be taken to mean that environmental law moves smoothly from phase to phase: it often progresses through a process of trial-and-error[82] and creativity.[83] Nonetheless, there has been a gradual move away from command-and-control mechanisms towards more market-oriented, adaptive, and complex instruments (although the extent to which this has occurred may vary from jurisdiction to jurisdiction).

[78] Jane Holder and Maria Lee, *Environmental Protection, Law and Policy: Text and Materials* (Cambridge University Press 2007) 158-64.

[79] Richard J Lazarus, 'The Greening of America and the Graying of United States Environmental Law: Reflections on Environmental Law's First Three Decades in the United States' (2001) 20 Virginia Environmental Law Journal 75.

[80] Craig Anthony Arnold, 'Fourth-Generation Environmental Law: Integrationist and Multimodal' (2011) 35 William and Mary Environmental Law and Policy Review 771, 790.

[81] In 2001, Plater asked, 'Is this the third generation of environmental law, or the fourth, or fifth?' (Zygmunt JB Plater, 'Environmental Law in the Political Ecosystem—Coping with the Reality of Politics' [2001] 19[2] Pace Environmental Law Review 423, 429 n 9). The answer has not become clearer over time.

[82] Carol M Rose, 'Environmental Law Grows Up (More or Less), and What Science Can Do to Help' (2005) 9 Lewis and Clark Law Review 273, 275.

[83] William H Rodgers Jr, 'The Most Creative Moments in the History of Environmental Law: "The Whats"' (2000) 2000 University of Illinois Law Review 1.

4.6.1 First Generation: Command-and-Control

Strong Beginnings

In 1968, the United Nations General Assembly passed a resolution on 'Problems of the Human Environment',[84] which led to the convening of a Conference on the Human Environment in Stockholm in 1972 (which focused on the significant issue of acid rain). This was followed by a declaration at the European Council meeting in Paris in the same year that the European Economic Community needed to consider 'the protection and improvement of the human environment' as something to be included within the overall efforts at removing barriers to economic activity between the Member States. This led to the 'Paris Declaration' later in 1972, affirming a commitment to 'intangible values and to protecting the environment', and the first Action Programme for the Environment in 1973.[85] This focused on five main objects: pollution reduction, biosphere protection, avoiding unbalancing ecosystems, better environmental planning, and international cooperation.[86]

In the United States of America, although there were instances of environmentally-focused litigation in the 1960s,[87] the birth of modern environmental law can be dated to the first day of January 1970, when the National Environmental Policy Act, commonly known as NEPA, was signed into law. This was followed by the Clean Air Act (1970), the Clean Water Act (1972) and the Endangered Species Act (1973). This 'first generation' of US environmental law was broad in scope, sweeping in scale and highly aspirational in forcing new norms on industry and the public at large. It was born out of a desire for change amongst the American public, sparked by (amongst other events) the publication of Rachel

[84] Problems of the Human Environment Resolution 2398 (XXIII) [1968].

[85] Declaration of the Council of the European Communities and of the representatives of the Governments of the Member States meeting in the Council of 22 November 1973 on the programme of action of the European Communities on the environment [1973] OJ C112/1.

[86] Holder and Lee (n 78) 156–8.

[87] Jeffrey G Miller, 'A Generational History of Environmental Law and Its Grand Themes: A Near Decade of Garrison Lectures' (2001) 19 Pace Environmental Law Review 501, 502–5.

Carson's 'Silent Spring' (on the adverse consequences of widespread pesticide use) in 1962,[88] an oil spill off the Santa Barbara coast in 1969, and the so-called 'burning river' in Cuyahoga, Ohio in the same year. These made environmental issues a live debate and possible source of political capital. The judiciary built on the new legislation in an expansive way.[89]

Focus on Central Controls

The first generation of environmental regulation was characterised by so-called 'command and control' (CAC) regulation, which focuses on the use of centrally-mandated standards. This involves 'detailed, legally enforceable limits, conditions, and affirmative requirements on industrial operations, generally controlling sources that generate pollution on an individual basis.'[90] 'Traditional' environmental regulation creates a regime which firms must comply with or risk sanction.

CAC regulation can be divided into two general and connected categories, technology-based and performance-based. These focus on minimum standards which must be met, based on technical characteristics, levels of emissions or energy use, or general environmental quality.[91] This in turn either requires the use of particular equipment, processes, or standards (but does not control pollution levels); or that the polluter does not exceed specified thresholds of emissions into the environment (which gives more flexibility).[92]

Technology-based measures involve design and product standards, which require that products made available for sale or use meet strict basic standards, including best available technology standards. These are very useful for creating a

[88]Rachel Carson, *Silent Spring* (Houghton Mifflin 1962).

[89]Lazarus (n 79) 77–80.

[90]Rena I Steinzor, 'Reinventing Environmental Regulation: The Dangerous Journey From Command to Self-Control' (1998) 22 Harvard Environmental Law Review 103, 104.

[91]Eric W Orts, 'Reflexive Environmental Law' (1995) 89 Northwestern University Law Review 1227, 1235.

[92]Robert N Stavins, 'Policy Instruments for Climate Change: How Can National Governments Address a Global Problem' [1997] University of Chicago Legal Forum, 300.

baseline floor, preferably in cooperation with industry, and can be gradually improved over time without creating an enormous burden for producers. However they will not tend to push innovation beyond the level that is needed in order to meet the standard.[93]

Performance-based measures require obtaining a license or meeting certain environmental performance obligations.[94] In the first category, in order to be able to emit certain types of pollutants, firms must apply for and be granted a licence, which may require compliance with certain terms and conditions. This provides clarity, certainty, and speed of operation, but can be expensive to operate, inflexible, and over-simplified.[95] Permits can require specific technologies, 'best available technology', or 'best available technology not entailing excessive cost'. However, this technology may not itself be environmentally benign, may not be installed, or may not function.

In the second category, firms must meet certain minimum environmental impact requirements, such as recycling a certain amount of packaging, or accepting waste products for disposal. There may also be emission limit values or energy use values: similar to design and product standards, these require that products meet certain basic levels of environmental impact before they are made available for purchase or use. Again, they can be gradually improved over time but tend to become a target to be met rather than to be exceeded. Finally, there may be environmental quality standards,[96] which require that the environment in a particular area meets certain minimum standards, for example, air or water quality.[97]

---

[93] ibid, 300–2.

[94] Neil Gunningham, 'Environment Law, Regulation and Governance: Shifting Architectures' (2009) 21(2) Journal of Environmental Law 179, 4–5.

[95] John Harman, 'Environmental Regulation in the 21st Century' (2004) 6 Environmental Law Review 141, 145–6.

[96] William Howarth, 'The Progression Towards Ecological Quality Standards' (2006) 18(1) Journal of Environmental Law 3.

[97] Judith Jones, 'Regulatory Design for Scientific Uncertainty: Acknowledging the Diversity of Approaches in Environmental Regulation and Public Administration' (2007) 19(3) Journal of Environmental Law 347, 358–9.

Economic Objections

Although it has its defenders,[98] command-and-control is criticised for being economically inefficient and for relying on the effectiveness of the regulator and its staff.[99] There are two main claims made against command-and-control mechanisms. First, they waste money, as they ignore differences between different locations, firms, and industries. It would also be very difficult to administer a scheme of individualised regulation, particularly as the information needed would largely come from the firms and they would have an incentive to lie.

Second, there is no incentive for firms to innovate and do more than the standard, even if this is very cheap. The overall cost-benefit calculation may argue for exceeding the baseline but there is no reason for the individual firm to do it. The regulator may not know this. Change may happen as a result of a cleaner firm pushing to build on this competitive advantage, or a supplier of pollution control technology with an eye to the market, lobbying for a higher standard. However, there is no immediate incentive for polluters so change occurs slowly. It is also very vulnerable to 'regulatory capture' (where the regulator becomes too close to the firms that it regulates and begins to identify with them) and can become ossified and unable to gather information or move fast enough to keep up with social, economic, and technological changes.[100] It leads to a voluminous and complex body of regulations, sometimes called 'juridification'.[101]

Some reforms were proposed or implemented to work with, rather than replace, this first generation of ER in the US, something which one scholar labelled

[98]For example, Sidney A Shapiro and Thomas O McGarity, 'Not So Paradoxical: The Rationale for Technology-Based Regulation' [1991] Duke Law Journal 729; Howard Latin, 'Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and "Fine-Tuning" Regulatory Reforms' (1985) 37 Stanford Law Review 1267.

[99]Bruce A Ackerman and Richard B Stewart, 'Reforming Environmental Law' [1985] Stanford Law Review 1333.

[100]Robert Baldwin, 'Regulation After "Command and Control"' in Keith Hawkins (ed), *The Human Face of Law* (Clarendon Press 1997) 66.

[101]Orts, 'Reflexive Environmental Law' (n 91) 1235–40.

'first generation and a half' strategies: more rational decision-making mechanisms (such as the use of cost-benefit and risk analysis); adaptive management ('muddling through' and tolerating slippage from the strict letter of the statute); negotiated contracts with polluters (either at the individual or industry level); and negotiated rule-making or regulatory negotiation.[102]

4.6.2 Second Generation: Market-Based Instruments

In parallel with these developments, ER has become more sophisticated. Scholars have claimed that 'traditional' command-and-control methods of dealing with pollution, involving the use of uniform technology standards, operate in a fragmented manner with the inefficiency of a large central bureaucracy and without coordination. Unresponsive to new information, they do not always properly balance the costs and benefits of regulation and do not encourage continual reductions in pollution.[103] These arguments have led to the development of a 'second generation' of regulatory instruments: market-based, further upstream, more flexible, built on public transparency, integrated into business planning and focusing on incentives rather than punishment.[104] These may operate in a flexible, modular way.[105]

Limiting the Power of Regulators

In Europe during the 1970s, Community legislators were intent on introducing environmental regulatory measures but first had to overcome difficulties of legal competence. Environmental protection was not mentioned as a policy goal or area of Community powers in the Treaty of Rome and therefore the European Council stated that environmental measures could be harmonised as part of efforts to equalise competi-

[102] Richard B Stewart, 'A New Generation of Environmental Regulation?' (2001) 29 Capital University Law Review 21, 38–94.

[103] ibid, 28–34.

[104] Dennis D Hirsch, 'Symposium Introduction: Second Generation Policy and the New Economy' (2001) 29 Capital University Law Review 1, 6–15.

[105] Jody Freeman and Daniel A Farber, 'Modular Environmental Regulation' (2005) 54(4) Duke Law Journal 795.

tive conditions across the EEC, something which was later affirmed by the European Court of Justice.[106] These issues were resolved by the insertion of Articles 130 r s and t, explicitly granting the European Community power to legislate for environmental issues, into the Treaty by the Single European Act in 1986, something which continued in subsequent treaties. Much of European environmental regulation during this period was first generation 'command-and-control' style.[107]

In the United States, the energy crisis of the mid-1970s forced some rethinking of the broad environmental laws enacted a few years before. The courts took a more restrictive view of issues such as schedules and standards for compliance. However, the overall structure of US environmental law survived and was even expanded in statutes such as the Toxic Substances Control Act, the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as 'Superfund'). The first two were traditional regulatory systems but the third was innovative as it introduced retrospective liability for polluted sites.[108]

In the 1980s, the Reagan Administration attempted to reduce the stringent application of environmental regulation and to hobble the Environmental Protection Agency (EPA). The negative reaction that this elicited from the general public gave the Congress an incentive to expand US environmental law still further. This was largely done not through the introduction of new statutes but by extensively amending the existing laws to make their requirements more specific, removing substantial discretion from the executive branch. Congress also innovated by introducing tradable permits (discussed further below) to the Clean Air Act in an effort to deal with acid rain.[109] The first generation of environmental law had focused on improving overall environmental quality, whereas the second generation tended to focus on

[106]Case 91/79 *Commission v Italy* [1980] ECR 1099; Case 240/83 *Procureur de la République v Association de Défense des Brûleurs d'Huiles Usagées* [1985] ECR 531.
[107]Holder and Lee (n 78) 158–64.
[108]Lazarus (n 79) 82–4.
[109]ibid, 85–7.

changing the behaviour of the various entities involved in regulation.[110]

Trusting in the 'Invisible Hand'

The second generation of environmental regulation is notable for an emphasis on the use of the market, rather than detailed rules and enforcement, as a means of controlling behaviour. It was largely developed and supported by economists who see regulation as a poor alternative and prefer to see the state share its capacity to 'steer' with other actors.[111] Amongst the tools available are contracts between government and regulated industries and firms (used for environmental regulation in Holland), negotiation over rule-making, economic incentive systems such as taxes, tradable permits, transferable development rights, and risk bubbles (an umbrella of permissible emissions for an entire facility). Supplementary options include consumer information strategies, liability schemes, strong private property rights in environmental resources, and subsidies in exchange for reductions in pollution.[112]

Environmental regulators have given a great deal of attention to the use of fiscal tools as a means of regulation. These can be broadly grouped into four categories: 'taxes (including charges and levies); subsidies; tradable emission permits; and deposit-refund schemes.'[113] The focus tends to be on the marginal cost of control. A means of guiding the market towards more sustainable outcomes is through the use of financial instruments to create price signals based on the environmental footprint of goods and services. Examples would include a carbon tax, a cap and trade system, subsidies to reduce pollution, or a deposit-refund scheme with particularly high environmental impacts.[114] These can encourage those who inno-

[110] Rose, 'Environmental Law Grows Up' (n 82) 276.

[111] Andrew Jordan, Rüdiger K W Wurzel, and Anthony R Zito, '"New" Instruments of Environmental Governance: Patterns and Pathways of Change' (2003) 12 Environmental Politics 1, 7–8.

[112] Stewart, 'A New Generation?' (n 102) 80-99; Richard B Stewart, 'The Importance of Law and Economics for European Environmental Law' (2002) 2 Yearbook of European Environmental Law 856.

[113] Jordan, Wurzel, and Zito, 'Patterns and Pathways of Change' (n 111) 10; See also Harman (n 95).

[114] Richard B Stewart, 'Instrument Choice' in Jutta Bodansky Daniel Brunnée and Ellen Hey (eds),

vate, can reach small firms and individuals in a more efficient way than permits, and focus attention on environmental costs. However, they may not go far enough, cannot guarantee a particular outcome, and can be avoided or evaded. A carbon tax will also provide an ongoing incentive to reduce pollution until the marginal cost of reducing a unit of pollution is at the same level as the tax. From the government's perspective, taxes have the advantage of generating continuing revenue, whereas permits will only generate revenue if they are auctioned. The revenue from a carbon tax could be used to offset the cost to industry by using the resulting income to lower taxes on other inputs, particularly labour, but there are indications that this may not be enough to prevent distortions in the market.[115] Permits can be time-limited which helps to reduce their anti-competitive effect.[116]

Tradable permits grant firms the right to pollute up to the level of permits which they hold. The initial allocation of permits can be determined either by grandfathering (granting permits based on existing levels of pollution) or by auctioning. Tradable permits ask the question, can a firm reduce a unit of pollution for less than it can trade a marketable permit? How much does a firm save by turning off the pollution control technology as against the cost of buying a unit of pollution on the market? Eventually, the marginal cost of pollution will be equalised at the minimal cost of pollution reduction. This would take a lot of work for the regulator to calculate but the marketplace will figure this out quickly. This creates incentives for additional reductions: innovators who reduce their own pollution can sell their excess permits. If new firms enter the industry, they drive up the cost of permits, which in turn encourages more innovation.[117]

There are some differences between the two tools: permits control the quantity but not the price, whereas taxes control the price but not the quantity. Therefore,

---

The Oxford Handbook of International Environmental Law (Oxford University Press 2007) 151–2.

[115] Stavins, 'Policy Instruments for Climate Change' (n 92) 303–5.

[116] ibid, 307.

[117] Stewart, 'Instrument Choice' (n 114) 155–6.

permits are better for dealing with the risk posed by threshold pollutants (where the substance is not a problem until the concentration of it in the environment is over a certain amount), such as greenhouse gases. The principal advantage of a carbon tax is that it is much easier to apply to small businesses and private individuals.[118]

Governments also sometimes use the power of their purse as a means of achieving policy change. The inclusion of 'sustainability' principles in the decision-making process for public expenditure is not, strictly speaking, a regulatory tool. However, it can nonetheless have a significant impact on the products that are on the market. If public procurement requirements mandate that items purchased must meet certain basic standards, or that higher scoring is given to items that better meet sustainability criteria, this will put pressure on the market to deliver goods which will comply. As producers will be reluctant to have two versions of their products, one for the public sector market and one for the private market, the benefits of this innovation should be made available to all.

Unpredictable and Uncontrollable Markets

While market-based instruments can achieve cost savings, they need to be designed with flexibility, simplicity, and market-building in mind, and enforcement and compliance remains important. Practical difficulties, such as the political pressure to provide initial permits to incumbent firms at no charge and the need for smaller firms to re-organise themselves in moving from command-and-control to market-based permits, can mean that optimal cost savings and pollution abatement are not reached.[119] They cannot guarantee a particular level of abatement,[120] maximum

[118] Benjamin J Richardson and Kiri L Chanwai, 'The UK's Climate Change Levy: Is it Working?' (2003) 15(1) Journal of Environmental Law 39, 57.

[119] Robert N Stavins, 'Market-based Environmental Policies: What Can We Learn from US Experience (And Related Research)?' (*Resources for the Future Discussion Paper*, 2003) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=421720⟩ accessed 27 August 2014, 7–9.

[120] Richard B Stewart, 'Economic Incentives for Environmental Protection: Opportunities and Obstacles' in *Environmental Law, the Economy and Sustainable Development: The United States, the European Union and the International Community* (Cambridge University Press 2000) 181.

levels of pollution in a specific location,[121] equal impact across socio-economic groups,[122] nor the removal of distortions of the policy-making process by special interest groups,[123] all of which are significant concerns from the perspective of environmental justice. Others have criticised market-focused environmental regulation as commodifying the environment, rewarding selfishness, and approving of pollution.[124]

Emissions trading, in particular, is not a panacea or an ideal solution. Analysis of the reductions it leads to indicates that it is not always an effective policy tool, and it may not drive technological innovation as expected,[125] leading to significant criticism from environmentalists.[126]

4.6.3 Third Generation: Reflexive Regulation

The third generation of environmental law is characterised by the use of 'collaborative and participatory processes, outcomes-based instrument choice, reflexive law principles, distributive justice concerns, sustainable development principles, and adaptive ecosystem management.'[127] The adoption of these so-called 'new environmental policy instruments' (NEPIs) is driven largely by economic factors: the cost of 'traditional' regulation to regulators and regulated entities; a perception that NEPIs were more efficient; a shift from models of government to lighter-touch 'governance' approaches; proposals from the European Commission; the impact of global recession and the resulting focus on cost; and political support for adopting

[121] Stewart, 'Economic Incentives for Environmental Protection' (n 120) 192–4.
[122] ibid, 194–6.
[123] Lisa Heinzerling, 'Selling Pollution, Forcing Democracy' (1995) 14 Stanford Environmental Law Journal 300.
[124] Stewart, 'Economic Incentives for Environmental Protection' (n 120) 194–6.
[125] David M Driesen, 'Sustainable Development and Market Liberalism's Shotgun Wedding: Emissions Trading Under the Kyoto Protocol' (2008) 83 Indiana Law Journal 21.
[126] Sarah-Jayne Clifton, 'A Dangerous Obsession' (2009) ⟨http://www.foe.co.uk/sites/default/files/downloads/dangerous_obsession.pdf⟩ accessed 27 August 2014.
[127] Arnold (n 80) 791.

new schemes.[128] They do not involve the displacement of the state or the disappearance of 'old' policy instruments, but rather the parallel application of both in a hybrid system.[129]

'New Governance' in Environmental Regulation

In the early years of this century, some new approaches to environmental law began to emerge and develop at a rapid rate.[130] In Europe, the rise of the concept of 'ecological modernization' (that economic and technical progress can provide solutions to the problems of pollution and environmental degradation that it creates) helped to push policy-makers from rigid ideas of government to more flexible application of governance (a development already discussed above), to developing a broad 'toolbox' of regulatory approaches and towards deregulation.[131] Although ecological modernization did not take complete hold on policy-making,[132] it nonetheless gave rise to what is called 'new governance', which can be defined as

> ... a range of processes and practices that have a normative dimension but do not operate primarily or at all through the formal mechanism of traditional command-and-control-type legal institutions ... [T]he common features ... involve a shift in emphasis away from command-and-control in favour of 'regulatory' approaches which are less rigid, less prescriptive, less committed to uniform outcomes, and less hierarchical in nature.[133]

In addition, researchers and policymakers had begun to understand the limitations of regulation as a policy tool, and the political tides moved in favour of market

[128] Andrew Jordan, Rüdiger K W Wurzel, and Anthony R Zito, 'Comparative Conclusions—"New" Environmental Policy Instruments: An Evolution or a Revolution in Environmental Policy?' (2003) 12(1) Environmental Politics 201, 202–5.

[129] Neil Gunningham, 'The New Collaborative Environmental Governance: The Localization of Regulation' (2009) 36(1) Journal of Law and Society 145, 165.

[130] Jordan, Wurzel, and Zito, 'Patterns and Pathways of Change' (n 111) 3–4.

[131] Holder and Lee (n 78) 164–5.

[132] Andrea Revell, 'Ecological Modernization in the UK: Rhetoric or Reality?' (2005) 15(6) European Environment 344.

[133] Gráinne de Búrca and Joanne Scott, 'Introduction: New Governance, Law and Constitutionalism' in Gráinne de Búrca and Joanne Scott (eds), *Law and New Governance in the EU and the US* (Hart Publishing 2006) 2.

liberalization.[134] As a result, environmental law may be becoming more concerned with establishing principles rather than rules. Examples in European environmental law might include the evolution of the Environmental Impact Assessment Directive[135] through a review and revision process based on implementation reports from member states; and the Common Implementation Strategy for the Water Framework Directive, which is not mentioned in the directive itself.[136]

Examples of the impact of these shifts in policy include the integration of environmental protection with other policies; the use of tracking progress towards specific goals; a commitment to the good governance values of openness and participation; and the use of new instruments for environmental protection, including voluntary agreements.[137] At European level, there is a shift to self-regulation, such as the introduction of environmental management systems, with rewards for voluntary participation.[138] However, while some states were willing to experiment, such as the Netherlands in making use of voluntary agreements,[139] most member states were slow to adopt new environmental policy instruments.[140] Industry preferred the certainty of command and control; politicians were reluctant to dismantle the existing regulatory structure; and 'new' instruments (by their nature) require challenges to 'old' thinking, which is often deeply ingrained.[141]

---

[134]Ian Bailey, *New Environmental Policy Instruments in the European Union: Politics, Economics and the Implementation of the Packaging Waste Directive* (Ashgate 2003) 4.

[135]Directive 1985/337/EEC of the European Parliament and of the Council of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment [1985] OJ L175/40.

[136]Joanne Scott and Jane Holder, 'Law and New Environmental Governance in the European Union' in Gráinne de Búrca and Joanne Scott (eds), *Law and New Governance in the EU and US* (Hart Publishing 2006).

[137]Joanne Scott and David M Trubek, 'Mind the Gap: Law and New Approaches to Governance in the European Union' (2002) 8(1) European Law Journal 1.

[138]Christoph Demmke, 'Implementation of Environmental Policy and Law in the United States and the European Union' in Norman J Vig and Michael G Faure (eds), *Green Giants?: Environmental Policies of the United States and the European Union* (MIT Press 2004).

[139]Anthony R Zito and others, 'Instrument Innovation in an Environmental Lead State: "New" Environmental Policy Instruments in the Netherlands' (2003) 12(1) Environmental Politics 157, 169–71.

[140]Bailey (n 134) 52–3.

[141]ibid, 3–4.

In the US during the early 1990s, the Republican majority in Congress sought, as part of its 'Contract with America', to roll back many of the environmental protections enacted in previous decades. The executive was able to portray this initiative to the public as a 'sell-out' to corporate interests and defeat it.[142] During the same period, industry groups mobilised to try to soften the broad, prescriptive, and detailed scheme of environmental regulation that had developed over the previous two decades. With a focus on tradeable permits and voluntary compliance with emission reduction goals, these efforts resonated with a general preference amongst the American public for moving control from the federal government to the state and local level. The Clinton administration sought to channel this appetite for change into a 'reinvention' of the federal government. In environmental regulation, this led to the 'Common Sense Initiative' (negotiated regulation for specific industries), the 'Environmental Leadership Program' (incentives to develop environmental management systems) and 'Project XL' (site-specific and industry-developed alternative compliance plans).[143]

These were broadly 'reflexive', meaning that they hoped to make individuals and firms internalize environmental norms rather coercing them into making more environmentally positive choices, an approach which will be explained more fully in the next section. This change in focus was driven by the claim that the machinery of government is too information-poor, resource-limited, and slow-moving to deal with dynamic organizations and marketplaces and will often stymie innovation. Reflexive law is 'a distinct and independent conception of law', renouncing standards and targets in favour of communication and structural supports for contemplation.[144] It has its roots in systems theory, outlined above.[145]

[142] Lazarus (n 79) 93–5.
[143] Steinzor (n 90) 107.
[144] Stewart, 'A New Generation?' (n 102) 127–30.
[145] See Section 4.3.3.

In the US, the role of environmental protection agencies has also been re-evaluated in recent years, with a move from conflict between business and environmental goals being resolved through legal rules and enforcement[146] to a focus on results and innovation, continuous improvement, negotiable and collaborative relationships, and multiple centres of leadership (government, business, communities, and others).[147] Businesses are seeking to move 'beyond compliance' to voluntary performance targets and internal environmental management systems, leading to a decline in environmental litigation and a shift by NGOs to collaborative solutions.[148]

This presents new challenges for lawyers, who have skills in advocacy, negotiation, and concluding agreements, but may not have experience with open, dynamic, and win-win solutions. Law may not always be the primary means of solving environmental problems (if it ever was),[149] and lawyers must work in a collaborative way with other professionals.[150] However, it should not be thought that command-and-control measures are no longer used. They are still introduced in Europe[151] and remain the foundation of US environmental law, although more integrated approaches are being adopted there.[152]

Reflexive and Informational Regulation

'Reflexive law' instruments, also known as 'process-based', 'systems-based', or 'management based' regulation,[153] include product labelling, emissions reporting

[146]George B Wyeth, '"Standard" and "Alternative" Environmental Protection: The Changing Role of Environmental Agencies' (2006) 31 William and Mary Environmental Law and Policy Review 5, 9–10.

[147]ibid, 18–22.

[148]Bradley C Karkkainen, 'Environmental Lawyering in the Age of Collaboration' [2002] Wisconsin Law Review 555, 559–67.

[149]Wyeth (n 146).

[150]Karkkainen, 'Environmental Lawyering' (n 148) 571–4.

[151]Suzanne Kingston, 'Environment' (2010) 59(4) International and Comparative Law Quarterly 1129, 1134.

[152]Uwe M Erling, 'Approaches to Integrated Pollution Control in the United States and the European Union' (2001) 15 Tulane Environmental Law Journal 1.

[153]Gunningham, 'Shifting Architectures' (n 94) 189.

and internal environmental audits. While examples of reflexive law can be found elsewhere, such as in the regulation of financial markets,[154] Orts mentions some that are specific to environmental law, such as NEPA, environmental auditing and enforcement policies, and eco-management and audit schemes (EMAS).[155] These attempt to make polluters internalise the norm of environmental protection as society moves to a more cooperative and coordinated approach to achieving its goals.[156] They can be divided into two main categories: 'reflexive regulation' and 'informational regulation'. These share certain common characteristics:

- mandated public disclosure
- by corporations or other private and public organizations
- of standardized, comparable, and disaggregated information
- regarding specific products or practices
- to further a defined public purpose.[157]

They also share particular design features:

- a specific policy purpose
- specified discloser targets
- a defined scope of information
- a defined information structure and vehicle
- an enforcement mechanism.[158]

However they differ in certain details and will be considered separately below.

In the environmental context, 'reflexive regulation' can be defined as:

> ... a legal theory and a practical approach to regulation that seeks to encourage self-reflective and self-critical processes within social institutions concerning the effects they have on the natural environment. ...

[154] Orts, 'Reflexive Environmental Law' (n 91) 1232.

[155] Eric W Orts, 'A Reflexive Model of Environmental Regulation' (1995) 5(4) Business Ethics Quarterly 779, 785–6.

[156] Stewart, 'A New Generation?' (n 102) 127–51.

[157] Archon Fung, Mary Graham, and David Weil, *Full Disclosure: The Perils and Promise of Transparency* (Cambridge University Press 2007) 6.

[158] ibid, 39.

> The idea is to employ law not directly in terms of giving specific orders or commands, but indirectly to establish incentives and procedures that encourage institutions to think critically, creatively, and continually about how their activities affect the environment and how they may improve their environmental performance.[159]

Reflexive regulation tends to focus on working with industry in a cooperative and collaborative fashion, often through *voluntary approaches*. These involve regulators negotiating with industry in order to establish a voluntary agreement or codes of practice which could achieve the aims of the regulatory scheme. These can achieve greater and quicker 'buy-in' but can require significant resources if the number of firms involved is large. Ensuring compliance can also be difficult.

Another non-regulatory method of achieving better environmental outcomes is through EMAS. Under these schemes, businesses can adopt these types of systems as a means of managing environmental risks, better engaging with regulators and reducing costs. For example, the EU has introduced a regulation on EMAS,[160] which aims to improve the environmental performance of participating firms over time, on a voluntary basis.[161] However, they do not guarantee specific results, standards can vary, and they are not always appropriate for small firms.

Informational approaches, which require only that firms provide information on their products and services to the public, have also been receiving attention in recent years.[162] Informational regulation is a prominent example of the direct application of reflexive law principles through disclosure requirements. It can be defined as 'rules requiring mandatory disclosure of information on environmental operations or performance of regulated entities to third parties, such as workers, consumers, shareholders, or the public in general.'[163] Examples of reflexive environ-

[159]Orts, 'A Reflexive Model' (n 155) 780.

[160]Regulation 761/2001 allowing voluntary participation by organisations in a community eco-management and audit scheme (EMAS) [2001] OJ L114/1.

[161]Orts, 'Reflexive Environmental Law' (n 91) 1287–1313.

[162]For a further discussion of these, see Section 6.3.

[163]David W Case, 'The Law and Economics of Environmental Information as Regulation' (2001) 31(7) Environmental Law Reporter 10773, 10775.

mental informational regulation include 'truth-in-environmental-advertising and environmental labels'.[164] The application of informational regulation can be broadly categorised as 'descriptive' or 'persuasive', depending on whether information is simply disclosed or framed in such a way as to encourage individuals to change the behaviour.[165] It can take negative or positive forms, be aimed at consumers or businesses, and be simple or complex. Examples include warnings on cigarette packets, environmental impact statements, or eco-labels.[166]

At the consumer level, these include *product labelling*, which involves placing environmental information labels on goods which are available for sale. Unlike design and product standards, these do not impose any obligation that standards are being met; instead, the hope is that consumers will use the product labels to guide their purchasing decisions and that market pressure will encourage producers to innovate and reduce environmental impact of their products. However, it is not clear that individuals or (more significantly) investors base very many of their decisions on the allocation of financial resources on environmental factors, even when this information is readily available.[167]

At the enterprise level, there may be *reporting and disclosure* requirements, which will be discussed further below. Firms may be placed under an obligation to disclose information about the environmental impact of their goods and services. The hope is that negative publicity and consumer choice will push suppliers towards providing more benign offerings. These schemes are relatively cheap to operate, but firms may resist reporting what they claim to be sensitive information, data may be unreliable, and the impact on consumer preferences is not always clear.

There also exist *voluntary disclosure schemes*, such as FAIRTRADE, which aim to persuade more ethically- or environmentally-conscious consumers that a par-

[164] Orts, 'A Reflexive Model' (n 155) 784.
[165] Michael P Vandenbergh, 'From Smokestack to SUV: The Individual as Regulated Entity in the New Era of Environmental Law' (2004) 57 Vanderbilt Law Review 515, 608–9.
[166] Stewart, 'A New Generation?' (n 102) 134.
[167] ibid, 97.

ticular product is superior to its competitors in those terms.[168] These are outside the scope of this discussion as they do not rely to a significant extent on the use of ICT.

Theory and Procedure over Substance

While it is undeniable that the use of these 'new environmental policy instruments' has increased in recent years, it does not follow that 'old' instruments have disappeared, or that that there is a wholesale move from command-and-control to a looser, governance-based approach. Both approaches co-exist to varying degrees in different jurisdictions.[169] In addition, academic study of NEPIs has tended to be more theoretical than practical, often omitting crucial 'real-world' issues, such as the influence of politics and institutions.[170] Without careful attention to design issues, flaws in such schemes may lead to underperformance and a need for retrospective command and control regulation.[171] They are not a panacea and are not appropriate for price-inelastic commodities or where an immediate abatement is required.[172]

EMAS has been criticised for being procedural rather than substantive in nature, as it does not define targets for firms. Eco-labels can lead consumers to think that they are making good choices, rather than encouraging them not to consume in the first place. The label may be missing essential information about the environmental record of the producer. Even if these issues can be overcome, there is little evidence that consumers will actually base their purchasing decisions on such labels.Voluntary agreements are vulnerable to free riding.[173]

---

[168]Karen Yeung, 'Government By Publicity Management: Sunlight or Spin?' [2005] Public Law 360, 369.
[169]Jordan, Wurzel, and Zito, 'Has Governance Eclipsed Government?' (n 55).
[170]Bailey (n 134) 5.
[171]ibid, 169–70.
[172]ibid, 188.
[173]Chris Hilson, *Regulating Pollution: A UK and EC Perspective* (Hart 2000) 107–11.

4.6.4 'Integrationist and Multimodal': The Outlines of a Fourth Generation

The future of environmental law in a world that is struggling to escape economic recession and perhaps facing rapid and potentially catastrophic climate change is difficult to predict. Farber puts forward three models for the future of environmental regulation: unilateral (self-regulation), multilateral (with many entities involved), and bilateral (negotiated regulation).[174] Morgera suggests that the environmental law of the future will be global, increasingly bilateral, and incorporating private actors and instruments.[175]

According to Arnold, a new generation of instruments is emerging in environmental law. He labels this a 'fourth generation', claiming that it is 'characterized by integrationist developments and multimodal methods'. By the first, he means 'processes that seek to connect or link multiple aspects of a system in a holistic, synthesized or coordinated way.'[176] By the latter, he means processes of a post-regulatory nature:

> ... the use of multiple modes or methods of protecting the environment [which] can occur in at least three different ways. [First] ... the use of multiple categories of policy instruments, such as command-and-control regulation, tort liability, public education, and market incentives. [Second] ... the use of more than one specific tool or mechanism for environmental protection ... Finally, multimodality might refer to the use of multiple institutions, organizations, groups, or authoritative entities to engage in environmental protection ...[177]

In order to be effective, it is important that this approach be 'integrated multimodality: the rational and interconnected use of multiple modes to accomplish particular goals or functions that would not be possible either with a single mode or with

[174] Daniel A Farber, 'Triangulating the Future of Reinvention: Three Emerging Models of Environmental Protection' [2000] University Of Illinois Law Review 61.

[175] Elisa Morgera, 'The Future of Law and the Environment: The Emergence of Global Environmental Law' in Sam Muller and others (eds), *The Law of the Future and the Future of Law: Volume II* (Torkel Opsahl Academic EPublisher 2012).

[176] Arnold (n 80) 795.

[177] ibid, 794.

disconnected or fragmented use of separate modes.'[178] Arnold predicts that the complexity of the interaction between social systems and ecological systems will require the creation of better integrated policy responses,[179] but he believes that this will not be a simple process because people prefer either simple, uniform solutions or ad hoc, fragmented responses.[180]

This shift to integrationism and multimodality was already visible in European environmental law from the early years of this century,[181] and is applied (somewhat weakly) in the Integrated Pollution Prevention and Control Directive.[182] It also has echoes in recent developments in international environmental law, such as the development of transnational systems of regulation of climate change emissions,[183] and responds somewhat to Boyd's call for a shift from 'environmental law' to 'sustainability law'.[184]

[178] Arnold (n 80) 795 (emphasis removed).
[179] ibid, 796.
[180] ibid, 822–31.
[181] Holder and Lee (n 78) 165–7.
[182] Council Directive 1996/61 concerning integrated pollution prevention and control [1996] OJ L257/96.
[183] Tseming Yang and Robert V Percival, 'The Emergence of Global Environmental Law' (2009) 36 Ecology Law Quarterly 615, 635–40.
[184] David R Boyd, 'Sustainability Law: (R)Evolutionary Directions for the Future of Environmental Law' (2004) 14 Journal of Environmental Law and Practice 357.

Chapter 5

The Application of ICT in Environmental Regulation: History and Current Practice

As background for the empirical aspects of the thesis, this chapter gives a historical overview of the application of information and communications technology (ICT) for environmental regulation (ER), outlining significant developments in each decade since the 1960s, both in ICT generally and ER.

5.1 Introduction

The use of technology to store, manage, and manipulate information has a long history, stretching back millennia and perhaps further, with applications in navigation, government, and commerce.[1] The ancient Greeks and Romans possessed devices which could be used to calculate lunar, solar, and stellar calendars. Astrolabes were also common. Various systems were developed in order to record numerical information, such as the use of knots, 'tally sticks', calculating rods, and the abacus. The slide rule was an early attempt at devising mechanical aids to mathematical calculations, making it easier for individuals to perform complex operations. Between the 1600s and the 1800s, progressively more complex adding machines were developed, work that led to the famous although never completed 'difference engine' and 'analytical engine' developed by Charles Babbage, and the electromechanical

[1] Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976) 24–9.

machines developed for the 1890 United States Census by Herman Hollerith.[2]

There were also early attempts at telecommunications: some relying on sight, such as the French télégraphe (semaphore towers) of the late 1700s,[3] and others on electricity, such as the Morse code and the electrical telegraph.[4] During this period also, bureaucracy developed, largely for the purpose of the record-keeping required by centralised government. A significant element of this was the census, which was increasingly automated.[5] The growth of these administrative processes, both in the public and the private sectors, relied heavily on (and encouraged) the development of sophisticated technology, at first mechanical and later digital.[6] However, the modern use of the term 'information and communications technology' is synonymous with electronic or digital computing devices, and the associated architecture of interconnections between them, whether wired or wireless. This type of ICT is the focus of this thesis.

5.2 A Very Brief History of ICT

Emergencies, particularly warfare, have been significant drivers for the development of ICT; this was the case even before digital computers, as can be seen from the way in which punched cards came to prominence as a way of dealing with staff shortages and increasing demands for services from His Majesty's Stationery Office in the UK during the First World War.[7] We may see similar development in the use of ICT for ER as the need to respond to ecological crises such as rapid climate change or the disappearance of bio-diversity becomes more urgent globally.

The development of the modern electronic computer has its roots in the need

[2]Eric G Swedin and David L Ferro, *Computers: The Life Story of a Technology* (Greenwood Publishing Group 2005) 1–23.

[3]James Gleick, *The Information* (Fourth Estate 2012) 129–36.

[4]ibid, 140–52.

[5]Mowshowitz (n 1) 29–32.

[6]James R Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Harvard University Press 1986) 390–425.

[7]Jon Agar, *The Government Machine* (MIT Press 2003) 159.

to compute ballistics tables during the Second World War.[8] A certain amount of development took place in the years before the war in the United States, chiefly led by John Atanasoff.[9] During the war years, the Allies' efforts to break German military codes gave rise to the development of a digital device known as the Colossus, while the US military's need for mechanical calculations gave rise to the Harvard Mark One and Mark Two computers, and the Electronic Numerical Integrator And Computer (ENIAC). In contrast, research in Germany led by Konrad Zuse was not significant in the development of this type of technology.[10] This development was need-driven, more the product of external social forces rather than itself a driver of social change.[11]

The design of the new technology was influenced by existing patterns of problem-solving and information-processing in engineering and business,[12] and many of the fundamental features of the design of modern computers, such as the stored program, shared storage of information and instructions, and the sequential processing of these, were defined in this early period.[13] This highlights how early design decisions can become difficult to change as a technology develops.

After the war, computer technology was developed in both the United Kingdom and in the United States of America. Machines became available on a commercial basis in the early 1950s, first the Ferranti Mark One (developed in Manchester) and the UNIVAC (developed in Philadelphia).[14] From early on, these new devices are connected together, first by teletype machines and then by modems.[15] This period was characterised by the mutual orientation of the military and engineers to-

[8] Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine* (Westview Press 2004) 71–85.

[9] Paul N Edwards, 'From "Impact" to Social Process: Computers in Society and Culture' in Sheila Jasanoff and others (eds), *Handbook of Science and Technology Studies* (Sage 1994) 258.

[10] Swedin and Ferro (n 2) 25–45.

[11] Edwards (n 9) 259.

[12] Paul E Ceruzzi, *A History of Modern Computing* (2nd edn, MIT Press 2003) 15–6.

[13] ibid, 15–6.

[14] Swedin and Ferro (n 2) 41–5.

[15] ibid, 111–2.

wards the development of new applications, with each group providing ideas for the other to support, either with funding or research effort. Salient examples include MIT's ambitious Whirlwind computer, which attracted funding when it was aligned with the Air Force's need for an air defence system and evolved to run SAGE (Semi-Automated Ground Environment). It was probably of limited operational application but very significant in the development of computer technology overall,[16] with IBM's involvement incentivising it to develop new capabilities and begin to dominate the market.[17]

In the period immediately following World War II, government and military funding continued to be important for the development of computer technology, as both sides in the Cold War sought for strategic advantage from the better control and management of information, particularly for air defence systems. These early devices used vacuum tubes which were large, generated significant heat, and were fragile. The invention of the transistor provided a solution and was significant in assisting with the development of increasingly widespread applications of computer technology. A thriving commercial sector developed, targeting both government (particularly defence) and large business.[18] Early applications included census processing, flight reservation and ticketing, and banking.[19] From the 1950s,[20] government departments were quick to adopt the new 'mainframe' computers, which could be used to store, manage, and process large quantities of data, and these were seen as essential to normal operation and new policy initiatives (such as the introduction of value-added tax in Britain in 1972).[21]

Throughout the 1950s, innovations in computer architecture made these tools

[16]Edwards (n 9) 266.
[17]Ceruzzi (n 12) 52–3.
[18]Swedin and Ferro (n 2) 47–57.
[19]Nicholas G Carr, *The Big Switch: Rewiring the World, From Edison to Google* (WW Norton and Company 2008) 48–51.
[20]Helen Margetts, 'The Automated State' (1995) 10 Public Policy and Administration 88, 89.
[21]Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) 11.

progressively more powerful.[22] The development of the 'integrated circuit' (or microchip) in the latter part of that decade, which allowed the combination of a variety of components in very close proximity to each other, permitted the construction of much faster, cheaper, and more reliable computer technology. This facilitated the commercial development of ubiquitous personal computer technology, such as electronic calculators.[23] Further development of microchips led to the 'microprocessor', which combined all of the fundamental elements necessary for a computer onto a single chip.[24]

On the software side, mathematicians developed methods of programming these devices using notation somewhat closer to human speech and writing than the generally inscrutable binary codes of the machinery and systems for the re-use of common sequences of instructions, culminating in the development of 'high level languages' such as FORTRAN, COBOL, and ALGOL, and 'operating systems' to manage the loading and unloading of the resulting programs.[25] Researchers developed 'time-sharing' systems, which allowed several individuals to use the same computer at the same time. Over time, this gave rise to the UNIX system, which was to be a mainstay of computer networking in the future.[26] The 'mainframe' (large, expensive, and managed by specialists) was supplemented by 'minicomputers' (smaller, cheaper, and more individual).[27] During the 1960s, the foundations of what was later to become the Internet were laid with the development of the ARPANET to connect laboratories doing work for the Pentagon.[28] With the advent of jet airliners, IBM developed a computerized reservation system, known as SABRE, for American Airlines. This was put into use in 1964 and still provides

[22] Ceruzzi (n 12) 58–64.
[23] Swedin and Ferro (n 2) 65–68.
[24] ibid, 80–83.
[25] Ceruzzi (n 12) 82–100.
[26] Swedin and Ferro (n 2) 69–71.
[27] Carr (n 19) 52-3.
[28] Swedin and Ferro (n 2) 111-2.

essential services for the travel industry today.[29] The building blocks for the expansion of computing technology into the home, and eventually to mobile devices, were now in place.

This diffusion of technology to somewhat unanticipated contexts was highly significant, taking the expensive, complex hardware available only to a limited and technical community and making it affordable for all as personal devices. Calculators and computers became commodities and individuals developed very personal uses for, and relationships with, these new devices.[30] During the 1970s, the availability of microchips led to the development of 'microcomputers' and a burgeoning software industry (and the perennial problem of intellectual property infringement). Apple developed easy-to-use computers, and early spreadsheet applications meant that microcomputers become common in business environments. IBM, who had dominated the market for mainframes, designed their own microcomputer, something which gave this new technology significant legitimacy in the business market.[31] Microsoft sought to dominate the market for home and small business computing that it saw developing.[32] The resulting availability of new information resources throughout all levels of the hierarchy of government made possible significant changes in business processes.[33] In this period, government came to contain 'networks of information systems processing data about individuals, organizations, goods and services, carrying out financial transactions, registering authority and providing management information.'[34]

As computer technology became more widespread, there was an increasing need to connect these new devices together. The open and portable nature of UNIX made it a natural foundation for these efforts.[35] The network control protocol (NTP)

[29]Swedin and Ferro (n 2) 61.
[30]Ceruzzi (n 12) 207–17.
[31]Swedin and Ferro (n 2) 85–109.
[32]Carr (n 19) 54.
[33]Bellamy and Taylor (n 21) 12.
[34]Margetts, 'The Automated State' (n 20) 90.
[35]Ceruzzi (n 12) 283–4.

developed for the ARPANET was elaborated into the Transport Control Protocol (TCP) and the Internet Protocol (IP). The new network, which developed into the Internet (commonly used by millions worldwide today), grew through a process of bottom-up, open development of standards and tools, largely through the Internet Engineering Task Force (IETF) and the Internet Engineering Steering Group (IESG). Over time, as it became the de facto standard, the Internet has subsumed into itself the Computer Science Network (CSNET). There were alternative networks of bulletin board systems (BBSs), both hobbyist (FidoNet) and commercial (CompuServe, Prodigy, and America Online), which have dwindled in importance or disappeared entirely as the Internet has become dominant. New technologies were laid on top of the basic Internet protocols, such as the USENET discussion forums, the Gopher information navigation system, and the Wide Area Information Service and Veronica search protocols. However, these are all absorbed and then supplanted by the World Wide Web, which was based on hypertext technology, which made text-based and difficult to use systems much more visually appealing and easy to navigate by ordinary users.[36]

The Web, combined with the growth in availability and speed of bandwidth for long-distance communication, has led to the resurgence of the client-server model of the early years of computer technology and the development of business models for the provision of computing services similar to electricity and water utilities.[37] These developments have also made it possible for public administrations to make available data both between agencies and with the public in a much more flexible fashion. Knowledge-based systems, or expert systems, can support decision-making by individuals. Multimedia, smart cards and information exchange enables new forms of access to information, the reduction of costs and the removal of barriers between organizations and even jurisdictions.[38] Radical frontiers of potential

[36] Swedin and Ferro (n 2) 116–30.
[37] Carr (n 19) 58–61.
[38] Bellamy and Taylor (n 21) 15–18.

change therefore open up.[39]

As the Internet moved into the mainstream, two significant forces emerged. One was labelled 'Web 2.0', denoting a move from one-way to two-way communication and the development of open, dynamic mash ups of data. These are developed in a collaborative fashion in an increasingly 'social' space of rapid entrepreneurial innovation. Prominent failures include Friendster and MySpace and well-known survivors include Facebook, Wikipedia, and Twitter.[40] The second was the increasing mobility of computing devices, assisted by the miniaturization of electronics technology and the growing availability of broadband.[41] If present trends continue, this will lead to the rise of the 'Internet of Things' and 'Web 3.0', in which many more devices contain micro-processors and are connected together in a dispersed communications network of 'intelligent' devices and sensors.[42]

5.3 Development of ICT for Environmental Regulation

The development of modern environmental law and the expansion of computer technology from a tool restricted to a limited number of military and advanced scientific applications to being gradually available to business and eventually into the home, take place in the same time period but not in parallel. Environmental law has not taken advantage of computer technology at the same pace as other aspects of the administrative process, such as social welfare or taxation. Indeed, it is difficult to trace this history, as although there was considerable interest in the potential of this new technology in the 1970s, ICT does not seem to have been a significant driver in the development of ER during the following two decades, and it is not until the new

[39] Margetts, 'The Automated State' (n 20) 91–2.

[40] Johnny Ryan, *A History of the Internet and the Digital Future* (Reaktion Books 2010) 137–50.

[41] ibid, 158–9.

[42] Gianluca Misuraca, 'Futuring E-Government: Governance and Policy Implications for Designing an ICT-Enabled Knowledge Society' in Tomasz Janowski (ed), *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance (ICEGOV '09)* (Association for Computing Machinery 2009) 87.

millennium that the literature provides evidence of a renewed focus on the potential contribution of digital processing for environmental regulation. Even then, take up and application is slow and uneven, for reasons that are unclear: difficulties in updating the legal framework, concerns regarding the admissibility and usefulness of digital evidence, or the need for significant investment are amongst the hypotheses which I would be put forward but have not researched.

5.3.1 1970s

Although, as I will discuss later in the thesis, ICT has many applications for environmental regulation, one of the most significant issues which regulators face is identifying environmental problems, particularly those which take place at a distance from population centres (and thus regulatory inspectors). Given that aerial photography had been used for this purpose since the 1940s,[43] it is no surprise that much of the early attention focused on the use of ICT as a tool to see at a distance:

> Satellite borne remote sensing and modern environmental policy thus came of age at the same time. The launch of the first Landsat satellite in the early 1970s coincided with the development of the first environmental policies, and the subsequently established environmental protection agencies created the initial demand for environmental [earth observation] products.[44]

While remote sensing has a long history, dating back to the early years of aircraft, in the modern context, it normally refers to the use of satellites to collect images or data, a practice which began in the early 1970s. The sensors may be passive (relying solely on incoming energy signals) or active (emitting electromagnetic radiation of their own. The data thus collected is stored and processed, usually to correct transmission errors. It is often integrated into a geographical information

[43] William Boyd, 'Ways of Seeing in Environmental Law: How Deforestation Became an Object of Climate Governance' [2010] Ecology Law Quarterly 101, 142.

[44] Jan de Leeuw and others, 'The Function of Remote Sensing in Support of Environmental Policy' (2010) 2(7) Remote Sensing 1731, 1732.

system (GIS).[45] Remote sensors gather data that is not directly understandable by humans, as the visible spectrum is quite a narrow portion of the overall electromagnetic spectrum.[46] The use of remote sensing data throws up a number of legal issues, such as the admissibility of evidence.[47]

There were efforts to use remote sensing in order to detect, for example, unauthorised land fill operations,[48] monitoring of mining operations,[49] and oil discharges and spills.[50] However, despite the clear benefits, the Landsat series of satellites developed in a chaotic fashion, with responsibility for the programme shifting from the government to the private sector and back again.[51]

5.3.2 1980s

In the 1980s, with the widespread and availability of database technology and computer-mediated communications, policy-makers and environmental regulators began to take notice of the potential this created.[52] Remote sensing was being used to monitor tropical forests.[53] According to Karkkainen, one of the first environmental law scholars to study these developments in a systematic way, the Toxics Release Inventory (TRI)[54] was 'the first regulatory statute of the contemporary "information age."'[55] Similar systems, known generally as 'pollutant release and transfer regis-

[45]Kenneth J Markowitz, 'Legal Challenges and Market Rewards to the Use and Acceptance of Remote Sensing and Digital Information as Evidence' (2002) 12 Duke Environmental Law and Policy Forum 219.

[46]Karen Kline and Kal Raustiala, 'International Environmental Agreements and Remote Sensing Technologies' in *Workshop on Remote Sensing and Environmental Treaties: Building More Effective Linkages* (Socioeconomic Data and Applications Center 2000).

[47]Nicolas Peter, 'The Use of Remote Sensing to Support the Application of Multilateral Environmental Agreements' (2004) 20 Space Policy 189.

[48]Howard A Latin, Gary W Tannehill, and Robert E White, 'Remote Sensing Evidence and Environmental Law' (1976) 64(6) California Law Review 1300, 1322.

[49]ibid, 1326.

[50]ibid, 1342.

[51]Space Studies Board, *Landsat and Beyond: Sustaining and Enhancing the Nation's Land Imaging Program* (National Academies Press 2013) 13–7.

[52]See further discussion in Section 6.3

[53]Boyd, 'Ways of Seeing' (n 43) 143.

[54]See Section 6.3.3.

[55]Bradley C Karkkainen, 'Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?' (2001) 89 Georgetown Law Journal 257, 289.

ters' (PRTRs) are common in developed countries and achieving some success in reducing pollution.[56]

5.3.3 1990s

A report of a workshop held in Harvard University in 1998 gives a snapshot of the use of ICT in environmental regulation in the 1990s: GIS applied to track brownfield sites in New York State, the EPA's Envirofacts database integrating diverse information sources, the Environmental Defence Fund developing an online Chemical Scorecard Project, and various projects to better integrate information held in government agencies and departments.[57] Elsewhere, Brazil made use of remote sensing data in order to support efforts to halt deforestation,[58] as did many other countries,[59] while various initiatives were underway to use such systems in support of multilateral environmental agreements (MEAs), such as the European Commission's Global Monitoring for Environment and Security (GMES), which supported treaties such as the Ramsar Convention on Wetlands,[60] the Kyoto Protocol of the UN Framework Convention on Climate Change,[61] the UN Convention to Combat Desertification,[62] and the Convention for the Prevention of Pollution from

[56] Vivek Ramkumar and Elena Petkova, 'Transparency and Environmental Governance' in Ann Florini (ed), *The Right to Know: Transparency for an Open World* (Columbia University Press 2007) 281.

[57] Bruce Tonn and Robert Turner, 'Environmental Decision Making and Information Technology: Issues Assessment' (1999) ⟨http://www.osti.gov/bridge/servlets/purl/7911-KYxW9I/webviewable/7911.pdf⟩ accessed 19 May 2014, 3–4.

[58] Douglas O Fuller, 'Tropical Forest Monitoring and Remote Sensing: A New Era of Transparency in Forest Governance?' (2006) 27(1) Singapore Journal of Tropical Geography 15.

[59] Boyd, 'Ways of Seeing' (n 43) 143.

[60] Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (opened for signature 2 February 1971, entered into force 21 December 1975) 996 United Nations Treaty Series 245.

[61] Kyoto Protocol to the United Nations Framework Convention on Climate Change (opened for signature 11 December 1997, entered into force 16 February 2005) 37 International Legal Materials 22.

[62] United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (opened for signature 17 June 1994, entered into force 26 December 1996) 33 International Legal Materials 1328.

Ships (MARPOL);[63] the Meso-American Biological Corridor; and the Millennium Ecosystem Assessment.[64]

ICT was being used in order to capture information on the environment (such as measuring water quality data and evaluating satellite imagery), to store data in GIS, and for data analysis and decision support (through, for example, simulation models, data analysis, making available information available to the public, environmental management information systems, and public environmental information systems).[65] Bringing together a wide range of software, hardware, and data from heterogenous sources was proving to be a significant challenge, requiring sophisticated systems.[66] Remote satellite systems were used for photography, passive or active microwave and radar imaging and synthetic aperture radar.[67]

In the UK, the Environment Agency's National Centre for Environmental Data and Surveillance was using remote sensing data to gather information on planning issues such as coastal zone management, erosion studies, flood plain mapping, and landfill assessment, but this was exceptional, with many local authorities not doing so, probably because of the low resolutions then available.[68] Indeed, this was the picture generally.[69]

---

[63]International Convention for the Prevention of Pollution From Ships (opened for signature 2 November 1973, entered into force 2 October 1983) 12 International Legal Materials 1319.

[64]Alex de Sherbinin and Chandra Giri, 'Remote sensing in support of multilateral environmental agreements: what have we learned from pilot applications?' (Rio de Janeiro, 2001) ⟨http://sedac.ciesin.columbia.edu/rs-treaties/adesherbinin_riopaper.pdf⟩ accessed 27 August 2014, 3–4.

[65]Oliver Günther, *Environmental Information Systems* (Springer-Verlag 1997).

[66]Oliver Günther, Franz Josef Radermacher, and Wolf-Fritz Riekert, 'Environmental Monitoring: Models, Methods, and Systems' in Nicholas M Avouris and Bernd Page (eds), *Environmental Informatics—Methodology and Applications of Environmental Information Processing* (Kluwer Academic 1995) 7–9.

[67]Molly K Macauley and Timothy Brennan, *Enforcing Environmental Regulation: Implications of Remote Sensing Technology* (Resources for the Future 1998) 4–7.

[68]NPA Group, 'Applications of Earth observation to the legal sector' (*BNSC Sector Studies Programme*, 2001) ⟨http://www.ucl.ac.uk/laws/environment/satellites/docs/EOdataLegalSector.pdf⟩ accessed 19 May 2014, 46.

[69]Sharon Hatch Hodge, 'Satellite Data and Environmental Law: Technology Ripe for Litigation Application' (1996) 14 Pace Environmental Law Review 691, 694.

5.3.4 2000s

A summary of a workshop held at New York University in 2000 provides a snapshot of the applications of ICT in environmental regulation in the early years of this century: the use of satellite monitoring to police compliance with international agreements, electronic reporting of hazardous substance use, information processing for risk assessment and enforcement (including transnational efforts to halt smuggling of ozone-depleting substances), together with enhancement of the capabilities of NGOs through remote sensing detection and information dissemination websites.[70] A similar workshop was held at American University's Washington College of Law (WCL) in 2001, where discussion focused on GIS and satellite sensors identifying nitrogen input to a river basin, wetlands inventories, oil spills and transboundary shipments of waste.[71]

Remote sensing was being applied in a variety of problem domains.[72] The availability of data was growing to such an extent that managing it was becoming an issue in its own right.[73] Database technology was proving essential to the US acid rain abatement program, which centered around the use of tradeable permits.[74] Environmental monitoring systems were used by the public sector for public awareness, decision support, monitoring, and enforcement. Environmental management information systems were being deployed in the private sector in order to assist with legal compliance, environmental reporting, and ecological efficiency.[75]

---

[70] Michael Penders and David Ronald, 'The Hanging Chads of International Environmental Law' (2000) 15(11) National Association of Attorneys General: National Environmental Enforcement Journal 4.

[71] Kenneth J Markowitz, Meredith R Reeves, and Steven D Jamar, 'A View From Space' in *Digital Earth Applications in Environmental Resource Management* (The Washington College of Law at American University 2001).

[72] Anthony Vodacek, 'Environmental Applications of Remote Sensing' (2000) 4 Informatik/Informatique 21.

[73] M Sharpe, 'The 21st Century Analyst: Developments in Data Analysis and Visualisation' (2002) 4(3) Journal of Environmental Monitoring 33N.

[74] Blas Perez Henríquez, 'Information Technology: The Unsung Hero of Market-Based Environmental Policies' (2004) Fall/Winter Resources 9.

[75] Lorenz M Hilty, Eberhard K Seifert, and René Treibert, *Information Systems for Sustainable Development* (IGI Global 2005) viii–xi.

Academics and policy-makers began to consider the possibilities of using remote-sensing technology as a means of supporting international environmental treaties, having seen its considerable power in galvanising public opinion on issues such as the hole in the ozone layer. The European Commission used GMES in order to coordinate and expand the use of remote sensing in a variety of domains, including support for environmental treaties.

Remote sensing was seen as having a role in framing issues for negotiation, assisting with environmental assessment, improving implementation reviews, and assisting with compliance and dispute resolution, while enabling better democratization through the widespread availability of data.[76] There was a developing understanding of the potential of this technology,[77] efforts by state agencies to encourage its use,[78] and preliminary and exploratory work on its application to a range of issues, such as tracking oil spills[79] and fishing vessels (with the Vessel Monitoring System).[80] Remote sensing was being deployed in support of a number of MEAs, such as Ramsar,[81] the Convention on Biological Diversity[82] and the Convention to Combat Desertification,[83] the Convention on International Trade in Endangered Species (CITES),[84] MARPOL,[85] and was being adopted for the verification systems

[76]Alex de Sherbinin, Karen Kline, and Kal Raustiala, 'Remote Sensing Data: Valuable Support for Environmental Treaties' (2002) 44(1) Environment 20, 29–30.

[77]Olivier Arino, Diego Fernandez-Prieto, and Espen Volden, 'Healing the Earth - Earth Observation Supporting International Environmental Conventions' (2006) 128 ESA Bulletin 52.

[78]Ikuko Kuriyama, 'Supporting Multilateral Environmental Agreement With Satellite Earth Observation' (2005) 21(2) Space Policy 151.

[79]Camilla Brekke and Anne HS Solberg, 'Oil Spill Detection By Satellite Remote Sensing' (2005) 95(1) Remote Sensing of Environment 403.

[80]N Kourti and others, 'Integrating Remote Sensing in Fisheries Control' (2005) 12(5) Fisheries Management and Ecology 295.

[81]Ramsar Convention (n 60); Ake Rosenqvist and others, 'The Potential of Long-Wavelength Satellite-Borne Radar to Support Implementation of the Ramsar Wetlands Convention' (2007) 17(3) Aquatic Conservation: Marine and Freshwater Ecosystem 229.

[82]Convention on Biological Diversity (opened for signature 5 June 1992, entered into force 29 December 1993) 31 International Legal Materials 818.

[83]UNCCD (n 62); Peter (n 47) 191–2.

[84]Convention on International Trade in Endangered Species of Wild Fauna and Flora (opened for signature 3 March 1973, entered into force 1 July 1975) 993 United Nations Treaty Series 243.

[85]MARPOL 73/78 (n 63).

of the United Nations Framework Convention on Climate Change (UNFCCC).[86]

Satellite imagery was being used across the world to detect illegal activity and as evidence and prosecution under environmental laws, particularly in jurisdictions involving large geographic areas, such as Australia,[87] despite initial concerns about evidentiary difficulties.[88] This increased spatial understanding also enabled more sophisticated understanding of eco-systems, even in remote areas, such as the Arctic, and on the sea bed. This data was shared across the Internet, enabling global eco-system research, and processed in ways that yielded new insights, particularly in the developing world.[89]

The European Community authorised the use of satellite data to monitor compliance with the common agricultural policy.[90] At national level, in the United Kingdom, it was being used for environmental management, such as floodplain mapping, landfill assessment and coastal zone management. There was some limited use of Participatory Geographic Information and Multimedia Systems in order to enable public participation in forestry[91] and planning[92] decisions, and exploration of the use of citizen-sourced data for environmental regulation.[93]

---

[86]United Nations Framework Convention on Climate Change (opened for signature 9 May 1992, entered into force 21 March 1994) 31 International Legal Materials 849; Clare Tenner, 'Multilateral Environmental Agreements: Trends in Verification' [2000] Verification Yearbook 133, 144–5.

[87]Ray Purdy, 'Satellites: A New Era for Environmental Compliance?' (2006) 3(5) Journal for European Environmental and Planning Law 406, 408–9.

[88]Richard Macrory and Ray Purdy, 'The Use of Satellite Images as Evidence in Environmental Actions in Great Britain' (2001) 51 Droit et Ville 72.

[89]Fred Bosselman, 'What Lawmakers Can Learn From Large-Scale Ecology' (2002) 17 Journal of Land Use and Environmental Law 207, 209–13.

[90]Birger Faurholt Pedersen, 'Use of Very High Resolution Imagery in the Control of Area Based Subsidies With Remote Sensing' in *EARSeL eProceedings 4(1)* (2005).

[91]Jon M Corbett and C Peter Keller, 'Empowerment and Participatory Geographic Information and Multimedia Systems: Observations From Two Communities in Indonesia' (2004) 2(2) Information Technologies and International Development 25.

[92]Steve Carver and others, 'Public Participation, GIS, and Cyberdemocracy: Evaluating On-line Spatial Decision Support Systems' (2001) 28(6) Environment and Planning B: Planning and Design 907.

[93]Cristina Gouveia and others, 'Promoting the Use of Environmental Data Collected By Concerned Citizens Through Information and Communication Technologies' (2004) 71(2) Journal of Environmental Management 135.

5.4 Current Applications of ICT in Environmental Regulation

This section is a critical discussion of the current state of the art in the application of ICT for environmental regulation, highlighting examples such as the use of remote sensing, satellite monitoring and earth observation technology generally. It also looks at the role of ICT in the associated legal processes, such as compliance monitoring and violation reporting and legal difficulties with computer-based evidence. Finally, it looks at the role of ICT in public administration, covering topics such as e-government, information dissemination, and public participation.

5.4.1 Monitoring

Accurate measurement of environmental conditions is vital to ER. Distributed sensors, embedded in buildings, devices, and even clothing, can be connected together through telecommunications and artificial intelligence to create a 'connected environment', which can help with security, disaster prevention, and emergency response.[94] Such sensors could also be used for the regulation of environmental pollution. ICT and electronic data interchange can be used to track and trace waste and waste disposal, leading to more efficient and accurate systems and statistics.[95] More advanced sensors allow ecologists to expand the scale and scope of the data that they collect on the systems that they observe.[96]

As a result, environmental monitoring is changing in scale, timescale, number of actors, and means. It is more accessible to NGOs and the public and incorporates new means of gathering data, such as web cams and satellites.[97] Mobile devices can

[94] Austin Tate, 'The "Helpful Environment": Geographically Dispersed Intelligent Agents That Collaborate' (2006) 21(3) IEEE Intelligent Systems 57.

[95] Franz Mochty and others, 'Electronic Data Management in Austrian Waste Management Act 2002' in Werner Pillmann and Klaus Tochtermann (eds), *Environmental Communication in the Information Society: Proceedings of the 16th Conference* (International Society for Environmental Protection 2002).

[96] John H Porter and others, 'New Eyes on the World: Advanced Sensors for Ecology' (2009) 59(5) BioScience 385.

[97] Arthur PJ Mol, 'Environmental Governance Through Information: China and Vietnam' (2009) 30(1) Singapore Journal of Tropical Geography 114, 116.

be used, including in the developing world.[98] Networks of advanced sensors are being used by biologists in the field, on land, underwater and in the air, to gather scientific data. Often, the resulting data is used for a purpose different than that which was originally intended: for example, meteorological data can be used to track a forest fire; wind sensors can detect tornadoes and help with emergency responses; and water monitoring in South Carolina can detect a tsunami near the Kuril Islands. Through networks such as the Organization of Biological Field Stations this data is being placed online and shared.[99]

Remote sensing is already in widespread use to manage hazardous waste, oil spills, wildlife, and wetlands,[100] and to measure deforestation (and thus assist in carbon accounting).[101] Remote harvest reporting[102] and satellite-based vessel monitoring systems[103] are seeing increasing use. However, the use of earth observation technology is limited outside the fields of agricultural and fisheries regulation, but has significant potential in targeted enforcement, monitoring high-risk offenders, and providing historical evidence which could lead to significant savings while maintaining a deterrent effect, with application beyond the state by NGOs.[104] In the US, the EPA makes use of satellites and remote sensing for four different purposes: in its efforts to deal with toxic wastes: emergency responses to the release of hazardous materials; the updating of data on known sites; continuous monitoring of the

[98] Yola Georgiadou and others, 'Sensors, Empowerment, and Accountability: A Digital Earth View From East Africa' (2011) 4(4) International Journal of Digital Earth 285.

[99] Porter and others (n 96).

[100] KA Taipale, 'Information Technology as Agent of Change In Environmental Policy' (*Center for Advanced Studies in Science and Technology Policy Working Paper*, 2003) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=712161⟩ accessed 19 May 2014.

[101] Boyd, 'Ways of Seeing' (n 43) 145–8.

[102] Daniel Huppert and Gunnar Knapp, 'Technology and Property Rights in Fisheries Management' in Terry L Anderson and Peter J Hill (eds), *The Technology of Property Rights* (Rowman and Littlefield 2001).

[103] Sara Monteiro, Xavier Vázquez, and Ronán Long, 'Improving Fishery Law Enforcement in Marine Protected Areas' (2010) 1(1) Aegean Review of the Law of the Sea and Maritime Law 95, 105.

[104] Ray Purdy, 'Using Earth Observation Technologies for Better Regulatory Compliance and Enforcement of Environmental Laws' (2010) 22(1) Journal of Environmental Law 59.

site over time; and the creation of inventories of possible waste disposal sites.[105] Data from passive sensors in satellites is also used to monitor land-use change, particularly forestry, wetlands, and agriculture.

However, there are a number of potential barriers to a wider use of this technology: data reliability and accuracy, lack of harmonization of requirements and standards, a lack of continuity of monitoring in time and space, and the absence of a coordinating institution.[106] Both the technology and data have their limitations: satellite monitoring is an indirect form of measurement, in which conditions on the ground must be extrapolated from the measurements taken; and a continuous stream of information is often not available for a particular site, even when it might be needed (such as in an emergency situation).[107] It is important to note that any remote sensing operation contains a number of linkages, from the calibration of the sensors, the collection of the data, the pricing of the imagery, storage, and archiving and retrieval software. The information is transformed and corrected in each of the stages, introducing the possibility of error.[108] In addition, the GIS in which the data is stored may itself contain errors.[109]

While the International Convention for the Prevention of Pollution from Ships[110] is one of the few MEAs that explicitly mentions remote sensing, this technology is being used to an increasing degree and is particularly important to the development of the national climate change regime. A number of international and intergovernmental entities have created the GMES initiative. This combines a range of observation, modelling, and communications technologies to support exchanges between service providers.[111]

---

[105] Markowitz (n 45) 228.

[106] Alexander M de Sherbinin, 'Remote sensing in support of ecosystem management treaties and transboundary conservation' (2005) ⟨http://sedac.ciesin.columbia.edu/rs-treaties/laguna.html⟩ accessed 19 May 2014, 39–40.

[107] ibid, 174.

[108] Markowitz (n 45) 236–9.

[109] ibid, 240–2.

[110] MARPOL 73/78 (n 63).

[111] Peter (n 47).

The Intergovernmental Panel on Climate Change, following a request by the Subsidiary Body for Scientific and Technological Advice to the UNFCCC, has prepared a Special Report on Land-Use, Land-Use Change and Forestry which recommends the use of remote sensing to measure land use change.[112] The second report on the adequacy of the global observing systems for climate in support of the UNFCCC concluded that these were not adequate.[113] Laws in this area remain somewhat fragmented and overlapping.[114] As a result,'remote sensing technology should be viewed as a tool in support of the Kyoto Protocol and its signatories, rather than an instrument for treaty policing.'[115] However, there is a trend towards increased formalization and the replacement of policies with legal instruments.[116]

5.4.2 Enforcement

With regard to environmental enforcement, ICTs can be used for observation and analysis, resource management, monitoring compliance, and providing violation reporting mechanisms.[117] The EU is using a combination of Vessel Monitoring System devices and Vessel Detection System analysis of satellite imagery for fisheries monitoring and enforcement.[118]

ICTs also make possible the use of mobile monitoring—vehicles containing specialised equipment that can test for pollutants at a variety of locations—which

[112] Josef Aschbacher, 'Monitoring Environmental Treaties Using Earth Observation' [2002] Verification Yearbook 172, 179.

[113] de Leeuw and others (n 44) 1735.

[114] Frans G von der Dunk, 'European Satellite Earth Observation: Law, Regulations, Policies, Projects, and Programmes' (2008) 42 Creighton Law Review 397.

[115] A Rosenqvist and others, 'Remote Sensing and the Kyoto Protocol: A Review of Available and Future Technology for Monitoring Treaty Compliance' (1999) ⟨http://sedac.ciesin.columbia.edu/rs-treaties/Remote_Sensing_Kyoto.pdf⟩ accessed 19 May 2014, 2.

[116] Joanne Irene Gabrynowicz, *The Land Remote Sensing Laws and Policies of National Government: A Global Survey* (National Center for Remote Sensing, Air, and Space Law 2007).

[117] Richard Labelle, 'ICTs for e-Environment: Guidelines for Developing Countries, with a Focus on Climate Change' (2008) ⟨http://www.itu.int/ITU-D/cyb/app/docs/itu-icts-for-e-environment.pdf⟩ accessed 19 May 2014, 65.

[118] Juan Cicuendez Perez and others, 'The Efficiency of Using Remote Sensing for Fisheries Enforcement: Application to the Mediterranean Bluefin Tuna Fishery' (2013) 147 Fisheries Research 24.

allows for real-time feedback and tracking of pollution from ephemeral sources. This can result in better regulation, although this approach has its limitations: limited accuracy, a need to pinpoint a violation by a identifiable entity, high resource requirements, and a lack of trust in local enforcement initiatives.[119] It can also be used to monitor for carbon monoxide.[120]

5.4.3 Environmental Trading Systems

ICT can also be used to lower the information costs in markets for intangible property rights.[121] GIS are being used in some American states, such as Arizona, Idaho, Wyoming, and Oregon to manage and enforce water rights.[122] The application of computer technology to water management can lead to greater efficiencies and the creation of new potential markets;[123] these ideas have been successfully implemented at a very local level.[124]

5.4.4 Public Participation

Pressure from NGOs can be considered as a form of 'civil regulation'[125] or 'meta-regulation',[126] where information is gathered and used by non-state actors. Community groups can take advantage of cheap technology to pool information and

[119]Thomas O McGarity, 'Hazardous Air Pollutants, Migrating Hot Spots, and the Prospect of Data-Driven Regulation of Complex Industrial Complexes' (2008) 86 Texas Law Review 1445, 1480–6.

[120]Demin Wang and others, 'Monitoring Ambient Air Quality With Carbon Monoxide Sensor-Based Wireless Network' (2010) 53(5) Communications of the ACM 138.

[121]Labelle (n 117) 63–4.

[122]Clay J Landry, 'The Role of Geographic Information Systems in Water Rights Management' in Terry L Anderson and Peter J Hill (eds), *The Technology of Property Rights* (Rowman and Littlefield 2001).

[123]Robert B Naeser and Mark Griffin Smith, 'Enforcing Property Rights in Western Water: Is it Better to be Upstream With a Shovel or Downstream With a Model?' in Terry L Anderson and Peter J Hill (eds), *The Technology of Property Rights* (Rowman and Littlefield 2001).

[124]Barrett P Walker, 'Using Geographic Information System Mapping and Education for Watershed Protection Through Better-Defined Property Rights' in Terry L Anderson and Peter J Hill (eds), *The Technology of Property Rights* (Rowman and Littlefield Publishers, Inc 2001).

[125]Christine Overdevest and Brian Mayer, 'Harnessing the Power of Information Through Community Monitoring: Insights From Social Science' (2008) 86 Texas Law Review 1493, 1501.

[126]ibid, 1504.

build more coherent and solidly-grounded responses to pollution problems, including so-called 'bucket brigades' of air-samplers under the auspices of the 'Global Community Monitor' NGO.[127] However, making best use of the technology requires specialist skills and investment in infrastructure.[128] In order to assist with this, the state should consider how it can better ensure the quality of the environmental data which it makes available, provide material resources and training for local NGOs, and perhaps even offer bounties for citizens who discover pollution control violations.[129]

ICT can also assist groups in coordinating their activities.[130] This can assist at the local community level, with (for example) cleanups, consumer awareness campaigns, or at a broader level, with consumer boycotts and grassroots campaigning. Although non-governmental organizations have maintained their focus on local issues, they have used ICTs to connect to global networks of activists.[131]

ICT can also lead to more inclusive law-making. The greater availability of information can lead to a more informed public and a better deliberative process.[132] To make this happen, information must be made accessible, searchable, and usable.[133] Government must also make an effort to include external experts in the process, managing discussions through wikis and civic juries.[134] ICT has been applied, for example, in the application of the Water Framework Directive (which seeks to achieve a more integrated and holistic approach to decision-making) in Europe.[135] However, because of the complexity of the issues, open and participatory

[127] ibid, 1510–20.
[128] Ramkumar and Petkova (n 56) 301.
[129] Overdevest and Mayer (n 125) 1520–3.
[130] Bill Tomlinson, *Greening Through IT: Information Technology for Environmental Sustainability* (MIT Press 2010) 154–5.
[131] Arthur PJ Mol, *Environmental Reform in the Information Age: The Contours of Informational Governance* (Cambridge University Press 2008) 196–7.
[132] Beth S Noveck, *Wiki Government: How Technology Can Make Government Better, Democracy Stronger, and Citizens More Powerful* (Brookings Institution Press 2009) 108–9.
[133] ibid, 121–6.
[134] ibid, 148–54.
[135] Carlo Giupponi, 'Decision Support Systems for Implementing the European Water Framework

environmental decision-making may not always lead to the best outcomes for the environment.[136]

ICT can facilitate greater public participation in the law-making[137] and rule-making process, although it is not without its costs and risks and is best used on a trial basis at this early stage.[138] By itself, information will not promote democracy: empowering citizens to contribute to the rule-making process does not mean that they will,[139] and e-democracy projects may fail.[140] Amongst the institutional challenges for the future are the need for cross-agency collaboration, organizational inertia, and compliance with legal obligations. Much research is required into issues such as the development of appropriate ICT tools, how agencies handle rule-making internally, how best to manage public input, and how to ensure compliance with formal requirements.[141]

5.4.5 Behaviour Change

A key issue in understanding the application of ICT for environmental regulation is a consideration of its impact on individual and firm behaviour, and how the provision of information may have to change their behaviour. If ICT supports these changes, it can have a direct effect on an individual's environmental footprint, but may also reinforce their personal identity as environmentally conscious (thus en-

Directive: The Mulino Approach' (2007) 22(2) Environmental Modelling and Software 248.

[136]Mol, *Environmental Reform in the Information Age* (n 131) 151–2.

[137]Vasiliy Burov, Evgeny Patarakin, and Boris Yarmakhov, 'Lawmaking in Democracy 2.0 Paradigm: The Shift for the New Forms of Lawmaking' in Elsa Estevez and Marijn Janssen (eds), *ICEGOV '11: Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance* (Association for Computing Machinery 2011).

[138]Stuart Minor Benjamin, 'Evaluating E-Rulemaking: Public Participation and Public Institutions' (2006) 55 Duke Law Journal 893.

[139]Cary Coglianese, 'Weak Democracy, Strong Information: The Role of Information Technology in the Rulemaking Process' in Viktor Mayer-Schönberger and David Lazer (eds), *From Electronic Government to Information Government: Governing in the 21st Century* (MIT Press 2007) 116.

[140]Åke Grönlund, 'The Rise and Fall (?) of Participatory Electronic Information Infrastructures' in Viktor Mayer-Schönberger and David Lazer (eds), *Governance and Information Technology: From Electronic Government to Information Government* (MIT Press 2007).

[141]Cary Coglianese, 'E-Rulemaking: Information Technology and the Regulatory Process' (2004) 56 Administrative Law Review 353.

couraging better choices in other domains) and can help to embed that individual with a network or community of similarly minded individuals. However, behaviour change is by no means easy given the way in which habits, culture, and economic choices can limit our freedom to make radical changes.[142] I will return to this issue later.[143]

The increasing complexity of regulation is a powerful force pushing commercial organizations to construct and implement ICT systems to manage the information which they must track in order to remain compliant.[144] ICT can also lead directly to savings in energy use, continuous improvements in manufacturing processes, and more efficient use of materials.[145] Data gathered through ICT can assist with more comprehensive and 'reflective' audits of corporate and individual emissions,[146] for example, the Building Energy Rating certificate.

ICT can have a systemic effect on individual behaviour, changing established patterns to operate in more environmentally benign ways, such as reducing travel, intelligent building design and management, and the 'de-materialization' of electronic commerce.[147] In support of individual desires to change their behaviour, we see the development of a wide range of ICT-based devices and systems which can provide information to individuals. Tomlinson classifies these systems into four major categories: information (such as devices that plug into a power socket and report the energy uses of devices, or websites that facilitate individuals in gathering information on more environmentally sustainable choices); analysis (such as online data collection, visualization, and tracking sites); action (such as smart transport or

[142] Tomlinson (n 130) 129–32.

[143] See Section 6.3.

[144] Sven Denecken, 'Environmental Compliance Management' in Philippe Minier and Alberto Susini (eds), *Proceedings of the 18th International Conference Informatics for Environmental Protection: Enviroinfo 2004* (Editions du Tricorne 2004).

[145] Deanna J Richards, Braden R Allenby, and W Dale Compton, 'Information Systems and the Environment: Overview and Perspectives' in Deanna J Richards, Braden R Allenby, and W Dale Compton (eds), *Information Systems and the Environment* (National Academies Press 2001) 4.

[146] The Climate Group, *Smart 2020: Enabling the Low Carbon Economy in the Information Age* (Global eSustainability Initiative 2008) 04/56.

[147] Labelle (n 117) 75–6.

smart heating systems, or carbon offset programs); and mobile (such as monitoring of air quality).[148]

5.5 The Future

It is, of course, difficult to make precise predictions about the future, particularly with such a fast-moving and dynamic area as the development of ICT.[149] However, according to Dunleavy, so-called 'digital era governance'[150] has flourished.[151] The power, scale, and speed of computing resources available to regulators will continue to grow in future.[152] This will enable the use of more ambitious 'data mash ups',[153] and the increasing use of 'big data' by government.[154]

There are, of course, significant challenges and issues to be overcome, but the development of future technologies in this area is attracting considerable academic and commercial interest. More widespread ambient monitoring faces significant cost, technical, and administrative barriers.[155] The need for a balanced intellectual property system in order to encourage the generation of remote sensing data but ensure that it is widely available requires careful consideration.[156]

Amongst the technologies being forecast for the future are a 'Digital Earth' representation of the planet as a whole, including social, cultural, and economic

[148]Tomlinson (n 130) 133–6.

[149]Bernd Carsten Stahl, 'What Future? Which Technology? On the Problem of Describing Relevant Futures' in Mike Chiasson and others (eds), *Researching the Future in Information Systems* (Springer 2011).

[150]Patrick Dunleavy and others, 'New Public Management is Dead—Long Live Digital-Era Governance' (2006) 16(3) Journal of Public Administration Research and Theory 467.

[151]Patrick Dunleavy and Helen Margetts, 'The Second Wave of Digital Era Governance' [2010] Philosophical Transactions A.

[152]Committee on Science for EPA's Future, *Science for Environmental Protection: The Road Ahead* (The National Academies Press 2012) 225–31.

[153]Tony Hey, 'The Next Scientific Revolution' (2010) 88(11) Harvard Business Review 56; Gregory Goth, 'Turning Data Into Knowledge' (2010) 53(11) Communications of the ACM 13.

[154]Gang-Hoon Kim, Silvana Trimi, and Ji-Hyong Chung, 'Big-Data Applications in the Government Sector' (2014) 57(3) Communications of the ACM 78.

[155]Eric Biber, 'The Problem of Environmental Monitoring' (2011) 83 University of Colorado Law Review 1.

[156]Frans G von der Dunk, 'Intellectual Property Rights as a Policy Tool for Earth Observation Data in Europe' in Ray Harris (ed), *Earth Observation Data Policy and Europe* (A A Balkema 2002).

factors. This would enable more optimised agriculture, better social planning, and the integration of a vast web of distributed sensors.[157] The US EPA is deploying more advanced monitoring technologies, including infrared cameras, shifting more and more of its reporting to electronic systems, and using the web to make data available to the general public.[158] In the future, social media may be used for greater outreach, including two-way communication, crowdsourcing, and collaborative drafting of legislation, but experience to date in the United States does not make for optimistic predictions in this regard, with many initiatives simply not achieving very much useful input from the public.[159] Nonetheless, mobile devices have significant potential.[160] Overall, new GIS tools may bring about significant changes in environmental law itself: spatial analysis will enable the type of holistic analysis which environmental impact assessment laws are intended to produce, more sophisticated trading-based schemes for land-use change and mitigation, and a more dynamic process of multilevel governance.[161]

[157] Max Craglia and others, 'Digital Earth 2020: Towards the Vision for the Next Decade' (2012) 5(1) International Journal of Digital Earth 4.

[158] Cynthia Giles, 'Next Generation Compliance' [2013] The Environmental Forum 22, 24–6.

[159] Michael Herz, 'Using Social Media in Rulemaking: Possibilities and Barriers' (*Cardozo Legal Studies Research Paper*, 2013) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2371406⟩ accessed 27 August 2014, 28–62.

[160] Leyland F Pitt and others, 'Integrating the Smartphone Into a Sound Environmental Information Systems Strategy: Principles, Practices and a Research Agenda' (2011) 20(1) Journal of Strategic Information Systems 27; Norm Archer, 'M-Government and E-Government: Transformative Relationships' in Hans J Scholl (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010).

[161] Dave Owen, 'Mapping, Modeling, and the Fragmentation of Environmental Law' [2013] Utah Law Review 219, 264–78.

Chapter 6

The Model is not the Reality: Difficulties in Measuring and Managing the Natural and the Social

As I have explained in Chapters 2 and 3, information and communications technology (ICT) is significantly altering the functioning of the machinery of government in ways that require attention from lawyers; and information is a key element in the bureaucratic processes of measurement and feedback that constitute the core of regulation. In this chapter, I examine some of the ways in which information is used in environmental regulation (ER) and the new types of regulatory scheme that the increasing availability of ICT makes possible. I highlight the importance of the physical sciences as a key cornerstone of modern environmental law, and review recent academic discussions about the problems that this creates in practice, such as the poor understanding of the proper place of models. I explain the need for policymakers to better understand and think through the choices that they make when they embed scientific models into environmental law and environmental regulatory regimes. I also critically examine the use of disclosure-based regulatory schemes, the gaps that may exist between aspirations of transparency and the reality of implementation and sketch some suggestions for how such schemes might be improved. In this chapter, I seek to raise questions about the unthinking deployment of ICT and disclosure-based schemes for environmental regulation and point out how both the measurements that it makes possible and the behaviour change that it can bring about are incomplete, contingent, and often misunderstood.

The information used in environmental regulation comes principally from the physical sciences, but the connection between science, policy, and law is not as linear or as coherent as policy-makers may believe. It is not always the case that legislators, bureaucrats, or the general public are sufficiently scientifically literate to understand the basis of a regulatory scheme. The models used in legislation may not be accurate or can often lag behind the state of the art. Indeed, the models themselves are only that: an attempt to understand a system rather than the system itself. The creation, evaluation, and choice of models can have important social, political, and legal consequences. The data collected in order to apply these models may not itself be accurate. It may not be verifiable or consistent.

The successful use of disclosure-based regulatory schemes requires careful design. While new schemes of regulation that depend on the public release of information may provide more cost-effective and flexible ways of achieving better environmental outcomes, these schemes do not always bring about the desired results. Human behaviour is often unpredictable, negative, and difficult to change. Any regulatory system based on the analysis and presentation of information, particularly information expressed in numerical form, can be manipulated so as to avoid thresholds or other triggers for regulatory intervention. In addition, the sometimes unclear goals of these programs raises questions about their appropriateness as a tool for intervention in the behaviour of individuals.

6.1 Transparency in Twenty-First Century Environmental Regulation

In order to place the role of information in ER in its proper context, it is necessary to consider two of its historical antecedents: freedom of information generally and environmental impact assessment.

6.1.1 Freedom of Information Laws

'Freedom of Information' (FOI) broadly refers to laws that grant access to official data. Although many European countries were reluctant to open government information to their public,[1] modern freedom of information law has its roots in Scandinavian measures which date back to 1766. Open government measures were introduced in Norway, Denmark, France, and the Netherlands in the 1970s. During the 1980s, many European countries introduced similar laws, and now most European Union member states have some such legislation on the books. In the common law countries, the United States of America introduced the Freedom of Information Act in 1966, followed by a number of Commonwealth countries in the 1980s and the United Kingdom in 2000. While details vary, the US model provides a common pattern of

> ... two main elements, namely the provision of a right of access to government documents and the imposition of obligations concerning the dissemination of information relating to the operations of government agencies.[2]

FOI is arguably a human right.[3] This, and a conception of access to information as an enabler for citizenship and civil society, seem to be the two underlying motivations for freedom of information laws. While access to government information is not directly addressed in international human rights law, Article 19 of the International Covenant on Civil and Political Rights and Article 10 of the European Convention on Human Rights (which deal with the right to freedom of expression) provide some support for an implicit obligation on states to provide information to their citizens. The Council of Europe has bolstered this through, for example,

[1] Peter H Sand, 'The Right to Know: Freedom of Environmental Information in Comparative and International Law' (2011) 20 Tulane Journal of International and Comparative Law 203, 207.

[2] Maeve McDonagh, *Freedom of Information Law* (Thomson Round Hall 2006) 4–6.

[3] Patrick Birkinshaw, 'Freedom of Information and Openness: Fundamental Human Rights' (2006) 58 Administrative Law Review 177; Patrick Birkinshaw, 'Transparency as a Human Right' in Christopher Hood and David Heald (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006).

the Declaration on Mass Communication Media and Human Rights (1970)[4] and a Recommendation on access to information held by public authorities (1981),[5] the Declaration of Freedom of Expression and Information (1982),[6] and a Recommendation on access to official documents (2002).[7] However, the European Court of Human Rights has taken a restricted view of the possibility of reading a right to freedom of information into the right to freedom of expression under the ECHR,[8] while the Council of Europe Convention on Access to Official Documents has not yet entered into force.[9]

The Maastricht Final Act contained a declaration on the rights of access to information which recommended that the Commission submit to the Council a report on measures to improve public access to the information available to the institutions by 1993. The Commission subsequently adopted two Communications, on *Public Access to the Institutions' Documents* (1993)[10] and *Openness in the Community* (1993)[11] which led in turn to Council,[12] Commission,[13] and Parliament[14] decisions on public access to documents ('the access decisions'). Article 255 of the Amsterdam Treaty explicitly recognised the right of access to European documents on the part of its citizens. Article 50 of the Charter of Fundamental Rights of the European Union also recognises this right,[15] which is regulated by Regulation

[4]Council of Europe Consultative Assembly, 21st ordinary session, resolution 428 of 23 January 23 1970.

[5]Recommendation R (81)19.

[6]Committee of Ministers, 29 April 1982

[7]Recommendation Rec(2002)2.

[8]McDonagh (n 2) 9–14.

[9]Council of Europe Convention on Access to Official Documents (opened for signature 19 June 2009) [2008] Council of Europe Treaty Series 205.

[10]European Commission, 'Public Access to the Institutions' Documents' (Communication) COM (1993) 191 final.

[11]European Commission, 'Openness in the Community' (Communication) COM (1993) 258 final.

[12]Council Decision on Public Access to Council Documents [1993] OJ L340/43.

[13]Commission Decision on Public Access to Commission Documents [1994] OJ L46/58.

[14]Parliament Decision on the Regulations and General Conditions Governing the Performance of the Ombudsman's Duties [1994] OJ L113/15.

[15]McDonagh (n 2) 19–23.

1049/2001.[16] FOI or so-called 'access to information' laws are becoming increasingly widespread, with legislation in the region of seventy countries,[17] although there can be a significant gap in implementation[18] and growing concern about how to cope with the increasing use of electronic documents, which are both more numerous and more difficult to manage.[19] In the context of rapidly-developing ICT, it may be that the European Union will have to make all of its internal information digitally available.[20] Civil society and academic focus is on the potential of open government data.[21]

6.1.2 Environmental Impact Assessment

With regard to public access to information on the environment, a type of legal measure that can have significant impact is environmental impact assessment (EIA).[22] Now widely adopted worldwide and embedded in international environmental agreements, EIA was considered innovative when introduced in the United States of America in 1969.[23] Domestic EIA systems follow a common general structure: '(1) screening; (2) scoping; (3) impact analysis and report preparation; (4) public agency participation; (5) the final decision; and (6) follow-up.'[24] EIA does not impose a substantive requirement to avoid a particular outcome or to meet a spe-

[16]Regulation 1049/2001 regarding public access to European Parliament, Council and Commission documents [2001] OJ L145/43.

[17]Laura Neuman and Richard Calland, 'Making the Law Work: The Challenges of Implementation' in Ann Florini (ed), *The Right to Know: Transparency for an Open World* (Columbia University Press 2007) 181.

[18]ibid, 183.

[19]ibid, 198.

[20]Deirdre M Curtin, 'Citizens' Fundamental Right of Access to EU Information: An Evolving Digital Passepartout?' (2000) 37 Common Market Law Review 7.

[21]Felipe I Heusser, 'Understanding Open Government Data' (2012) ⟨http://www.od4d.org/wp-content/uploads/2012/10/OGD-Paper-1-DRAFT-20120618.pdf⟩ accessed 19 May 2014; Daniel Lathrop and Laurel Ruma (eds), *Open Government: Collaboration, Transparency, and Participation in Practice* (O'Reilly Media 2010).

[22]Joseph FC DiMento and Helen Ingram, 'Science and Environmental Decision Making: The Potential Role of Environmental Impact Assessment in the Pursuit of Appropriate Information' (2005) 45 Natural Resources Journal 283.

[23]Neil Craik, *The International Law of Environmental Impact Assessment: Process, Substance and Integration* (Cambridge University Press 2008) 4.

[24]ibid, 27.

cific standard and is therefore often criticised for being overly procedural,[25] while the information that is made available can be uncertain and lack a proper baseline.[26] The use of ICT to make EIA reports available in a searchable, map-linked database would add considerably to its usefulness.[27]

6.1.3 The Aarhus Convention

Although a (restricted) feature of the UK legal landscape since the 1950s, rights of access to information on the environment are now well established despite opposition from industry.[28] In particular, the Aarhus Convention[29] codifies and extends the geographical area, amount, and clarity of the three pillars of environmental information, public participation, and access to justice.[30] It can be seen as the product of 'the intersection of two human rights—the right to government information and the right to a clean environment—and the emergence of a right to government information about the environment.'[31] It is claimed that access to environmental information enhances 'equity, legitimacy, accountability, and self-protection.'[32]

The Convention defines 'environmental information' as:

---

[25]Craik (n 23) 34–5.

[26]ibid, 52.

[27]Michael B Gerrard and Michael Eric Herz, 'Harnessing Information Technology to Improve the Environmental Impact Review Process' (2003) 12 New York University Environmental Law Journal 18; Daniel A Farber, 'Bringing Environmental Assessment Into the Digital Age' in Jane Holder and Donald McGillivray (eds), *Taking Stock of Environmental Assessment: Law, Policy and Practice* (Routledge-Cavendish 2007).

[28]Richard Macrory, 'Environmental Regulation as an Instrument of Constitutional Change' in Jeffrey Jowell and Dawn Oliver (eds), *The Changing Constitution* (5th edn, Oxford University Press 2004) 293–4.

[29]UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (opened for signature 25 June 1998, entered into force 30 October 2001) 2161 United Nations Treaty Series 447.

[30]Robert McCracken and Gregory Jones, 'The Aarhus Convention' [2003] Journal of Planning and Environment Law 802, 802.

[31]Benjamin W Cramer, 'The Human Right to Information, the Environment and Information About the Environment: From the Universal Declaration to the Aarhus Convention' (2009) 14(1) Communication Law and Policy 73, 74.

[32]Vivek Ramkumar and Elena Petkova, 'Transparency and Environmental Governance' in Ann Florini (ed), *The Right to Know: Transparency for an Open World* (Columbia University Press 2007) 283.

> any information in written, visual, aural, electronic or any other material form on:
>
> (a) The state of elements of the environment, such as air and atmosphere, water, soil, land, landscape and natural sites, biological diversity and its components, including genetically modified organisms, and the interaction among these elements;
>
> (b) Factors, such as substances, energy, noise and radiation, and activities or measures, including administrative measures, environmental agreements, policies, legislation, plans and programmes, affecting or likely to affect the elements of the environment within the scope of subparagraph (a) above, and cost-benefit and other economic analyses and assumptions used in environmental decision-making;
>
> (c) The state of human health and safety, conditions of human life, cultural sites and built structures, inasmuch as they are or may be affected by the state of the elements of the environment or, through these elements, by the factors, activities or measures referred to in subparagraph (b) above;[33]

However, this definition raises more questions than it answers. As Haklay says, '[i]f this is the definition of environmental information, then what kind of information is excluded?' Speculating that it could include landscape paintings, he suggests that it is a deliberately vague definition, a choice made by policymakers in order not to prevent information requests that they had not foreseen.[34]

In European law, the Aarhus Convention is implemented by Directive 2003/4/EEC.[35] This requires

> Member States [to] ensure that public authorities are required, in accordance with the provisions of this Directive, to make available environmental information held by or for them to any applicant at his request and without his having to state an interest.[36]

As another example, the Convention for the Protection of the Marine Environment in the North-East Atlantic (commonly known as the OSPAR Convention) also

[33] Aarhus Convention (n 29) art 2(2).

[34] Mordechai E Haklay, 'Public Environmental Information Systems: Challenges and Perspectives' (PhD thesis, Department of Geography, University College London 2002) 31–2.

[35] McDonagh (n 2) 29–35.

[36] Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC [2003] OJ L41/26, art 3(1).

includes access rights provisions, under which 'competent authorities are required to make available ... information ... to any natural or legal person, in response to any reasonable request, without that person's having to prove an interest, without unreasonable charges, as soon as possible and at the latest within two months.'[37]

6.1.4 Problems with Transparency

Greater transparency is generally seen as a positive thing, particularly in environmental regulation, but it is no panacea.[38] While the right of access to environmental information is linked to public participation, it can have the paradoxical effect of excluding the public because when information is forthcoming, it is not easily understood or used by non-experts.[39]

It brings with it some potential risks: the resources required to collect data mean that a regime with reporting requirements favours those with power; making use of data also requires resources and information literacy, which is not evenly distributed; transparency can become surveillance, particularly for the citizen-consumer; over-disclosure of information can lead to overload; and a concern with data quality can stifle the distribution of information held or developed by the government.[40] While transparency is generally to be welcomed, too much openness can leave the regulatory process open to attack by those who prefer to evade control.[41] Giving the public access to information on the environment serves no practical purpose if the state will not provide that information. Information which can be challenged on the basis of 'objectivity' is always subject to recall.[42]

[37]Convention for the Protection of the Marine Environment of the North-East Atlantic (opened for signature 25 June 1998, entered into force 30 October 2001) 32 International Legal Materials 1069, 9(1).

[38]Mark Fenster, 'The Opacity of Transparency' (2006) 91 Iowa Law Review 885.

[39]Mordechai E Haklay, 'The Contradictions of Access to Environmental Information and Public Participation in Decision Making' in *Nordic Environmental Social Science 2009* (2009).

[40]Arthur PJ Mol, 'The Future of Transparency: Power, Pitfalls and Promises' (2010) 10(3) Global Environmental Politics 132, 133–8.

[41]Sheila Jasanoff, 'Just Evidence: The Limits of Science in the Legal Process' (2006) 34(2) Journal of Law, Medicine and Ethics 328.

[42]Charles N Herrick, 'Objectivity Versus Narrative Coherence: Science, Environmental Policy,

While the use of ICT for transparency is often lauded as a positive step forward, Grimmelikhuijsen argues that transparency may not always have positive effects and that ICT is not always the most appropriate way of achieving it. The media may use access to government information as a source for negative stories which tarnishes the authority of the state; and not all government information should be made public, particularly that with a security dimension. ICT can be used to 'drown' individuals in information, which can hide real problems and contain misinformation. As citizens realise that government does little more than 'muddling through', they may lose faith in institutions generally.[43] While this argument has some merit—there is no doubt that certain state-held information should not be freely available to all—taken as a whole, it is unconvincing: media spin will occur whether or not government data is publicly available, and a poorly-functioning bureaucracy should not be able to hide behind secrecy. Nonetheless, the reality is that some government information and much privately-held information on the environment remains hidden from public view.[44]

It is of more interest to focus on what lies beneath the surface of transparency efforts: Raman discusses the underlying rationales for the Indian government's move to the digitization of spatial information and land ownership records. These include the centralization of power, internal politics within the civil service, facilitating the development of economic growth and foreign direct investment, and benefits to private sector technology companies. She suggests

> ... that a techno-managerial approach overlooks the underlying political issues with respect to the construction of different types of information archives and the State's decisions to open information. This may, contrary to the intention of a progressive [open government data] project, disadvantage relatively weaker groups in protecting their land

and the US Data Quality Act' (2004) 7(5) Environmental Science and Policy 419, 421–2.

[43] Stephan Grimmelikhuijsen, 'A Good Man But a Bad Wizard. About the Limits and Future of Transparency of Democratic Governments' (2012) 17(3) Information Polity 293.

[44] Peter H Sand, 'Information Disclosure as an Instrument of Environmental Governance' (2003) 63 Heidelberg Journal of International Law 487, 499-501.

> claims rather than strengthening their power. Further, information disclosure in itself will not reduce conflicts ...
>
> [and she] argues for situating the debates on spatial information transparency in the political-economic context of information and land in order to understand the workings of power.[45]

I will return to these issues later in this chapter.[46]

6.2 Models in the Regulatory Process

In order to properly understand the role and application of information in the regulatory process, it is necessary to pay some attention to the uses of models:

> Models are developed for regulatory purposes and those regulatory purposes will influence how models are developed. Models regulate power and thus their use relates to the legitimacy of regulatory decision-making. Models are increasingly institutionalised and the subject of policy and legal disputes. Models are thus part of the administrative and legal landscape.[47]

This 'progressive mathematization of "nature" '[48] is fundamental to the construction of the perspectives on the world that underly environmental regulation,[49] but the effect that this may have on the structuring of legal regimes receives little attention.[50] Models play three significant roles: as a catalyst for policy where no regime exists; as a structure for regulatory decision-making; and as a mechanism for collaborative policy and strategy.[51] Despite this, policy-makers and lawyers rarely inquire into the substance or internals of models.[52] This happens because lawyers

[45] Bhuvaneswari Raman, 'The Rhetoric of Transparency and Its Reality: Transparent Territories, Opaque Power and Empowerment' (2012) 8(2) *Journal of Community Informatics*.

[46] See Section 6.3.4.

[47] Elizabeth Fisher, Pasky Pascual, and Wendy E Wagner, 'Understanding Environmental Models in Their Legal and Regulatory Context' (2010) 22(2) Journal of Environmental Law 251, 273.

[48] Sebastien Malette, 'Foucault for the Next Century: Eco-Governmentality' in Sam Binkley and Jorge Capetillo (eds), *A Foucault for the 21st Century: Governmentality, Biopolitics and Discipline in the New Millennium* (Cambridge Scholars Publishing 2009) 228.

[49] See Section 7.3.

[50] William Boyd, 'Ways of Seeing in Environmental Law: How Deforestation Became an Object of Climate Governance' [2010] Ecology Law Quarterly 101, 109.

[51] Fisher, Pascual, and Wagner (n 47) 254–6.

[52] ibid, 263.

prefer not to enquire into 'science' or into the internal details of regulatory decision-making.[53]

Dutton and Kraemer categorise political perspectives on models along two dimensions: the locus of control over the model, and the dominant interest served by the model. From this matrix, they highlight four viewpoints on the modelling process: the *rational perspective*, which sees models as 'scientific aids to policy-making and analysis'; the *technocratic perspective*, which sees models as 'a complex technology controlled by the new priests of the information society and poorly understood by politicians, bureaucrats, or the public'; the *partisan perspective*, which sees models as 'tools of propaganda and persuasion of special interests in the policy process'; and the *consensual perspective*, which sees models as 'primarily tools for negotiation, bargaining, and interactive decision making among the representatives of conflicting interests and opinions in the policy process.'[54]

6.2.1 Misuse of Models

Misplaced reliance on models as infallible oracles or an excessive scepticism about their validity can have significant negative impact on the policy-formation process. As Corrigan points out,

> [m]odels have inherent limitations because they are *simplified representations* of some aspect of reality, *constructed* for a particular *purpose*, usually by an expert with a particular *perspective* of the situation. The models therefore have the modeller's assumptions built into them. Sometimes the simplification and assumptions do not make a big difference to the value of the model but in many cases they can be critical.[55]

The creation and choice of models can have important social, political, and legal consequences, as they 'limit and direct regulatory power ... [and] ... the quality of

[53] ibid, 263–4.

[54] William H Dutton and Kenneth L Kraemer, *Modeling as Negotiating: The Political Dynamics of Computer Models in the Policy Process* (Ablex Publishing Corporation 1985) 5–9.

[55] Ray Corrigan, *Digital Decision Making* (Springer 2007) 196 (emphasis in original).

models directly affects the quality of law and policy'.[56] The scientific models used in legislation may not be accurate or can often lag behind the state of the art. Indeed, the models themselves are only that: an attempt to understand a system rather than the system itself.[57]

While it is claimed that 'it is well understood that models of complicated systems are not "truth machines," but primarily tools to generate insights relevant to decisions',[58] the reality is different. Because natural systems are never closed, models are unverifiable[59] and attempts to make them more realistic by adding more parameters may (paradoxically) make them less accurate.[60] This is something which lawyers and policy-makers need to understand,[61] but

> ... the new models come replete with the enormous prestige of the scientific enterprise, so that there is a built-in tendency for policy-makers to accept the results of simulations as gospel truth, in spite of the fact that the underlying societal models are highly imperfect.[62]

Models are also inherently malleable, which means that 'the characterization of models as being purely "scientific" and "objective" is naive.'[63] Nonetheless, models are an essential part of environmental regulation, a tool for filling in gaps in imperfect data, and 'a means of assessing, measuring, and/or predicting exposure or harm.'[64] However, although they are sometimes perceived as 'answer machines',[65] the reality is that models are limited by the initial question which they seek to an-

[56]Fisher, Pascual, and Wagner (n 47) 269–70.
[57]ibid, 265.
[58]Herrick (n 42) 426.
[59]Naomi Oreskes, Kristin Shrader-Frechette, and Kenneth Belitz, 'Verification, Validation, and Confirmation of Numerical Models in the Earth Sciences' (1994) 263 Science 641.
[60]Naomi Oreskes, 'The Role of Quantitative Models in Science' in Charles Draper and others (eds), *Models in Ecosystem Science* (Princeton University Press 2003).
[61]Fisher, Pascual, and Wagner (n 47) 272.
[62]Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976) 220–1.
[63]Fisher, Pascual, and Wagner (n 47) 272–3.
[64]Wendy Wagner, Elizabeth Fisher, and Pasky Pascual, 'Misunderstanding Models in Environmental and Public Health Regulation' (2010) 18 New York University Environmental Law Journal 293, 297–9.
[65]ibid, 295.

swer, what data is already available or will be measured in future, and the difficulty in validating or verifying an output which is largely a product of internal (and not immediately obvious) assumptions.[66]

Policymakers will often have an overly optimistic view of how reliably models can answer the questions that arise in the policy-making process, which can lead to one of two negative outcomes:

> In some and likely most cases the analyst will tend to place too much confidence in the model, viewing it as empirically determinative, and thus will fail to evaluate or qualify it in a rigorous way. In other cases, the policymaker will inquire further into the workings of the model and become disillusioned with the uncertainties and multiple sources for judgment and reject it in total. In both cases, models are misused and their true contributions—about relationships, dynamic qualities, and even uncertainties in the system—are passed over.[67]

This weakness is accentuated by the widespread misunderstanding of the values embedded in computational technologies.[68] This misunderstanding and misuse can lead to a number of unrealistic expectations for policy-makers: that there is a single, perfect model which will produce an objective truth; that they can remain detached from the consideration and construction of the model; that the model, and the answer which it gives, will remain static and unchanging in the future; and that decisions are best delayed until the model is perfected.[69] This perspective is fundamentally mistaken:

> In most areas of human endeavor—from performing a symphony to orchestrating a society—the processes and rules that constitute the enterprise and define the roles of its participants matter quite apart from any identifiable 'end state' that is ultimately produced. Indeed, in many cases it is the process itself that matters most to those who take part in it.[70]

---

[66] ibid, 308–12.

[67] ibid, 316–17.

[68] Laurence Tribe, 'Technology Assessment and the Fourth Discontinuity: The Limits of Instrumental Rationality' (1972) 46 Southern California Law Review 617, 75–6.

[69] Wagner, Fisher, and Pascual (n 64) 326–30.

[70] Tribe, 'Technology Assessment' (n 68) 83.

In fact, choices with regards to ' "privileging" of different data, different models, different animating assumptions, and different analytical frameworks' can lead to different conclusions.[71] This undermines efforts to include and explore diverse understanding of an environmental or social problem.[72] However, models often have a role in the policy process in spite of, rather than because of, their success as an objective decision-making tool, and are often used as weapons in debate. They can, however, play some constructive roles: defining the common ground for debate, enforcing a consistent approach to problem, and highlighting solutions that are certain to fail.[73]

There is a 'new era of legal formalism in relation to pollution standards and objectives.'[74] Numbers obviously play a significant role in this, through, for example, statistical analysis.[75] Objectivity through statistics is a common means to overcome the discomfort that experts may feel in relying solely on their intuition or judgement.[76] Given the complexity and scale of computer models of large environmental systems (such as climate), the more realistic the model, the more difficult it is to verify it.[77] In addition, the input data is often itself derived from a model—a synthesis of various measurements.[78] Overly complex models cannot be tested or

[71]Herrick (n 42) 424.

[72]Kevin Ramsey, 'GIS, Modeling, and Politics: On the Tensions of Collaborative Decision Support' (2009) 90(6) Journal of Environmental Management 1972.

[73]John Leslie King and Kenneth L Kraemer, 'Models, Facts, and the Policy Process: The Political Ecology of Estimated Truth' in Michael F Goodchild, Bradley O Parks, and Louis T Steyaert (eds), *Environmental Modeling With GIS* (Oxford University Press 1993).

[74]Richard Macrory, 'Environmental Law: Shifting Discretions and the New Formalism' in Richard Macrory (ed), *Regulation, Enforcement and Governance in Environmental Law* (Hart Publishing 2010) 361.

[75]David E Adelman, 'Scientific Activism and Restraint: The Interplay of Statistics, Judgment, and Procedure in Environmental Law' (2003) 79 Notre Dame Law Review 497.

[76]Theodore M Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton University Press 1995) 7.

[77]Naomi Oreskes, 'Why Believe a Computer? Models, Measures, and Meaning in the Natural World' in Jill S Schneiderman (ed), *The Earth Around Us: Maintaining a Livable Planet* (WH Freeman and Co, San Francisco 2000) 74–5.

[78]ibid, 78.

refined[79] and can exclude the public from participation.[80] In addition, there is a constant temptation to exclude factors which cannot be neatly measured and thus included in a computational model, even when they are very important.[81]

Overall, therefore, a regulatory approach that does not take proper account of the uncertainty implicit in science, relies on analytical and computational models to an unwarranted degree, and does not allow space for professional judgement by regulators risks 'drowning' proper transparency, public engagement and accountability in the administrative process under seemingly objective numbers.[82]

6.2.2 Unpacking the Embodiment of Models in ICT

It is not always the case that legislators, policy-makers and the general public are sufficiently scientifically literate to understand the basis of a regulatory scheme. Bad science can displace good science. In addition, the general public and policy-makers do not always properly understand the scientific process of '(1) repeatability, (2) open communication, (3) objective interpretation, and (4) peer review',[83] meaning that they are not able to properly appreciate and engage with a debate that involves scientific detail. As a result, science is sometimes idealized by policy-makers and lawyers, although this can be 'subtle or implicit'.[84]

In considering the role of information and science in present-day environmental regulation, we must be aware of our fuzziness with regard to what constitutes 'information', the contested and contingent nature of much of what we consider to

[79] David E Adelman, 'The Art of the Unsolvable: Locating the Vital Center of Science for Environmental Law and Policy' (2007) 37 Environmental Law 935, 955.

[80] James D Fine and Dave Owen, 'Technocracy and Democracy: Conflicts Between Models and Participation in Environmental Law and Planning' (2004) 56 Hastings Law Journal 901.

[81] Tribe, 'Technology Assessment' (n 68) 627.

[82] Elizabeth Fisher, 'Drowning By Numbers: Standard Setting in Risk Regulation and the Pursuit of Accountable Public Administration' (2000) 20 Oxford Journal of Legal Studies 109.

[83] Katherine L Gross and Gary G Mittelbach, 'What Maintains the Integrity of Science: An Essay for Nonscientists' (2008) 58 Emory Law Journal 341, 342.

[84] David S Caudill and Donald E Curley, 'Strategic Idealizations of Science to Oppose Environmental Regulation: A Case Study of Five TMDL Controversies' (2009) 57 Kansas Law Review 251, 275.

be 'scientific fact', and the very real dangers posed by idealising science and scientific modelling. Science, scientific modeling and the application of ICT are not neutral, objective observers of some distant world but instead are simultaneously constructing and constructed by the world that they measure and seek to make sense of. Scott makes the point that

> [c]ertain forms of knowledge and control require a narrowing of vision. The great advantage of such tunnel vision is that it brings into sharp focus certain limited aspects of an otherwise far more complex and unwieldy reality. This very simplification, in turn, makes the phenomenon at the centre of the field of vision more legible and hence more susceptible to careful measurement and calculation. Combined with similar observations, an overall, aggregate, synoptic view of a selective reality is achieved, making possible a high degree of schematic knowledge, control, and manipulation.[85]

In this technical construction of a 'selective reality', seemingly small differences in scientific or technological processes can make quite significant differences in the political, policy, and decision-making process. An excessive focus on the 'reality' seen by science risks the creation of a picture, based on incomplete and inaccurate data and excluding elements which are not susceptible to simple, quantifiable measurement, or whose interaction is not properly understood or calculable.

While ICT can help to create better integration between government, society, and marketplace that deals with environmental problems and pollution more efficiently,[86] we should be conscious that more is not always better. I have already highlighted how installed technology can become a barrier to efforts at reform.[87] For all that we need science for environmental regulation, we must remain properly conscious of its limitations and be wary that the enthusiastic embrace of ICT does not further accentuate the problems that already exist in the continued 'troubled

[85] James C Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (Yale University Press 1998) 11.

[86] See Section 1.3.2.

[87] See Section 3.4.

marriage'[88] between two very different disciplines:

> Both the disposition to exploit information technology and the changes brought about in doing so reveal the operation of historical forces. The widespread belief in the necessity of using computers to cope with social complexity may be traced to the modern conception of progress and our faith in its ultimate beneficence. Progress has come to mean the unending advance of civilization toward material perfection—a millennial future of abundance and ease made possible by the conquest of nature. ... Alternatives to the technological approach to social problems are rarely contemplated.[89]

In the same way that science cannot escape the values of the social context that produces it, ICT is not ideologically neutral but can have a significant impact on power relationships.[90] We must therefore be careful to critically evaluate the results of applying ICT for environmental regulation: in practice, the results do not always match the promises. If we rely too much on an elite cadre of expert scientists, ICT, and numerical analysis, we may lose sight of the human element that should exist in all systems of government and and the core values which should underlie the regulatory process. We should instead subject any 'normative technology' to rigourous analysis.[91] I shall return to this issue in the concluding chapter.[92]

6.2.3 Implications for Policy-Makers

The models on which regulators and policy-makers rely are often managed through digital technology.[93] In the early 1970s, the dominant thinking on computers was 'rationalistic ... [seeing] computers as an apolitical technology for improving the

[88] Oliver Houck, 'Tales From a Troubled Marriage: Science and Law in Environmental Policy' (2003) 302 Science 1926.

[89] Mowshowitz (n 62) 4–5.

[90] Philip D Zimmermann, Matthias Finger, and Philipp S Mueller, 'Moving Beyond the Technological Neutrality Myth: ICTs and Power in Public Administration' (2008) 1(2) International Journal of Electronic Governance 215.

[91] Bert-Jaap Koops, 'Criteria for Normative Technology: The Acceptability of "Code as Law" in Light of Democratic and Constitutional Values' in Roger Brownsword and Karen Yeung (eds), *Regulating Technologies* (Hart Publishing 2008).

[92] See Section 9.3.

[93] Fisher, Pascual, and Wagner (n 47) 266.

rationality of decision making and the efficiency of operations in organizations',[94] although more prescient thinkers were pointing out the difficulties with this uncritical perspective.[95] By the 1980s, there was an expectation that 'computerized data and sophisticated models can bring new elements to public policy making that make a qualitative improvement in the outcome of the policy process,'[96] but this was already being problematised by scholars:

> The basic issue is that policymakers and the public apparently cannot expect policy analyses conducted with the aid of information technology to be objective, credible, and accurate. Indeed the technology is expected to automate the partisan biases of politicians.[97]

Discussing recent bitter debates regarding the technical details of water models in California, Stephen Jackson comments that

> ... the real-world challenges of 'modeling democratically' within realms of complex and bitterly contested public policy ... [regularly raise issues] of trust, confidence, and credibility which modelers and water managers are ill-equipped by training to deal with[.][98]

As I have already discussed when outlining systems theory,[99] the elements that define what is included in, and excluded from, debate around policy choices are highly significant.

This question of the relationship between ICT, access to information and communication spaces, and power is central to this thesis. A recent salient example from the British courts is *R (Easai Ltd) v National Institute for Health and Clinical Excellence*,[100] in which a pharmaceutical company seeking to challenge a regulatory de-

[94] James N Danziger and others, *Computers and Politics: High Technology in American Local Governments* (Columbia University Press 1982) xii.

[95] Mowshowitz (n 62) 200.

[96] Dutton and Kraemer (n 54) 3.

[97] ibid, 4.

[98] Steven Jackson, 'Water Models and Water Politics: Design, Deliberation, and Virtual Accountability' in *Proceedings of the 2006 International Conference on Digital Government Research* (Digital Government Society of North America 2006) 102.

[99] See Section 4.3.3.

[100] *R (Easai Ltd) v National Institute for Health and Clinical Excellence* [2008] EWCA Civ 438, [2008] 11 CCL Rep 385.

cision with regard to one of its products claimed that it was not being treated fairly as it was not given access to the full version of the computerized model used by the regulator, but only a 'read-only' version in which parameters and assumptions could not be changed. Lord Justice Richards in the Court of Appeal for England and Wales concluded that

> ... procedural fairness does require release of the fully executable version of the model. It is true that there is already a remarkable degree of disclosure and of transparency in the consultation process; but that cuts both ways, because it also serves to underline the nature and importance of the exercise being carried out. The refusal to release the fully executable version of the model stands out as the one exception to the principle of openness and transparency that [the regulator] has acknowledged as appropriate in this context. It does place consultees ... at a significant disadvantage in challenging the reliability of the model. In that respect it limits their ability to make an intelligent response on something that is central to the appraisal process.[101]

6.2.4 Conclusion

If regulators do not respond in an informed, integrated, and holistic way to the challenges of the limits of modelling as a tool for understanding, the invisible choices which they embody, and the need to prevent the introduction of ICT from creating or accentuating power imbalances, they risk undermining their accountability, authority, and legitimacy. However, these agencies are very vulnerable to falling prey to the myth of inevitable, value-neutral 'development', in which the

> ... negative social 'effects' of new technologies are seen as fortuitous, or incidental, even unavoidable side-effects of history's juggernaut of 'progress'. These effects may be rectified, it is suggested, by sagacious use of the technologies.[102]

[101] ibid [66].

[102] Kevin Robins and Frank Webster, *Times of the Technoculture: From the Information Society to the Virtual Life* (Routledge 2004) 49.

6.3 Disclosure as a Regulatory Tool

Another aspect of the perceived power of information in environmental regulation is the use of disclosure-based regulation as one of the responses to the perceived inefficiency and ineffectiveness of traditional command and control regulation.[103] Often called 'informational regulation', this can be defined as 'government mandated public disclosure of information on the environmental performance of regulated entities.'[104] While it has a history that stretches back to US federal securities laws in the 1930s,[105] it has become a significant feature of environmental regulation since the 1960s.[106]

Much of the promise of the application of ICT to environmental regulation relies on the power of information to change behaviour, whether individual or organizational.[107] This notion, that providing people with information on the consequences of their actions will cause them to modify those actions, can be conceptualised as a combination of command-and-control and market-based approaches to regulation[108] and can be put under the broad heading of 'reflexive' theories of regulation.

These have already been discussed in broad terms in Section 4.6.3. The aim is 'to encourage businesses to incorporate permanent operational and decisionmaking processes to address environmental concerns.'[109] Embedding this focus into the

[103]David W Case, 'Corporate Environmental Reporting as Informational Regulation: A Law and Economics Perspective' (2005) 76 University of Colorado Law Review 379, 380–1.

[104]ibid, 383.

[105]Mary Graham, *Democracy By Disclosure: The Rise of Technopopulism* (Brookings Institution Press 2002) 1-2.

[106]Case, 'Corporate Environmental Reporting' (n 103) 384.

[107]Arthur PJ Mol, *Environmental Reform in the Information Age: The Contours of Informational Governance* (Cambridge University Press 2008) 114–115.

[108]Karen Yeung, 'Government By Publicity Management: Sunlight or Spin?' [2005] Public Law 360, 367.

[109]Eric W Orts, 'Reflexive Environmental Law' (1995) 89 Northwestern University Law Review 1227, 1339.

thought process of individuals is essential in order to overcome the difficulty created by the Jevons Paradox—that 'greater efficiency produces greater use because the increased efficiency reduces the cost of operations'.[110] As Morriss explains, in the context of transportation needs, 'as population grows, transportation methods become more efficient, and our economy grows, our transportation needs are likely to continue to grow despite the increased efficiency of transportation'.[111] This analysis can obviously be extended to other instances of resource and energy-use, as Rattle does in his consideration of Moore's Law (that electronics become rapidly more efficient),[112] making an awareness of the need for parsimony vital in order to balance out increasing efficiencies.

Overall, the impact of 'regulation through disclosure' is still not adequately studied or properly understood. Its results may be limited,[113] it does not always achieve the desired results,[114] and the response from practitioners is not always positive.[115]

6.3.1 Development of Disclosure

Informational regulation is not new.[116] It has been used in railway regulation since the 1860s,[117] in financial regulation since the 1930s, and was a significant part of the development of environmental and health and safety law in the 1960s and 1970s.[118]

[110] Andrew P Morriss, 'The Next Generation of Mobile Source Regulation' (2008) 17 New York University Environmental Law Journal 325, 326.

[111] ibid, 327.

[112] Robert Rattle, *Computing Our Way to Paradise: The Role of Internet and Communication Technologies in Sustainable Consumption and Globalization* (Altamira Press 2011) 95–6.

[113] Geraint Howells, 'The Potential and Limits of Consumer Empowerment By Information' (2005) 32(3) Journal of Law and Society 349.

[114] Klaus Dingwerth and Margot Eichinger, 'Tamed Transparency: How Information Disclosure Under the Global Reporting Initiative Fails to Empower' (2010) 10(3) Global Environmental Politics 74.

[115] Yeung, 'Government By Publicity Management' (n 108) 375.

[116] Michael E Kraft, Mark Stephan, and Troy D Abel, *Coming Clean: Information Disclosure and Environmental Performance* (MIT Press 2011) 57.

[117] Giandomenico Majone, 'The New European Agencies: Regulation By Information' (1997) 4(2) Journal of European Public Policy 262, 265.

[118] David W Case, 'The Law and Economics of Environmental Information as Regulation' (2001) 31(7) Environmental Law Reporter 10773, 10074–5.

In the US, it developed as a 'middle ground' between the competing priorities of the Republican and Democratic Parties, who favoured less government and more risk-based regulation respectively.[119] More recently, governments have used 'league tables' of, for example, school performance or business environmental performance as a means of 'exclamation and excoriation', or highlighting good and bad performers in health and safety ('naming and faming'/'naming and shaming'),[120] while efforts to deal with political corruption, poor diet and energy efficiency in cars and household appliances have made use of information disclosure techniques.[121] Disclosure requirements have also been used in an effort to deal with the more recently developing problem of large-scale data breaches,[122] with some success.[123]

The practical development of these styles of regulation have been driven by several critiques of conventional command-and-control regulation: many major pollution problems have been identified and dealt with to the extent that is economically feasible, and the significant problems that remain are generally non-point sources, such as water pollution, which are much less amenable to centralised solutions.[124] They are also connected to the increasing availability of ICT, which provide new capabilities to access, integrate, and select information.[125] From an academic perspective, the conceptual development of reflexive law can be traced back to Teubner's work from the 1980s on, in which he argued that law goes through three phases of development, from 'formal law' (basic rules) to 'substantive law' (administrative procedures) to 'reflexive law' (indirect, abstract, rational).[126]

Although disclosure-based instruments might seem on the surface to be exam-

[119]Graham, *Democracy By Disclosure* (n 105) 11–3.
[120]Yeung, 'Government By Publicity Management' (n 108) 372–3.
[121]Kraft, Stephan, and Abel (n 116) 8.
[122]Paul M Schwartz and Edward J Janger, 'Notification of Data Security Breaches' (2007) 105 Michigan Law Review 913.
[123]Sasha Romanosky, Rahul Telang, and Alessandro Acquisti, 'Do Data Breach Disclosure Laws Reduce Identity Theft?' (2011) 30(2) Journal of Policy Analysis and Management 256.
[124]Kraft, Stephan, and Abel (n 116) 4.
[125]Mary Graham, 'Information as risk regulation: Lessons from experience' (2001) ⟨http://www.transparencypolicy.net/assets/information.pdf⟩ accessed 27 August 2014, 11.
[126]Orts, 'Reflexive Environmental Law' (n 109) 1255–63.

ples of 'soft law', the reality is that they are used as both 'soft' and 'hard' tools (for example, to help with enforcement and prosecution) in a hybrid mix.[127] This flexibility is often achieved through ICT, which allows for greater transparency (by making available information on interactions between the regulator and the regulated), two-way interaction with the public, and dissemination of emissions data.[128] The widespread availability of networked digital telecommunication systems creates the possibility of new forms of informational regulation. These will increasingly empower individual citizens and will involve interactive, customisable, and more quickly updated interfaces. The systems are likely to be increasingly collaborative, with government still playing a key role but somewhat displaced to the position of convener and facilitator. The capacities of ordinary users, information disclosers, and regulators will be expanded by these new systems.[129] However, as with any human system, they will be vulnerable to distortion, panic, and manipulation.[130]

6.3.2 Rationales for Regulation by Disclosure

A reflexive model of behaviour control is 'a social theoretical perspective rather than a strictly legal one' and operates in quite a different way to traditional black letter, command and control mechanisms, simultaneously acknowledging and seeking to control individual autonomy.[131] The mechanisms of change are public pressure and communication, which seek to expand the usual scope of government activity.[132] Reflective law acknowledges its own limits, the limits of the system in which it

[127] Dorit Kerret, 'Don't Judge a Book By Its Cover: Use of an Analytic Framework and Empirical Data in Analyzing Environmental Policy Tools' (2012) 42 Environmental Law Reporter 10078.

[128] Dennis D Hirsch, 'Globalization, Information Technology, and Environmental Regulation: An Initial Inquiry' (2001) 20 Virginia Environmental Law Journal 57, 72.

[129] Archon Fung, Mary Graham, and David Weil, *Full Disclosure: The Perils and Promise of Transparency* (Cambridge University Press 2007) 152–8.

[130] ibid, 164–5.

[131] Eric W Orts, 'A Reflexive Model of Environmental Regulation' (1995) 5(4) Business Ethics Quarterly 779, 780.

[132] Graham, *Democracy By Disclosure* (n 105) 10–11.

operates and the limits of individual humans. It seeks to continually learn and improve, while accepting that it can never provide a comprehensive solution to social problems.[133] It can also be applied in a way that takes advantage of the insights of the 'tri-partism' theory of regulation,[134] by using disclosure as a way of introducing third parties into the regulatory process.[135]

Regulation by disclosure has been labelled ' "populist maxi-min regulation," which can be thought of simply as a kind of environmental blacklisting.'[136] The requirement that information on environmental performance be disclosed may drive behaviour change in a number of ways. It can focus the minds of senior management on a problem that has hitherto been hidden,[137] or unnoticed.[138] For commercial firms, the incentive may be the impact on financial performance: the stock market seems to read new information on pollution emissions as indicative of future performance and future costs, something which can directly impact on share prices.[139] Requiring firms to provide information to the public reduces the transaction costs incurred by individuals in gathering information on pollution, thus mitigating or eliminating the information asymmetry that would otherwise exist between the citizen and the corporation.[140] The social impact of being explicitly highlighted for bad performance in a 'name and shame' campaign may serve as a form of punishment.[141] It can also serve to alert consumers to a problem, thus motivating them to

[133] Orts, 'Reflexive Environmental Law' (n 109) 1265–7.

[134] See Section 4.3.3.

[135] Orts, 'A Reflexive Model' (n 131) 787.

[136] Archon Fung and Dara O'Rourke, 'Reinventing Environmental Regulation From the Grassroots Up: Explaining and Expanding the Success of the Toxics Release Inventory' (2000) 25(2) Environmental Management 115, 120.

[137] Graham, *Democracy By Disclosure* (n 105) 21–3.

[138] Shakeb Afsah, Allen Blackman, and Damayanti Ratunanda, 'How Do Public Disclosure Pollution Control Programs Work? Evidence From Indonesia' (*Resources for the Future Discussion Paper,* 2000) ⟨http://core.kmi.open.ac.uk/download/pdf/9308153.pdf⟩ accessed 27 August 2014.

[139] Shameek Konar and Mark A Cohen, 'Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions' (1997) 32(1) Journal of Environmental Economics and Management 109.

[140] Kraft, Stephan, and Abel (n 116) 38–40.

[141] Yeung, 'Government By Publicity Management' (n 108) 374.

put pressure elsewhere in the regulatory structure in order to bring about change.[142] Finally, firms come under significant external pressure to act in line with an implicit 'social contract' which constrains their behaviour in ways that go beyond the strict legal requirement but may be a rational response to an expectation of further regular in the future;[143] the use of disclosure requirements to highlight transgressions of these unspoken rules may incentivise higher levels of compliance.

On a more positive note, the possibility of benchmarking a firm's performance against its peers gives managers a greater understanding of what is and is not possible and helps in driving a process of continuous improvement.[144] The use of more flexible regulatory tools allows regulators to avoid an 'information bottleneck' and respond quickly to a fast-moving and complex marketplace and changes in technology,[145] at a relatively low cost.[146] It can bring new information on environmental impacts to the attention of decision-makers and provide a framework within which data is readily available for the purposes of ongoing monitoring.[147] It can also enable those not involved in the day-to-day operations of an entity, such as the Board of Directors or external investors, to assess and compare its performance.[148] This type of pressure may also be effective in reducing greenhouse gas emissions,[149] leading to NGOs calling for greater disclosure of emissions and the United States EPA requiring large emitters to track these.[150] Similarly, poor national performance on comparative measures of environmental performance can be a significant spur

[142]Katherine Renshaw, 'Sounding Alarms: Does Informational Regulation Help or Hinder Environmentalism?' (2005) 14 New York University Environmental Law Journal 654.

[143]Neil Gunningham, Robert A Kagan, and Dorothy Thornton, 'Social License and Environmental Protection: Why Businesses Go Beyond Compliance' (2004) 29(2) Law and Social Inquiry 307.

[144]Bradley C Karkkainen, 'Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?' (2001) 89 Georgetown Law Journal 257, 261.

[145]ibid, 263–4.

[146]ibid, 291–2.

[147]ibid, 297–8.

[148]ibid, 299–300.

[149]Andrew Schatz, 'Regulating Greenhouse Gases By Mandatory Information Disclosure' (2008) 26 Virginia Environmental Law Journal 335.

[150]Kraft, Stephan, and Abel (n 116) 9.

for action.[151]

Writing in the context of the regulation of toxic chemicals, but with an analysis that can clearly be extended to other domains, Lyndon states that information on toxicity is a public good and is therefore not readily produced by the market because of free rider issues[152] and concerns about tort liability create a disincentive for firms to build a full picture of the consequences of their products are placed on the market.[153] There is therefore a need for regulatory intervention to create more transparency.[154]

6.3.3 Applications of Regulation by Disclosure

Perhaps the best-known example of the application of information disclosure in environmental regulation, developed as a response to a catastrophic leak of toxic chemicals at the Union Carbide plant in Bhopal India,[155] is the US Toxics Release Inventory (TRI), required under section 313 of the Emergency Planning and Community Right-To-Know Act. This requires regulated firms to submit annual data to the EPA on the volumes of certain toxic chemicals released into the air, water, land or transferred off-site. This information is made publicly accessible through an online database and otherwise. It is reported and commented upon by the media and environmental NGOs. It seems to have reduced the release of chemicals subject to reporting requirements by as much as 40%[156] or perhaps even 61%[157] and as much as 82% in some locations.[158] There may be other reasons for this reduction, such as other regulations, changes in production levels and improvements in technology, but

[151]Daniel C Esty, 'Environmental Protection in the Information Age' (2004) 79 New York University Law Review 115, 168.

[152]Mary L Lyndon, 'Information Economics and Chemical Toxicity: Designing Laws to Produce and Use Data' (1989) 87 Michigan Law Review 1795, 1810.

[153]ibid, 1817.

[154]ibid, 1825.

[155]Kraft, Stephan, and Abel (n 116) 11.

[156]Case, 'Environmental Information as Regulation' (n 118) 10775.

[157]Kraft, Stephan, and Abel (n 116) 15.

[158]James T Hamilton, *Regulation Through Revelation: The Origin, Politics, and Impacts of the Toxics Release Inventory Program* (Cambridge University Press 2005) 4.

it seems clear that TRI was a success and brought about significant voluntary reductions in chemical releases.[159] Similar programmes have been applied successfully at the state level in the US.[160]

The TRI seems to focus the attention of senior management to the issue in a way that brings about change.[161] It also helps to create (unfavourable) news stories and impacts on stock prices.[162] These news stories are a significant incentive for firms to reduce pollution.[163] The TRI may succeed because in addition to the reflexive impact, it allows for benchmarking and demands continuous improvement.[164] There seems to be a connection between the impact of emissions disclosure on the stock price of a particular firm and subsequent emissions reduction efforts by that firm.[165]

A similarly successful exercise is California's Proposition 65,[166] which requires manufacturers to place labels on products warning consumers of associated health risks,[167] and which has met with some success[168] but also some criticism.[169] In Massachusetts, mandatory reporting to customers on the quality of their water seems to have reduced health violations.[170] The provision of information on the existence of lead paint in a house can have an impact on mitigation behaviour but

[159]Karkkainen, 'Information as Environmental Regulation' (n 144) 287–8.

[160]Lori Snyder Bennear, 'Are Management-Based Regulations Effective? Evidence From State Pollution Prevention Programs' (2007) 26(2) Journal of Policy Analysis and Management 327.

[161]Hamilton, *Regulation Through Revelation* (n 158) 54.

[162]ibid, 58–74.

[163]ibid, 190.

[164]Karkkainen, 'Information as Environmental Regulation' (n 144) 261.

[165]Konar and Cohen (n 139); Madhu Khanna, Wilma Rose H Quimio, and Dora Bojilova, 'Toxics Release Information: A Policy Tool for Environmental Protection' (1998) 36(3) Journal of Environmental Economics and Management 243.

[166]The Safe Drinking Water and Toxic Enforcement Act of 1986 1986.

[167]Karkkainen, 'Information as Environmental Regulation' (n 144) 345.

[168]Michael P Vandenbergh, 'From Smokestack to SUV: The Individual as Regulated Entity in the New Era of Environmental Law' (2004) 57 Vanderbilt Law Review 515, 610.

[169]Bradley Karkkainnen, 'Keynote: "You manage what you measure": Information, Incentives, and the Architecture of Environmental Regulation' (*Information and Communications Technology for Environmental Regulation: Developing a Research Agenda*, Galway, 2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

[170]Lori S Bennear and Sheila M Olmstead, 'The Impacts of the "Right To Know": Information Disclosure and the Violation of Drinking Water Standards' (2008) 56(2) Journal of Environmental Economics and Management 117.

this is not the same across all income levels.[171] In England and Wales, the release of information through the Environment Agency's Pollution Inventory has reduced emissions from the chemical industry.[172] Disclosure can also be used by international organizations and NGOs as a means of putting pressure on states that are not complying with multi-lateral environmental agreements.[173]

6.3.4 Difficulties with Disclosure

Disclosure-based regulatory schemes are, of course, not perfect:

> Most information is not meaningful in itself, but requires interpretation and analysis. Because not all information is relevant to making an informed decision, more information is not always better. It is often claimed that people are smart enough to sort through the information they are given, but this argument can be taken too far, especially when the information is highly technical. Indeed, information-gathering or labeling that is excessive or too detailed can easily confuse, mislead, or be used to manipulate consumers; it may make people misperceive risks, misallocate resources, and frustrate health, safety, and environmental objectives.[174]

Overall, the impact of 'regulation through disclosure' is still not adequately studied or properly understood. It does not always achieve the desired results. More information is not necessarily better but may instead cause overload and poorer decision-making.[175] Simply disclosing 'raw' data may not have a significant impact on emissions reduction; further processing to make the information useful and relevant to end users increases the possibility that the overall policy goal of reduc-

[171] Hyunhoe Bae, Peter Wilcoxen, and David Popp, 'Information Disclosure Policy: Do State Data Processing Efforts Help More Than the Information Disclosure Itself?' (2010) 29(1) Journal of Policy Analysis and Management 163.

[172] Andy Gouldson, 'Risk, Regulation and the Right to Know: Exploring the Impacts of Access to Information on the Governance of Environmental Risk' (2004) 12(3) Sustainable Development 136.

[173] Jennifer Shkabatur, 'A Global Panopticon—the Changing Role of International Organizations in the Information Age' (2011) 33 Michigan Journal of International Law 159, 16–8.

[174] Alexander Volokh, 'The Pitfalls of Environmental Right-to-Know' (2002) 2 Utah Law Review 805, 807.

[175] Douadia Bougherara, Gilles Grolleau, and Naoufel Mzoughi, 'Is More Information Always Better? An Analysis Applied to Information-Based Policies for Environmental Protection' (2007) 10(3) International Journal of Sustainable Development 197.

ing health risks will be achieved.[176] There are also social and environmental justice issues, as not all individual and groups have the same capability to analyse and use the information. Seeming reductions in emissions may actually be the result of underreporting rather than better environmental management.[177] Reclassification of activities can remove reporting requirements and there may be little reduction in use of toxic chemicals at source.[178] In addition, polluters may respond strategically to the thresholds in a reporting program. A study of the Massachusetts Toxics Use Reduction Act reveals that there was a 'a significant behavioral response to regulatory thresholds ... [and] up to 40 percent of the observed decrease in releases in Massachusetts may be artificial declines created by strategic behavior around the reporting thresholds.'[179] Finally, implementation (and success) is very context-specific—if the political, legal, and markets conditions are not suitable, it may achieve limited results.[180]

Replicating the Problems of Command-and-Control

The provision of information, by itself, is not a form of risk assessment.[181] We should not assume that simply because information is publicly available, it is accurate,[182] properly understood,[183] or complete. Analysis of the TRI data has revealed that it has contained significant errors in recording the quantity and location of toxic

[176] Bae, Wilcoxen, and Popp (n 171).

[177] Dinah A Koehler and John D Spengler, 'The Toxic Release Inventory: Fact or Fiction? A Case Study of the Primary Aluminum Industry' (2007) 85(2) Journal of Environmental Management 296.

[178] Thomas E Natan and Catherine G Miller, 'Are Toxics Release Inventory Reductions Real?' (1998) 32(15) Environmental Science and Technology 368A, 373A.

[179] Lori Snyder Bennear, 'Strategic Response to Regulatory Thresholds: Evidence from the Massachusetts Toxics Use Reduction Act' (2005) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=776504⟩ accessed 19 May 2014, 2.

[180] Eungkyoon Lee, 'Information Disclosure and Environmental Regulation: Green Lights and Gray Areas' (2010) 4(3) Regulation and Governance 303.

[181] Susan E Dudley, 'It is Time to Reevaluate the Toxic Release Inventory' (2004) 12 Missouri Environmental Law and Policy Review 1, 6.

[182] Mark A Cohen, 'Information as a Policy Instrument in Protecting the Environment: What Have We Learned?' (2001) 31(4) Environmental Law Reporter 10425, 10427.

[183] Graham, *Democracy By Disclosure* (n 105) 141–2.

releases.[184] If it is not carefully designed, a disclosure program will contain many of the weaknesses ascribed to command and control environment regulation: an unwarranted focus on major sources, a lack of discrimination between pollution types or little incentive for further research.[185]

Gaming the System

Although the application of ICT as a tool for reflexive environmental governance has great potential, practical implementations require careful design due to Goodhart's Law: 'any observed statistical regularity will tend to collapse once pressure is placed on it for control purposes'.[186] Seeming reductions in emissions may actually be the result of underreporting rather than better environmental management.[187] In addition, polluters may respond strategically to the thresholds in a reporting program.[188] This type of behaviour is observed in other contexts, such as health care management.[189] The data provided may also be underestimated through a simple lack of awareness on the part of the reporting entities rather than deliberate attempts at deception or reluctant compliance.[190]

Unpredictable Results

Unlike more traditional methods of regulation, such as command and control, informational regulation brings with it no guarantee of results. The data that is presented and used is about the past and is not necessarily a reliable guide to future performance. In addition, informational regulation cannot guarantee any particular level

[184]Dudley (n 181) 16.

[185]William F Pedersen, 'Regulation and Information Disclosure: Parallel Universes and Beyond' (2001) 25 Harvard Environmental Law Review 151, 176.

[186]CAE Goodhart, *Monetary Theory and Practice: The UK Experience* (MAssociation for Computing Machineryillan 1984) 96.

[187]Koehler and Spengler (n 177); Graham, *Democracy By Disclosure* (n 105) 48.

[188]Bennear, 'Strategic Response to Regulatory Thresholds' (n 179) 2.

[189]Gwyn Bevan and Christopher Hood, 'What's Measured is What Matters: Targets and Gaming in the English Public Health Care System' (2006) 84(3) Public Administration 517.

[190]Graham, *Democracy By Disclosure* (n 105) 47.

of reduction, or any reduction at all.[191] Indeed, it can be difficult to directly link emission reductions to a disclosure scheme.[192] The potential impact of negative information on corporate reputation may lead to changes in management behaviour, and these can be significant, but they can drop off with time.[193]

Excessive Costs

It is difficult to quantify the benefits of the disclosure of data on environmental harms and risk, and many may be more elusive than real, as the results may be public alarm, erosion of company value and the diversion of funds from salaries to pay for health and safety measures.[194] The costs of a disclosure regime can be high,[195] but also very difficult to measure,[196] making it hard to assess whether or not it is yielding adequate results.

Limited Understanding of Sustainability

Many attempts to use measurement and disclosure as tools for behaviour change are rooted in a limited perspective of sustainability as energy efficiency, take a 'modernist' perspective on human behaviour and regulation, and are conducted over short timeframes. This narrow focus misses broader social issues about power differences, control, and values, assumes that individuals have a great deal of control over their resource use choices, and that those individuals are rational in their choices.[197] Many such schemes focus on minor, easy changes with limited impact, omitting major, difficult changes which could make a significant difference to over-

[191] Cohen, 'Information as a Policy Instrument' (n 182) 10427.
[192] Dudley (n 181) 14.
[193] Graham, *Democracy By Disclosure* (n 105) 144–6.
[194] Dudley (n 181) 10.
[195] Kraft, Stephan, and Abel (n 116) 10.
[196] Yeung, 'Government By Publicity Management' (n 108) 368.
[197] Hronn Brynjarsdottir and others, 'Sustainably Unpersuaded: How Persuasion Narrows Our Vision of Sustainability' in Joseph A Konstan, Ed H Chi, and Kristina Höök (eds), *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2012).

all sustainability.[198]

Intractable Habits

Although it is difficult to build comprehensive and reliable data, individuals are responsible for a great deal of pollution.[199] However, regulation is more complicated at this level, as individuals find it difficult to change or even resist externally-imposed behaviours.[200] Information disclosure can help, by overcoming the limited cognitive capacity of individuals and also creating a market incentive for polluters to change their behaviour.[201] However, changing individual habits is not as easy as we might wish,[202] and many of the behaviours which are important for environmental protection are ongoing and routine (such as managing heating), rather than rare and significant (such as purchasing a motor vehicle), and thus difficult to change.[203]

While informational regulation has been somewhat successful in regulating corporate behaviour, its applications to individuals may be more difficult. There is an underlying assumption that consumers are rational and will properly assimilate, understand, and act on information provided. However, studies indicate that this is not necessarily true.[204] Individuals may not easily understand the information that is released, and therefore not put it to the best possible use.[205] The most successful uses of information regulation are 'user-centred', focusing 'first on the needs and interests of information users, as well as their abilities to comprehend the information provided by the system.'[206]

[198] Susie Moloney and Yolande Strengers, '"Going Green"?: The Limitations of Behaviour Change Programmes as a Policy Response to Escalating Resource Consumption' (2014) 24(2) Environmental Policy and Governance 94.

[199] Vandenbergh, 'From Smokestack to SUV' (n 168) 537–84.

[200] Michael P Vandenbergh, 'Order Without Social Norms: How Personal Norm Activation Can Protect the Environment' (2004) 99 Northwestern University Law Review 1101, 1103.

[201] Christopher H Schroeder, 'Third Way Environmentalism' (1999) 48 Kansas Law Review 1, 823.

[202] Vandenbergh, 'Order Without Social Norms' (n 200) 593–4.

[203] Michael P Vandenbergh and Anne C Steinemann, 'The Carbon-Neutral Individual' (2007) 82 New York University Law Review 1673, 1696–7.

[204] Yeung, 'Government By Publicity Management' (n 108) 368–9.

[205] Kraft, Stephan, and Abel (n 116) 10.

[206] Fung, Graham, and Weil (n 129) 11.

Part III

ICT in Environmental Regulation: Empirical Explorations

Introduction to Part III

In this central part, I integrate the findings from the empirical fieldwork—semi-structured interviews with staff in regulatory agencies and non-governmental organizations concerned with environmental regulation—into the thesis. As will be explained, this process of identifying appropriate and knowledgeable individuals, obtaining consent, and making sense of what they said was not straightforward or linear. Nonetheless, the data collected was rich and the resulting perspectives on how ICT is applied in practice by regulators are valuable, particularly as they are founded on rigorous exploration of the interview transcripts.

I first provide an overview of the major theoretical frameworks that I will be relying on to analyse the data gathered during the empirical fieldwork and to contextualize the operation of the increasingly digital regulator. These come from a variety of disciplines: information systems, library studies, and sociology (including governmentality and the sociology of science and technology). From these, an overall framework for the later analysis is assembled.

After an explanation of the theoretical perspectives and pragmatic choices that guided my approach to the interviews, I summarize the process of analyzing the interviews, which proceeded through several cycles of coding and was assisted by the use of diagrams and visualizations as tools for solidifying understandings, verifying conclusions, and explaining these to others. This involved the application of techniques such as Thematic Network Analysis and theories such as Information Ecology and Actor-Network Theory.

Chapter 7

Assembling Perspectives on the Development and Application of Technology

As discussed in Section 1.4, the underlying research question informing this thesis is: *Does the increased use of ICT in environmental regulation redistribute power (whether express or implicit) within that system, and does this raise rule of law issues?* I began with an understanding that ICT is itself a persuasive tool: not simply a more efficient processor of information, but a socially constructed artefact of considerable power and influence. The theories on the rule of law discussed in Section 2.2 and the theories on regulation discussed in Section 4.3 (other than perhaps systems theory) will not be adequate to explore this question as they stand *outside* the changes that are underway, privileging the perspective of theorists rather than using the descriptions of those who were in fact involved in the actualization of new forms of organization and regulation.[1] They suffer from two analytic flaws that confuse those seeking to understand the social impact of ICT highlighted by Sassen:

> [First, confining] interpretation to a technological reading of the technical capabilities of digital technology. This is crucial for the engineering side, but it is problematic for a sociological understanding. ... [Second,] the continuing reliance on analytical categorizations that were developed under other spatial and historical conditions, that is, conditions preceding the current digital era. Thus the tendency is to conceive

[1] J Murdoch, 'Actor-Networks and the Evolution of Economic Forms: Combining Description and Explanation in Theories of Regulation, Flexible Specialization, and Networks' (1995) 27(5) Environment and Planning A 731.

> of the digital as simply and exclusively digital and the nondigital ... as simply and exclusively non-digital ... precluding a more complex reading of the interactions between the digital and the nondigital ...[2]

Transcending these flaws and finding a way to clearly see the 'complex assemblage of rules, practices, values and imageries embedded in institutional and normative frameworks'[3] requires several excursions into disciplines other than law in order to assemble a sufficiently broad range of perspectives. I begin with the rather basic frameworks offered by the Technology Enactment Framework and Information Ecology, and move on to more sophisticated and complex perspectives, such as Foucauldian governmentality theory, understandings of the relationship between ICT and power, and sociological theories of the development of technology, particularly Actor-Network Theory (ANT).

7.1 Technology Enactment Framework

In the literature on e-government and institutions, one of the foundational theories is the Technology Enactment Framework (TEF) first developed by Jane Fountain.[4] This seeks to integrate ICT and organizational theory.[5] It begins from the insight that the technical capabilities of ICT are of little concern unless they are put to use by agents within an organization. ICT therefore has objective, material components (the functionality of the devices) but also a subjective perception, definition, and use. ICT is embedded and then enacted within an organization in a way that tends to support the existing institutions, whether these are formal rules, informal norms and expectations, or social relationships. Individual actors seek to pursue their own

[2] Saskia Sassen, *Territory, Authority, Rights: From Medieval to Global Assemblages* (Cambridge University Press 2006) 342.

[3] Giovan Francesco Lanzara, 'Building Digital Institutions: ICT and the Rise of Assemblages in Government' in Francesco Contini and Giovan Francesco Lanzara (eds), *ICT and Innovation in the Public Sector: European Studies in the Making of E-Government* (Palgrave Macmillan 2009) 26.

[4] Antonio Cordella and Federico Iannacci, 'Information systems in the public sector: The e-Government enactment framework' (2010) 19(1) Journal of Strategic Information Systems 52, 55.

[5] Jane E Fountain, *Building the Virtual State: Information Technology and Institutional Change* (Brookings Institution Press 2001) 83.

interests in this process but these change over time. Individuals also tend to try to use technology to strengthen so-called 'deep institutions' (the history and culture of the organization). However, the outcomes from this process are indeterminate, multiple, and sometimes unanticipated.[6] This echoes, in many ways, Teubner's theory of autopoesis.[7]

Fountain puts forward a number of propositions as part of her framework:

1. Government agencies will resist the potential for dramatic efficiency gains if those gains translate into loss of resources (budget and personnel) for the agency.

2. Federal interagency networks will be difficult to build and maintain because the formal institutions reward agency-centred activities and discourages cross-agency activities.

3. Agencies lack resources for learning to use IT.

4. Intergovernmental and public-private networks will overshadow cross-agency IT-based networks because the institutional context favours those arrangements.

5. Agencies are likely to focus reform efforts on constituents, or 'customers' who also are potential or actual strategic allies in the appropriations process.

6. The nature of changes necessary to develop a network affects the probability of success of the effort.

7. The culture, history, mental models, and standard practices of a policy domain or agency will affect technology enactment—that is, whether and how an agency uses the Internet.[8]

[6] ibid, 88–90.
[7] See Section 4.3.3.
[8] ibid, 102–3.

The TEF has been criticised for a certain level of contradiction and confusion in the propositions, such as number four above, which does not derive clearly from what has gone before,[9] and for being 'highly abstract and generalized, making it difficult to use as a predictive tool.'[10] It has also been criticised for ignoring existing social science research, studying organizational politics rather than institutional change and making claims about the increasing use of ICT to create networks within government that have not been borne out by research.[11] Fountain's work is best used as a starting point,[12] particularly as it is somewhat deterministic in its view of technology.[13]

7.2 Information Ecology

For an alternative, Information Ecology (IE) is a way of capturing the dynamics that surround information in the modern organization. According to Davenport, writing principally about commercial organizations, there is a need for 'a holistic perspective, one that can weather sudden business shifts and adapt to ever-changeable social realities.' This includes a consideration of organizational culture, behaviour, and work processes, politics, and installed technology. Without this broad understanding, managers will continue to apply a 'machine engineering' approach, believing that information is easily captured as 'data', that technical systems are the only way to record this data, that these systems must be standardised, and that technological change can only bring improvements.

He argues instead for an understanding that data is not information, that it is not easily captured, that information models should be simple to be useful, infor-

[9] Stuart Bretschneider, 'Information Technology, E-Government, and Institutional Change' (2003) 63(6) Public Administration Review 738, 739.

[10] ibid, 741.

[11] Donald F Norris, 'Building the Virtual State. Or Not? A Critical Appraisal' (2003) 21(4) Social Science Computer Review 417.

[12] Kaifeng Yang, 'Neoinstitutionalism and E-Government: Beyond Jane Fountain' (2003) 21(4) Social Science Computer Review 432, 432.

[13] ibid, 434–5.

mation has multiple meanings, and technology is only one element of the overall environment and not always the best way to change.[14] He defines IE by its four key attributes: '(1) integration of diverse types of information; (2) recognition of evolutionary change; (3) emphasis on observation and description; and (4) focus on people and information behavior',[15] and 'six most critical components ... strategy, politics, behavior/culture, staff, processes, and architecture'.[16] Of secondary importance is 'the broader organizational environment including the overall business situation, existing technology investment, and physical arrangement.'[17] Finally, there is the external environment, including the firm's own markets, the markets from which it obtains technology, and the information markets (meaning where the firm obtains information on competitive conditions).[18] Properly applying these insights requires integration of all of the foregoing elements, a human-focused perspective, and humility in the face of inevitable failure.[19]

Nardi and O'Day provide a slightly different perspective on the same concept. Querying the tendency towards the rhetoric of inevitability in the use of ICT,[20] they consider and set aside metaphors of technology as a tool, text, or system (with its own dialectic, politics, and power to control),[21] in favour of an 'information ecology', which they define as

> ... a system of people, practices, values and technologies in a particular local environment. In information ecologies, the spotlight is not on technology, but on human activities that are served by technology.
> ...
> An information ecology is a complex system of parts and relationships. It exhibits diversity and experiences continual evolution. Dif-

[14]Thomas H Davenport, *Information Ecology: Mastering the Information and Knowledge Environment* (Oxford University Press 1997) 3–5.
[15]ibid, 29.
[16]ibid, 34.
[17]ibid, 37.
[18]ibid, 39.
[19]ibid, 40.
[20]Bonnie A Nardi and Vicki L O'Day, *Information Ecologies: Using Technology With Heart* (MIT Press 2000) 17.
[21]ibid, 27–47.

> ferent parts of an ecology coevolve, changing together according to the relationships in the system. Several keystone species necessary to the survival of the ecology are present. Information ecologies have a sense of locality.[22]

This latter framework is less commercially-focused than Davenport's, not as developed, and more explicitly normative and prescriptive. Nonetheless, there are common elements which can be used to help to identify aspects of the informational context within which environmental regulation takes place, such as the primacy of people rather than technology or data, the complex interrelationship between the various components of the ecology, and the evolving nature of the ecology.

According to Bekkers and Homburg, in the context of e-government, IE can be extended to capture a number of insights, such as the importance of interaction ('power, dependency, interdependency, strategic behaviour, the existence of several games and playing rules'[23]); the way in which the meaning given to ICT develops through this interaction; and the simultaneously externally connected but very local nature of the process. They underline the unpredictable nature of the outcomes.[24]

Nonetheless, this framework is missing any consideration of power relationships. Technology is taken as a harmonious whole, there is little discussion of power or interest groups, and the meaning which the technology may contain or communicate (from the perspective of diverse actors) is not considered. It therefore needs to be supplemented by a discussion of the relationship between ICT and power and with socio-constructionist perspectives.[25]

---

[22]Nardi and O'Day (n 20) 49–50.

[23]Victor Bekkers and Vincent Homburg, 'E-Government as an Information Ecology: Backgrounds and Concepts' in VJJM Bekkers and VMF Homburg (eds), *Information Ecology of E-Government: E-Government as Institutional and Technological Innovation in Public Administration* (IOS Press 2005) 15.

[24]ibid, 15–16.

[25]ibid, 14.

7.3 Foucauldian Perspectives on ICT and Power

A more sophisticated understanding of power in society is therefore needed, with particular attention to the technologies that shape and manage the flow of information. Pickles, discussing the use of Geographic Information Systems (GIS), points out that

> [a]s social relations and new subjectivities are embodied [in GIS], we need to ask how such identities are sustained, how power flows through the capillaries of society in particular settings, and what role new technologies of the self and of society play in this circulation of power.[26]

I will expand this enquiry beyond GIS into the use of ICT in environmental regulation (ER).

7.3.1 Power: Coercion, Circuits, and Strategies

One perspective on power conceptualizes it as a duality of behavioural control, either hard or soft—the ability to force compliance or a platform from which to persuade and encourage.[27] Similarly, Introna divides theories about power into two main categories: *sovereign* and *strategic*.[28] The first, arising from Hobbes' work, sees power as something possessed by an individual or unified entity, normally the sovereign. Sovereign or instrumental power has been the primary focus of governments, policy-makers and researchers, but structural power is also significant. Overly structural theories of power, which see it more as a possession than a practice, can be criticised for an mechanistic view of technology,[29] a perspective which

[26] John Pickles, 'Representations in an Electronic Age: Geography, GIS and Democracy' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 24.

[27] Robert O Keohane and Joseph S Nye Jr, 'Power and Interdependence in the Information Age' [1998] Foreign Affairs 81, 86.

[28] Lucas D Introna, *Management, Information and Power* (MAssociation for Computing Machineryillan London 1997) 118.

[29] Brian P Bloomfield and Rod Coombs, 'Information Technology, Control and Power: The Centralization and Decentralization Debate Revisited' (1992) 29(4) Journal of Management Studies 459, 466.

must be transcended in order to properly understand the importance of ICT in the exercise of power in the modern state. Foucault's insights into the nature of power are key here:

> The power in the hierarchized surveillance of the disciplines is not possessed as a thing, or transferred as a property; it functions like a piece of machinery. ... Discipline makes possible the operation of a relational power that sustains itself by its own mechanism ...[30]

Clegg provides an initial framework within which to analyse strategic power relationships, particularly applicable to information systems (IS) research,[31] which sees power as circulating in three circuits:

- the *episodic* circuit (which manages the struggle between agents for the allocation of resources and the achievement of outcomes);
- the *social integration* circuit (which are the rules of meaning and membership that define the legitimate and illegitimate dimensions of power and either facilitate or militate against the integration of particular groups within the organization); and
- the *system integration* circuit (which is made up of the inseparable technologies and techniques which control the physical and social environment and empower or disempower agents in their productive activities).[32]

These are linked by *obligatory passage points*, a term from ANT,[33] which refers to the process by which an organization integrates innovation and its consequence disturbance of the social and system integration circuits by creating new meanings which then allocate control over resources.[34]

---

[30]Michel Foucault, *Discipline and Punish: The Birth of the Prison* (Pantheon 1977) 177.

[31]Leiser Silva, 'Epistemological and Theoretical Challenges for Studying Power and Politics in Information Systems' (2007) 17(2) Information Systems Journal 165, 175.

[32]Stewart R Clegg, *Frameworks of Power* (Sage 1989) 211–39.

[33]See Section 7.4.3.

[34]Introna (n 28) 132–6.

There are also understandings of power that place it in social structures, or 'in the interface between actors and structures'[35] (structuration theory). These tend to divide power into three types. Singh categorises power as instrumental, structural, or meta. The first concerns 'the capacity or capability of power holders to affect particular outcomes';[36] the second is 'the ability to effect rules and institutions that govern those items';[37] and the third 'refers to how networks reconfigure, constitute, reconstitute identities, interests, and institutions.'[38]

Perhaps the most developed theory of power that takes this tri-partite view is that of Lukes. He sees it first as the ability to require an individual to do something they would not otherwise do (the one-dimensional view);[39] second, the creation or reinforcement of barriers which prevent an individual or group from raising issues of importance to them (the two-dimensional view),[40] which raises questions of 'coercion, influence, authority, force and manipulation';[41] and finally, a more thorough critique of the behavioural focus of the one-dimensional view, which emphasises the role of inaction (as well as action) in shaping agendas, the importance of hidden issues and latent conflict, together with the ways in which the real interests of individuals may in fact be unknown to them (and thus not raised) because of the ways in which their perceptions have been shaped (the three-dimensional view).[42]

Lukes sees these as connected to liberal, reformist, and radical moral and political positions, respectively.[43] He claims that the three-dimensional view 'offers ... the prospect of a serious sociological and not merely personalized explanation of

[35] Philipp Zimmermann and Matthias Finger, 'Information-and Communication Technology (ICT) and Local Power Relationships: An Impact Assessment' (2005) 3(4) The Electronic Journal of E-Government 231, 231–2.

[36] JP Singh, 'Introduction: Information Technologies and the Changing Scope of Global Power and Governance' in James N Rosenau and JP Singh (eds), *Information Technologies and Global Politics: The Changing Scope of Power and Governance* (2002) 7.

[37] ibid, 10.

[38] ibid, 13.

[39] Steven Lukes, *Power: A Radical View* (2nd edn, Palgrave Macmillan 2005) 16.

[40] ibid, 20.

[41] ibid, 21.

[42] ibid, 25–8.

[43] ibid, 37–8.

how political systems prevent demands from becoming political issues or even from being made.'[44] These power relationships are not binary or unidirectional; individuals or groups may be stronger or weaker on specific issues, more or less dominant in different ways, and their interests may in fact coincide on specific issues.[45] Lukes claims that

> ... social life can only properly be understood as an interplay of power and structure, a web of possibilities for agents, whose nature is both active and structured, to make choices and pursue strategies within given limits, which in consequence expand and contract over time.[46]

Strategic understandings of power draw on Machiavelli's views of power as a tool to achieve outcomes, 'shaping and reshaping relations in everyday practice'.[47] Clegg's theory of power can assist in providing a systematic approach to mapping power relations in the context of IS/ICT developments.[48] Introna, an IS scholar, suggests that the extrapolation of the latter perspective by Foucault, Clegg, and Callan is a useful way to understand the impact of ICT on power. According to him, Foucault sees power as a technique that achieves its effects through a disciplinary power (surveillance) and bio-power (control of bodies). Power is exercised through relationships in a network of forces, which control, constrain, manage, and create options for individuals. It is not simply the use of violence or physical force. All human activity is embedded in a ongoing relationship of power, acquiescence, and resistance. This creates local, contingent, and unstable relations and sometimes unpredictable actions, but power itself is not localised. 'Knowledge' (in the sense of the objects of discourse) co-constitutes power, through discourse, which is both an instrument and an effect of power, giving rise to *regimes of truth*.[49]

[44]Lukes (n 39) 40.
[45]ibid, 64–65.
[46]ibid, 68–9.
[47]Introna (n 28) 118–20.
[48]Debra Howcroft, Nathalie Mitev, and Melanie Wilson, 'What We May Learn From the Social Shaping of Technology Approach' in Leslie P Willcocks and John Mingers (eds), *Social Theory and Philosophy for Information Systems* (John Wiley and Sons, Ltd 2004) 358–9.
[49]Introna (n 28) 124–30.

7.3.2 Governmentality

Foucault developed his thoughts on the transmission of power through mechanisms of surveillance and measurement in government through the concept of *governmentality*, which Dean defines as 'how we think about governing, with the different mentalities of government',[50] and elaborates as

> ... [a]n analytics of government [approach which] ... is a study of the organised practices through which we are governed and through which we govern ourselves, what we shall call here *regimes of practices* or *regimes of government*. These regimes, however, involve practices for the production of truth and knowledge, comprise multiple forms of practical, technical and calculative rationality, and are subject to programmes for their reform.[51]

Scholars have extended these concepts into notions of 'geo-power',[52] 'environmentality',[53] 'eco-governmentality',[54] or 'ecological rationalities of government.'[55] These see 'the environment' not as 'the naturally given sphere of ecological processes which human powers try to keep under control, nor ... as a mysterious domain of obscure terrestrial events which human knowledge works to explain ... [but as] a historical artifact that is openly constructed'.[56] The connection to ICT as a locus and tool in these discourses become obvious when one considers the importance of these new technologies for control of time, space, and place.

As a method of analysis, governmentality has a number of characteristic elements: identifying problematizations (controversies surrounding the process of processes of government); attention to the practices of government, which themselves

[50] Mitchell Dean, *Governmentality: Power and Rule in Modern Society* (Sage 1999) 16.

[51] ibid, 18–9 (emphasis in original).

[52] Timothy W Luke, 'On Environmentality: Geo-Power and Eco-Knowledge in the Discourses of Contemporary Environmentalism' [1995] Cultural Critique 57, 57.

[53] Arun Agrawal, *Environmentality: Technologies of Government and the Making of Subjects* (Duke University Press 2005).

[54] Sebastien Malette, 'Foucault for the Next Century: Eco-Governmentality' in Sam Binkley and Jorge Capetillo (eds), *A Foucault for the 21st Century: Governmentality, Biopolitics and Discipline in the New Millennium* (Cambridge Scholars Publishing 2009).

[55] ibid 221.

[56] Luke (n 52) 67.

govern how government is conducted; and viewing these practices as assembled from diverse, heterogenous, and contingent elements. As a result of this last element, there are four closely connected enquiries into how these assembled regimes function. First, what they seek to make visible and legible; second, what technologies and techniques are deployed in the application of power; third, what forms and systems of thought and knowledge are privileged within a particular regime; and finally, what forms of identity does the operation of the system presuppose or attempt to construct. Governmentality analysis also seeks to identify the 'ultimate ends and ... utopian goals' of a particular regime of government. However, while values are very significant, they are analysed more as elements of a governance regime rather than the source or end goal of that regime. Finally, Dean argues that an 'analytics of government' approach (as he terms this method) is modest in the sense that it does not seek to be global or radical, but instead seeks to view in a detached fashion the operation of systems of government. Nothing is taken for granted.[57]

Nonetheless, once these organised practices are in place and the 'technologies of government' (to use Dean's phrase) are deployed as a means of control, the consequences are significant:

> [T]he system is a condition of particular forms of life and social and political organization, patterns of consumption and communication, professional expertise and methods of training, and so on, and that once made durable and necessary it is able to to exercise certain determination on patterns of innovation.[58]

The applicability of this perspective to the use of ICT in environmental regulation should be clear from a re-consideration of Esty's article on the topic,[59] which is a prominent example of 'resource managerialism'—reducing nature

> ... through the encirclement of space and matter ... to a cybernetic

[57]Dean, *Governmentality* (n 50) 27–38.

[58]Mitchell Dean, 'Putting the Technological Into Government' (1996) 9(3) History of the Human Sciences 47, 58.

[59]See Section 1.3.2.

> system of biophysical systems that can be dismantled, redesigned, and assembled anew to produce 'resources' efficiently and in adequate amounts when and where needed in the modern marketplace.[60]

Viewing initiatives to expand the use of ICT as instances in the creation of a wider mesh of tools and techniques for controlling both human populations and the natural world highlights the political importance of these new technologies and the consequences for power relationships in society.

7.3.3 The Role of ICT in the Practices of Power

Information has political significance as a resource which enables or prevents action, as a symbol which helps to control interactions, and as an embodiment and expression of the biases within institutions.[61] Power is now more often tied to control of information than discourse.[62] ICT has a key role in this ongoing interplay between individuals and groups, by giving effect to values and norms through processes of measurement and calculation that make visible or legible particular social phenomena while ignoring others.[63]

ICT makes Foucault's 'mechanised surveillance' truly part of a machine. The role of ICT as an 'inscription device'[64] gives these new tools great power over individuals, routines, and public discourse.[65] A focus on the circulatory routes of power allows us to see that technologies, including ICT, co-constitute the framework, context, and relationships of power between individuals and groups in society through a process of mutual shaping.[66]

---

[60] Luke (n 52) 70–1.

[61] Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) 162–5.

[62] Scott Lash, *Critique of Information* (Sage 2002) 3.

[63] Bill Doolin, 'Information Technology as Disciplinary Technology: Being Critical in Interpretive Research on Information Systems' (1998) 13(4) Journal of Information Technology 301, 305–6.

[64] '... devices which produce, reproduce, and disseminate "inscriptions", which are essentially sets of marks, symbols, drawings or other graphical representations'. Brian P Bloomfield, 'The Role of Information Systems in the UK National Health Service: Action At a Distance and the Fetish of Calculation' (1991) 21(4) Social Studies of Science 701, 705.

[65] ibid, 708.

[66] Bert-Jaap Koops, 'Law, Technology, and Shifting Power Relations' [2009] Berkeley Technology

Therefore, taking into account the meta-nature of ICT, we should not see digital technology as having a predetermined impact, possessing absolute power or being the only important factor. Physical space, social space, and digital space are 'partly embedded' in each other, and changes in one can affect power relationships in another.[67] Knowledge is not always power; choices must still be made.[68] ICT may in fact reinforce existing arrangements rather than change them,[69] although this conclusion has been contested by other studies.[70]

Despite these uncertainties, the application of ICT in ER can create opportunities for changing power relationships, including new opportunities for resistance. Hamilton discusses how Toxics Release Inventory data was analysed using Geographic Information Systems to highlight how pollution impacts more highly on communities of colour and poorer communities in the United States of America, providing information which was used by those advocating for environmental justice.[71] In a later work, he highlights how the Environmental Working Group (EWG), an NGO, was able to take the raw data provided by the United States Department of Agriculture (USDA), process it and place it online with detailed commentary that highlighted how a farm subsidy scheme intended to enhance land conservation was benefiting large producers to a disproportionate extent. These lessons were contained in the USDA data, but were not sufficiently analysed by the government; its release to the public enabled EWG to have a significant impact on public dis-

---

Law Journal 973, 979; Richard E Sclove, 'Making Technology Democratic' in James Brook and Iain A Brook (eds), *Resisting the Virtual Life: The Culture and Politics of Information* (City Lights Books 1995) 89.

[67]Saskia Sassen, 'Digital Networks and the State: Some Governance Questions' (2000) 17(4) Theory, Culture and Society 19, 28.

[68]Langdon Winner, 'Mythinformation' in *The Whale and the Reactor* (University of Chicago Press 1986) 109–10.

[69]Kenneth L Kraemer and John Leslie King, 'Information Technology and Administrative Reform: Will E-Government be Different?' (2006) 2(1) International Journal of Electronic Government Research 1.

[70]Arild Jansen and Einar Løvdal, 'Can ICT Reform Public Agencies?' in Maria A Wimmer and others (eds), *Electronic Government 8th International Conference (EGOV 2009)* (Springer 2009).

[71]James T Hamilton, *Regulation Through Revelation: The Origin, Politics, and Impacts of the Toxics Release Inventory Program* (Cambridge University Press 2005) 234–9.

course.[72]

In this regard, it is important to bear in mind that disciplinary power (such as physical punishment or imprisonment) has not been replaced by network power (such as surveillance), but that the latter 'is currently transforming social relations and allowing other forms of power to be brought to bear'[73] by controlling the flow of information within the network. ICT is nonetheless significant. Michael, writing about urban planning in the early years of computerization but with an analysis that can be extended to other forms of governmental and regulatory activity, points out that

> ... control ... [and] power, will increasingly be based on access to and control of information and the means for generating new knowledge out of it. ... [This] takes on significant new aspects when the computer provides an improved basis for choosing among options.[74]

7.3.4 Avoiding Technological Determinism

In light of this discussion, it is important to examine closely and critically the new and subtle ways in which ICT allows the state to exercise power over its citizens and regulators to exercise power over the entities which it seeks to manage and control,[75] while creating the potential for resistance, individual or collective. As far back as the 1970s, scholars were discovering that the outcomes of computerization programs were politically rather than technologically determined,[76] and Mowshowitz highlighted that

> [t]he key issue is the distribution of political power. Information tech-

[72] James T Hamilton, *Conserving Data in the Conservation Reserve: How a Regulatory Program Runs on Imperfect Information* (RGG Press 2010) 78–90.

[73] Lain Munro, 'Non-Disciplinary Power and the Network Society' (2000) 7(4) Organization 679, 693.

[74] Donald N Michael, 'On Coping With Complexity: Planning and Politics' [1968] Daedalus 1179, 1182.

[75] Koops, 'Shifting Power Relations' (n 66) 992.

[76] Kenneth C Laudon, *Computers and Bureaucratic Reform: The Political Functions of Urban Information Systems* (Wiley 1974).

> nology may create opportunities for wider participation in decision-making, or it may serve as an instrument of manipulation and coercion.[77]

On the positive aspects of ICT, Schmidt and Cohen of Google sketch a future with considerable appeal to those currently disempowered:

> The advent and power of connection technologies—tools that connect people to vast amounts of information and to one another—will make the twenty-first century all about surprises. Governments will be caught off-guard when large numbers of their citizens, armed with virtually nothing but cell phones, take part in mini-rebellions that challenge their authority. For the media, reporting will increasingly become a collaborative enterprise between traditional news organizations and the quickly growing number of citizen journalists.[78]

However, Webster and Robins query whether this so-called 'Information Revolution' is as radical as is claimed.[79] As Bloomfield and others remind us, 'claims about IT tend to emphasise either discontinuity—it will revolutionise everything ... —or continuity—things will continue as before',[80] and Winner queries what he calls

> ... mythinformation: the almost religious conviction that a widespread adoption of computers and communications systems along with easy access to electronic information will automatically produce a better world for human living.[81]

---

[77] Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976) 188.

[78] Eric Schmidt and Jared Cohen, 'The Digital Disruption: Connectivity and the Diffusion of Power' (2010) 89 Foreign Affairs 75.

[79] Frank Webster and Kevin Robins, 'Plan and Control' (1989) 18(3) Theory and Society 323.

[80] Brian P Bloomfield and others, 'Introduction: The Problematic of Information Technology and Organization' in Brian P Bloomfield and others (eds), *Information Technology and Organizations: Strategies, Networks, and Integration: Strategies, Networks, and Integration* (Oxford University Press 1997) 2.

[81] Winner, 'Mythinformation' (n 68).

Nonetheless, ICT are and will continue to be an important element in social and political change,[82] albeit not in a deterministic or uni-directional fashion.[83] Therefore, the result of increasing application of ICT is not the same across all fields of endeavour. In human rights activism, for example, ICT assists in creating capacity for distributed organizations, information gathering, and holding governments accountable, but also creates more opportunities for interception and surveillance.[84] Sassen points out how what she calls 'the three properties of digital networks—decentralized access/distributed outcomes, simultaneity, and interconnectivity ... have produced strikingly different outcomes' in electronic financial networks and electronic activist networks: the first were centralised and the second more locally and globally distributed. She highlights the need to consider what 'social logics' are driving changes within a particular network.[85]

The reality is likely to be less predictable, more complex, and much more situationally specific than Schmidt and Cohen's positive but deterministic prediction. We must remember that '[p]olitics will shape the information revolution as much as vice versa.'[86] However, there is a lack of useful research on these issues,[87] and the social sciences still working to understand ICT.[88]

I will therefore assemble a toolbox of critical research methods that is fit for a complex purpose and not simply a random collection of ideas from elsewhere.[89] Adopting a critical perspective enables me to identify and query the (sometimes

[82]Richard Heeks, 'Reinventing Government in the Information Age' in Richard Heeks (ed), *Reinventing Government in the Information Age: International Practice in IT-Enabled Public Sector Reform* (Routledge 1999) 15.

[83]Doolin (n 63) 307; Jannis Kallinikos, *Governing Through Technology: Information Artefacts and Social Practice* (Palgrave Macmillan 2011) 17–8.

[84]Stephanie Hankey and Daniel Ó Clunaigh, 'Rethinking Risk and Security of Human Rights Defenders in the Digital Age' (2013) 5(3) Journal of Human Rights Practice 535.

[85]Saskia Sassen, 'Interactions of the Technical and the Social' (2012) 15(4) Information, Communication and Society 455, 3–4.

[86]Keohane and Nye (n 27) 85.

[87]Zimmermann and Finger (n 35).

[88]Sassen, *Territory, Authority, Rights* (n 2) 329.

[89]Roger Cotterrell, 'Interdisciplinarity: The Expansion of Knowledge and the Design of Research' (1979) 11(3) Higher Education Review 47, 54; Bernd Carsten Stahl, *Information Systems: Critical Perspectives* (Routledge 2008) 83.

unspoken) assumptions about individuals, society, and technology that underlie research and public policy documents on ICT. These often take for granted that people will make appropriate, positive, and consistent use of technology; that society is a homogenous, static background, operating according to market priorities; and that the technology will have deterministic effects, will be functional, fulfilling needs and desires, and will have morally good consequences.[90] It is important to avoid technological determinism, which 'portrays technology as an exogenous and autonomous development which coerces and determines social and economic organizations and relationships.'[91] This tendency towards determinism is present in the scholarly literature also,[92] particularly in foundational writings in cyberlaw, such as Lawrence Lessig's work.[93] However, we should also remember that technological change can bring with it significant social and institutional change,[94] and that embedded technologies and their associated processes can constrain choices, creating path dependencies and a 'runway effect'.[95]

7.4 Sociological Theories of Technology Development

Foucault's perspective on power is a useful first step in understanding the importance of ICT as a control mechanism in modern society. However, in a Foucauldian analysis,

> ... power is a network type of mechanism, which is not fully con-

[90]Bernd Carsten Stahl, 'What Does the Future Hold? A Critical View of Emerging Information and Communication Technologies and Their Social Consequences' in Mike Chiasson and others (eds), *Researching the Future in Information Systems* (Springer 2011).

[91]Keith Grint and Steve Woolgar, *The Machine At Work: Technology, Organisation and Work* (Polity Press 1997) 11.

[92]See, for example, Lyria Bennett Moses, 'Recurring Dilemmas: The Law's Race to Keep Up With Technological Change' (2007) 7 University of Illinois Journal of Law, Technology and Policy 239; Lyria Bennett Moses, 'Agents of Change: How the Law Copes With Technological Change' (2011) 20 Griffith Law Review 763.

[93]Viktor Mayer-Schönberger, 'Demystifying Lessig' [2008] Wisconsin Law Review 713, 736.

[94]Jannis Kallinikos, *The Consequences of Information: Institutional Implications of Technological Change* (Edward Elgar Publishing 2006) 16–7.

[95]ibid, 79.

> trolled by anyone and which is constantly extended, edited, challenged and modified—as definitions and rationality circulate from instance to another. … [I]t gives little clarity as to how to focus and carry out actual analyses of power and organizing.[96]

I must therefore turn to other perspectives. Bearing in mind the shortcomings in IE,[97] it is necessary to examine sociological theories on the development of technology.[98] Although there is a significant literature on the role of science in environmental law, policy, and regulation, there is a dearth of similar material on the role of ICT. However, as Mowshowitz pointed out in the 1970s:

> The effects of computer applications on people and institutions cannot be understood apart from the larger issue of the role of science and technology in our society. The computer neither emerged in a vacuum nor is it used in a vacuum. Most, if not all, of the problems surrounding computer technology derive from well-established trends in the modern world.[99]

This research involves social questions,[100] and as Jasanoff points out, any serious study of science must take into account the sociology of science.[101] Sassen's prescription for appropriate methods for the study of technology in social contexts is also important:

> Understanding the place of these new technologies from a social perspective requires, then, avoiding a purely technological interpretation and recognising the embeddedness and the variable outcomes of these technologies for different social orders. … The challenge is to develop

[96] Toumo Peltonen and Henrikki Tikkanen, 'Productive Power, Organised Markets and Actor-Network Theory' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 276.

[97] See Section 7.2.

[98] Bellamy and Taylor (n 61) 18–9.

[99] Mowshowitz (n 77) 4.

[100] Michel Callon, 'Society in the Making: The Study of Technology as a Tool for Sociological Analysis' in Wiebe E Bijker, Thomas Parke Hughes, and Trevor J Pinch (eds), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Open University Press 1987) 84.

[101] Sheila Jasanoff, *The Fifth Branch: Science Advisers as Policymakers* (Harvard University Press 1994) 12–3.

> analytic categories that allow us to capture the imbrications of the digital and the nondigital moment in the often complex processes wherein these new technologies get deployed.[102]

In academic sociological explorations of the relationship between society and technology, which can be collectively labelled as aspects of science and technology studies (STS), there are three significant schools of thought. These are closely related and sometimes overlapping. They are also evolving perspectives, growing in different ways with the preferences of individual champions, making them sometimes contradictory and confusing. There is no canonical view and the following discussion may differ from the perspectives of other scholars in the field.

What these schools of thought have as a common starting point is a social constructivist viewpoint—in other words, they begin with the premise that 'reality' as it is perceived by individuals and groups is not a unmalleable objective fact but is something whose existence and meaning is agreed (often implicitly or unconsciously) by people, that these perceptions can change and shift, and that societies collectively build a model of the world which may not match those built by others (or the 'objective' reality, if such does in fact exist).

In addition to regarding reality as contingent and contested, social constructivist approaches take the same approach to technology: in other words, 'advancement' is not guaranteed nor does it follow a single, pre-determined path. Instead, controversies between interest groups are resolved in ways that are not always predictable in advance ('stabilization') and generally in a way that rewards one group rather than another ('closure'). In order to be able to identify and trace these controversies, researchers take a relativist approach, sometimes called symmetrical, in which they are regard all claims made about a technology equally and not as true, false, or 'real', in order to avoid regarding the outcome of a debate as being some-

[102] Sassen, *Territory, Authority, Rights* (n 2) 343.

how the product of some characteristic of the technology.[103]

For ease of explanation, but at the risk of some over-simplification, the theories under consideration can be placed on a continuum depending on how strongly they hold to such a view, beginning with the Social Shaping of Technology and ending with Actor-Network Theory.

7.4.1 Social Shaping of Technology

Social Shaping of Technology (SST) is a mildly social constructivist perspective on the development of technological artefacts, in the sense that it draws boundaries between the natural and the social and between the technological and the social. It accepts that nonsocial factors can impact on technological development and that the characteristics of a technology can be significant in this. Nonetheless, social factors are significant in the development of a particular technology.[104]

SST seeks to scrutinise and problematise the process by which technology is developed in order to 'open the black box'. This process is not one with a single route but one which involves choices with different social outcomes, often *negotiated* between the various interest groups involved (although not always in an open, polite, and equal manner). As choices are made, they may become *irreversible*, closing off future choices and options and a particular technological form may become stabilised and then reach closure.[105]

The focus is on the process of innovation. It seeks to model this through stages of *generation* (generally in a laboratory context) to *transformation* (by commercialization), which can incorporate *implementation* and *feedback* in a spiral rather then linear progression. Technologies, and the organizations that develop and use them, are not clearly delineated but instead interact with and modify each other. This cre-

[103] Philip Brey, 'Social Constructivism for Philosophers of Technology: A Shopper's Guide' (1997) 2(3-4) Society for Philosophy and Technology.

[104] ibid.

[105] Robin Williams and David Edge, 'The Social Shaping of Technology' (1996) 25(6) Research Policy 865, 866–7.

ates *configurations* of technology, particularly when ICT is involved, and these can become quite specific to a particular industry or entity.[106]

The theories under consideration here do not accept notions of technological determinism: claims that technology is indeed an independent factor, and that changes in technology cause social changes.[107] Instead, these perspectives argue that each society is unique and that the choices made by a particular society regarding the adoption of technology and the way in which it interacts with it will be specific to that individual context.[108] However, this does not mean that technologies have no effects. Instead, they can be deeply political,[109] carrying with them inherent (and sometimes unnoticed) ideologies.

7.4.2 Social Construction of Technology

Social Construction of Technology (SCOT) is a related theory, but with a stronger constructivist orientation, which means that it is much more relativist or symmetrical: technology is not considered to have innate characteristics, powers, or impacts; all of its effects must be explained in terms of social interactions.[110] Although SCOT has antecedents, it emerged as a distinct approach in a 1984 article by Pinch and Bijker.[111] Rooting themselves in what were then recent developments in the sociology of science, particularly the development of a distinct sociology of scientific knowledge (SSK), they endorsed Bloor's so-called 'Strong Programme' of sociology and its extension into the hard sciences, which meant that scientific knowledge was no longer to be regarded as special or 'true'. Pinch and Bijker saw a need to explore the relationship between science and technology in more depth but were not satisfied

[106]Williams and Edge (n 105) 873–7.

[107]Donald MacKenzie and Judy Wajcman, 'Introductory Essay' in Donald MacKenzie and Judy Wajcman (eds), *The Social Shaping of Technology* (Open University Press 1985).

[108]ibid 6.

[109]Howcroft, Mitev, and Wilson (n 48) 334.

[110]Brey (n 103).

[111]Trevor J Pinch and Wiebe E Bijker, 'The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other' (1984) 14(3) Social Studies of Science 399.

with the existing theoretical tools at their disposal, claiming that the philosophy of science was disappointing and that research into innovation was not rigourous. The latter tended to treat technology as an un-openable 'black box'. Historical studies of technology fell into a similar error, being too descriptive and focusing overly on success, using an implicitly linear model of development which did not explain that success.

As an alternative, the authors grounded their method in the Collinsian approach of the Empirical Programme of Relativism, which had an explicitly empirical preference and a focus on scientific controversies. This used a method incorporating three stages of explanation: a demonstration of the interpretive flexibility of scientific findings (in other words, that the results of experiments could be read in different ways); a description of the social mechanisms that limit this flexibility (the institutional structures of shared knowledge, discourse, and power that constrain discussion); and relating these 'closure mechanisms' to the wider socio-cultural context.

For the study of technological artefacts, the authors put forward a model that took account of variation and selection in the developmental process, which was seen as multi-directional. This required four steps: a definition of the 'relevant social group' (the boundaries of which depended on whether the artefact had meaning for that group and whether the group was homogeneous with regard to the meanings its members gave to the artefact); a detailed description of that group; a discussion of the problems which the group has with the artefact and the solutions which it identifies; and an observation of the degrees of stabilization of the artefact (in other words, the way in which it comes to have a fixed form and widely-accepted meaning).[112]

SCOT was critiqued by a number of authors, notably Russell and Winner. The first thought that relativism was limited as a heuristic device, bringing with it a ten-

[112] ibid.

dency to focus entirely on process and to move from its use as a tool to its adoption as a moral or political position. He felt that SCOT's conceptions of social structure were incomplete, ignoring the reality of inequality of group power, and the method made it too easy to either omit or over-aggregate groups. He also claimed that the stated objective of a group may not match its real interests and that groups may be able to secure their objectives without direct participation in the stabilization process.[113] Pinch and Bijker rejected these criticisms, being strongly of the view that the development of science and technology should be treated similarly as they are similar in culture and operation and difficult to separate in practice.[114]

Winner, a noted philosopher of technology, was welcoming of the idea of a deeper engagement by philosophers and others with the development of technology and saw the advantages to SCOT as providing clear step-by-step guidance for researchers, bringing to the fore the role and scale of choices in technological development and querying arbitrary distinctions between the technological and the social. Nonetheless, he was critical of SCOT for not paying sufficient attention to the social consequences of technological choices, too narrow a focus on 'relevant social actors', perhaps missing the underlying social dynamics and (probably most importantly) a lack of moral or political principles.[115] (This last criticism has been repeatedly levelled at theories within the general rubric of SSK.[116])

Sokal and Bricmont also critique what they perceive as a lack of clarity in Bloor's logic regarding what evidence can be used in order to decide whether something is 'true' or 'false':

> If the claim were merely that we should use the same principles of sociology and psychology to explain the causation of all beliefs irrespec-

[113]Stewart Russell, 'The Social Construction of Artefacts: A Response to Pinch and Bijker' (1986) 16(2) Social Studies of Science 331.

[114]Trevor Pinch and Wiebe Bijker, 'Science, Relativism and the New Sociology of Technology: Reply to Russell' (1986) 16(2) 347.

[115]Langdon Winner, 'Upon Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology' (1993) 18(3) Science, Technology, and Human Values 362.

[116]Howcroft, Mitev, and Wilson (n 48) 352–3.

> tive of whether we evaluate them as true or false, rational or irrational, then we would have no particular objection. But if the claim is that only social causes can enter into such an explanation—that the way the world *is* (ie, Nature) cannot enter—then we cannot disagree more strenuously.[117]

Writing from a feminist perspective, Wacjman points out a gap in SST generally and its approach to power, pointing out that '[w]hat many have overlooked is the fact that the exclusion of some groups, while not empirically discernible, may nevertheless have an impact upon the processes of technological development.'[118] This critique points us to the need to consider the exclusionary effect of ICT, including issues beyond gender, and is particularly important for a rule of law analysis.

7.4.3 Actor-Network Theory

The third and most strongly social constructionist theory is Actor-Network Theory, also known, sometimes playfully, as the 'sociology of translations', 'actant rhizome ontology', 'the sociology of associations', and the 'semiotics of materiality'.[119] ANT 'has never been really codified into a fully-fledged theory and is better described as an interpretive sensitivity and a literary genre.'[120] Most closely associated with French scholars such as Bruno Latour and Michel Callon and British researchers such as John Law and John Hassard, this approach has gone through many changes over the years[121] and has been both repudiated[122] and re-asserted[123] by Latour. It is a strongly empirical and relativist approach, with links to Bloor's

[117] Alan D Sokal and Jean Bricmont, *Intellectual Impostures: Postmodern Philosophers' Abuse of Science* (Profile Books 1998) 83.

[118] Judy Wajcman, 'Reflections on Gender and Technology Studies: In What State is the Art?' (2000) 30(3) Social Studies of Science 447, 452.

[119] Jim Dolwick, '"The Social" and Beyond: Introducing Actor-Network Theory' (2009) 4(1) Journal of Maritime Archaeology 21, 36.

[120] Silvia Gherardi and Davide Nicolini, 'Actor-Networks: Ecology and Entrepreneurs' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 286.

[121] Howcroft, Mitev, and Wilson (n 48) 335.

[122] Bruno Latour, 'On Recalling ANT' in *Actor Network Theory and After* (Wiley 1999).

[123] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network Theory* (Oxford University Press 2005).

strong programme.[124] Its most distinctive characteristic is that it gives non-humans the status of actors within the overall network of ongoing and changing relationships that it seeks to recognise and re-assemble.[125]

Introduction

ANT, according to Latour, deliberately sets itself up as an alternative to what he calls 'sociologies of the social'. As far as he is concerned, there is no such thing as society, by which he means that he rejects explanations that rely on an invisible substance that carries unseen social forces that somehow influence individual behaviour. Instead, he only recognises those connections between people and non-humans that leave visible traces and create associations (from which he derives one of his alternative names for ANT, 'sociology of associations').[126]

Latour also calls what he puts forward 'critical sociology'. He claims that his shift of focus from objects to social relations is often unbearable for the actors involved, as they prefer to cling to a belief that there are other forces at work rather than social relations only, and that this resistance is itself proof that his social explanations are true.[127]

Latour claims that there are five major uncertainties which social scientists must be aware of:[128]

1. Uncertainties regarding the nature of *groups*, which are constantly re-creating themselves through ongoing *performance*, which is conducted through *intermediaries* (who transport meaning or force without transforming it) or *mediators* (who transform, translate or modify the meaning that they carry). Groups are identified by observing the traces that they leave by these instances of

[124]Dolwick (n 119) 37.
[125]Jim Johnson, 'Mixing Humans and Nonhumans Together: The Sociology of a Door-Closer' [1988] Social Problems 298.
[126]Latour, *Reassembling the Social* (n 123) 4–5.
[127]ibid, 9.
[128]ibid, Part II.

transportation or translation.

2. Uncertainties regarding the nature of *actions*. Actors do not have complete freedom of movement: their actions may be inspired, dictated, or constrained by others. The actor's own descriptions of action are primary and are probed by exploring instances of controversy, wherein agency manifests by producing change and is identified by '*figuration*' (a identifiable presence, whether abstract or concrete).

3. Uncertainties concerning the nature of *objects*. From Latour's perspective, if something that produces change is manifesting agency, then a non-human which modifies the current state of affairs has agency and is either an actor or if it has no figuration, an actant. Humans and objects are elements of the one world, not two distinct natural and social worlds, and can act on each other. Objects can act as intermediaries and thus need to be studied to be made visible through a perspective from a distance (whether in time, space or skills). Particularly useful ways to achieve this include observation of accidents, breakdowns, and strikes; historical accounts; and fiction or fictionalised accounts (such as counterfactuals).

4. Uncertainties about *facts*. For Latour, facts are fabricated because they emerge from artificial situations although he sees this as making them more exact.

5. Finally, there are uncertainties regarding the *types of studies* which should be conducted. His priority is to retrace and *reassemble* the social, which means that all of the actors described must engage in some activity (if they do not leave traces, they do not really exist) and the network that they form must be described. Network is used here to describe the interaction of power between actors, not the transfer of information, a meaning which was not common

when ANT was first developed but which the widespread use of the Internet has made widespread and which leads to confusion.

These studies are based on the written word, kept in logbooks, documents generated by or about the actors, sketches, and drafts of the research and an account of the effects of the written account on the actors. For Latour, a 'mere description' is perfectly adequate. He sees a full description of the network as needing no explanation.[129]

As a method, therefore, he prescribes as the principal rule to 'follow the actors themselves'. The researcher is to learn from the actors what collective existence they have created, what methods of operation they have elaborated and what accounts best define the new associations that they have created. The researcher has three duties: to deploy controversies as a way of identifying the actors in a network, see how those actors stabilize the network, and compose a description of it thus stabilized. She must trace paths of interaction between sites of production, which is no easy task, as these interactions may not all happen together, in the same places or in the same ways (although ICT can help to make these more easily visible).[130] Latour resists attempts to move easily from the micro to the macro, claiming that such 'zooming' is inherently artificial, and to make claims about what is not visible in the intermediaries or mediators that transfer meaning or force between actors. For him, the macro consists of multiple connected instances of the micro and there is no 'social plasma' in the unmapped, invisible spaces between conduits. An ANT researcher does not fill in the blanks.[131]

The creation of an actor-network is necessary in order to exert power.[132] This concept is key to understanding ANT, and similar notions are commonplace in the law (for example, companies, governments, states):

[129]Latour, *Reassembling the Social* (n 123) 80-82.
[130]ibid, Part II.
[131]ibid, Part III.
[132]Bruno Latour, 'The Powers of Association' [1986] Sociological Review 264, 271.

> When a network operates so smoothly that the connections and separate identities are no longer discernible, we can then speak of an actor-network, a network that (successfully) pretends to be one actor.[133]

This stabilization occurs through *moments of translation*. Callon identifies four significant moments: *problematization* (where the initial set of actors, their identities and relationships are identified by some initial actor); *interessement* (sometimes called an obligatory point of passage, where some actor 'attempts to impose and stabilize the identity of the other actors it defines through its problematization', by interesting them in joining forces through adopting a shared identity put forward by that first actor, thus consolidating a social structure); *enrolment* (the simultaneous process of negotiation that ensures that these new allies cooperate and collaborate) and *mobilization* (directed activity by the actors, or their representatives, either elected or self-selected, which produces material effects). These moments may be undermined by instances of *dissidence* (active resistance by an actor). Throughout, the actors are *displaced* and *transformed*, moving from equilibrium to equilibrium.[134] The material end result of these moments are known as *inscriptions*. The technology itself can be seen as an example of this, a text (a 'script' or 'scenario') embodying the vision or prediction of an innovator,[135] which then constrains future action.[136] Once these are in a state of *irreversibility* (where options are closed), they become *black boxes* (a frozen element of the network) and perhaps *immutable mobiles* (with effects across time and space).[137] Some items may be more fluid in identity, functioning as 'boundary objects', with meanings that are adaptable

[133]Lena Porsander, '"My Name is Lifebuoy": An Actor-Network Emerging from an Action-Net' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 19.

[134]Michel Callon, 'Some Elements of a Sociology of Translation' in John Law (ed), *Power, Action and Belief* (Routledge 1986).

[135]Madeleine Akrich, 'The De-Scription of Technical Objects' in Wiebe E Bijker and John Law (eds), *Shaping Technology/Building Society* (MIT Press 1992) 208; Bloomfield and others (n 80).

[136]Bruno Latour, 'Technology is Society Made Durable' in John Law (ed), *A Sociology of Monsters: Essays on Power, Technology and Domination* (Routledge 1992).

[137]Geoff Walsham, 'Actor-Network Theory and IS Research: Current Status and Future Prospects' in Allen Lee, Jonathon Liebenau, and Janice DeGross (eds), *Information Systems and Qualitative Research* (Springer 1997) 470–1.

between different groups without being too diffuse to serve as conduits for coherence.[138] The accepted understanding that may develop of the ratio decidendi of a court judgment is a good example of both a black box and an immutable mobile, as that understanding may prove difficult or impossible to dislodge and this is then applied in subsequent cases and perhaps in other jurisdictions, while journal articles on it might serve as boundary objects between the academic and practitioner community.

The principle of symmetry is core to ANT—the success or failure of a technology is not seen as inevitable,[139] and humans and non-humans are seen as equivalent, at least as elements in a controversy.[140] As a result,

> [a]ctants can be anything—humans, machines or just symbolic references to abstractions (such as 'our culture' or 'our hiring process'). Second, actors have projects and interests—things they are trying to do. And finally, actants get enrolled (translated) whenever an actor mentions (or invokes or refers to) the actant as part of planning, performing or accounting for their projects. ...
>
> ... [S]omething is an actant because, according to a narrative, it acts or is acted upon. By invoking actants as part of narratives, people create associations between them.[141]

ANT sees non-humans as having four functions: maintaining ongoing relationships in human society (such as an invoice), mediating in a chain of interaction between humans, being part of a moral and political community (such as a seatbelt and associated alarm when it is not worn), and gathering various other actors together in and across space and time. It is important to underline that their agency is limited, a point which is sometimes misunderstood by critics of ANT: they may not have full

[138] Susan Leigh Star and James R Griesemer, 'Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39' (1989) 19(3) Social Studies of Science 387, 393.

[139] Madeleine Akrich, 'Les objets techniques et leurs utilisateurs, de la conception à l'action' (1993) 4 Raisons Pratique 35.

[140] Porsander (n 133) 19.

[141] Martha Feldman and Brian Pentland, 'Organizational Routines and the Macro-Actor' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 92–3.

human agency but need only show 'the ability to make a difference'.[142] This status, being non-human but having agency, is more a matter of method than theory—in other words, ANT does not claim that seeing non-humans as having agency is a general statement about the world but only that researchers should be alert to this possibility when they conduct their studies.[143]

Critiques of Actor-Network Theory

Latour has been criticised for claiming that there is no reality other than that which is socially constructed and discovered by scientists (so that, for example, it was impossible for the pharaoh Ramses II to die of tuberculosis in 1213 BC because the bacillus responsible was not discovered by Western science until 1882).[144] More generally, ANT has been criticised for focusing too much on micro-details and not providing adequate tools for considering the wider social structure.[145]

It has limits in the study of organizations because it is unable to fully explore the power relationships that delimit and decide the choices that are made in stabilising the network, and as the objects that it claims to treat on the same basis as humans cannot speak for themselves, it must rely on the researcher to decide which is which, thus re-creating the dualism that it seeks to avoid.[146] In describing carefully the outcomes of power struggles, it (perhaps unwittingly) strengthens the truth claims of the victors.[147] It has been criticised for focusing excessively on the goals of actors and privileging the centre of the spaces which it examines, thus ignoring margins and alternatives.[148]

---

[142] Edwin Sayes, 'Actor-Network Theory and Methodology: Just What Does it Mean to Say That Nonhumans Have Agency?' (2014) 44(1) Social Studies of Science 134, 137–141.

[143] ibid, 142.

[144] Sokal and Bricmont (n 117) 96–7 fn 123.

[145] Walsham (n 137) 472–3.

[146] Andrea Whittle and André Spicer, 'Is Actor Network Theory Critique?' (2008) 29(4) Organization Studies 611, 614–6.

[147] ibid, 620–2.

[148] Eric Monteiro, 'Actor Network Theory and Cultural Aspects of Interpretative Studies' in Christanthi Avgerou, Claudio Ciborra, and Frank Land (eds), *The Social Study of Information and Com-*

In particular, it is not good at highlighting the application of power through institutions, the routine, and the mundane.[149] According to Star, an important element that is missing in a great deal of STS research is an awareness of differences, particularly minor and marginal ones, of dissidence and of exclusion.[150] This point is echoed by Lee and Brown, who say that 'focusing on the crossroads of the network's many highways ignores a significant amount of more pedestrian traffic.'[151]

Latour's application of the principle of symmetry (treating human and non-human actors as equal and claiming that nature and society are simultaneously co-produced) has been criticised as confusing, obscure, and impossible to translate into a practical research method; while his actual research method is in practice much less radical than he claims.[152] Collins and Yearley argue that despite the claims to treat non-humans equally, ANT accounts still see the world through human eyes.[153] This may, however, miss the point, which is that there is really no distinction: humans and non-humans are mixed together.[154]

ANT has been criticised for vagueness around the boundaries of networks, and the assumption that the researcher is somehow 'objective'; for being overly realist in giving nonhumans a determining role; and for seeming to ascribe some 'essential' characteristics to technological artefacts. Therefore, it is best to use it to re-describe rather than to explain, so that technological items can be seen in a flexible light, with one set of characteristics at one point in time and a different set at another time.[155]

---

munication Technology: Innovation, Actors, and Contexts (Oxford University Press 2004) 131–2.

[149]Neil Hutton, 'From Intuition to Database: Translating Justice' (2013) 17(1) Theoretical Criminology 109, 124.

[150]Susan Leigh Star, 'Power, Technologies, and the Phenomenology of Standards: On Being Allergic to Onions' in John Law (ed), *A Sociology of Monsters: Power, Technology, and the Modern World* (Routledge 1991) 34–9.

[151]Nick Lee and Steve Brown, 'Otherness and the Actor Network: The Undiscovered Continent' (1994) 37(6) American Behavioral Scientist 772, 787.

[152]David Bloor, 'Anti-Latour' (1999) 30 Studies in History and Philosophy of Science 81, 95–100.

[153]HM Collins and Steven Yearley, 'Epistemological Chicken' in Andrew Pickering (ed), *Science as Practice and Culture* (University of Chicago Press 1992) 313.

[154]Chris McLean and John Hassard, 'Symmetrical Absence/Symmetrical Absurdity: Critical Notes on the Production of Actor-Network Accounts' (2004) 41(3) Journal of Management Studies 493, 503.

[155]Grint and Woolgar (n 91) 30–1.

It remains useful for analysing detailed empirical work[156] and processes of change, as it highlights 'the assembling of something new and different'.[157]

Actor-Network Theory and Information Systems Research

ANT can be used to make sense of the development of pervasive computing,[158] and 'can be useful for studies of information systems in situations where interactions of the social, technological and political are regarded as particularly important',[159] particularly where there is a strong empirical component. However, it must be used as more than simply a lens; its underlying ontology (giving equal status to both human and non-human actors) must be respected.[160]

Nonetheless, ANT is a particularly useful tool for this project because it is malleable[161] and it can provide a tool of exploring the impact of technology without seeing ICT as an extraneous, uncontrolled factor,[162] particularly for 'information infrastructures'.[163] While an ANT approach to law as such may find it difficult to clearly identify the 'material' elements of a process which works largely with abstracts,[164] a study of ICT in the regulatory process does not face this issue.[165] The approach has been put to use by a variety of IS researchers, including for research

[156] Whittle and Spicer (n 146) 623.

[157] Hutton, 'From Intuition to Database' (n 149) 111.

[158] Alex Soojung-Kim Pang, 'Actants Attack! Using STS to Think About Pervasive Computing and the Future' (2004) ⟨http://askpang.typepad.com/relevant_history/files/actants_attack.pdf⟩ accessed 19 May 2014.

[159] Arthur Tatnall and Anthony Gilding, 'Actor-Network Theory and Information Systems Research' in Pak Yoong and Beverley Hope (eds), *10th Australasian Conference on Information Systems* (1999) 963.

[160] Antonio Cordella and Maha Shaikh, 'Actor Network Theory and After: What's New for is Research' in *European Conference on Information Systems* (AIS 2003).

[161] Johnson, 'Mixing Humans and Nonhumans Together' (n 125).

[162] Grint and Woolgar (n 91) 31.

[163] Eric Monteiro and Ole Hanseth, 'Social Shaping of Information Infrastructure: On Being Specific About the Technology' in WJ Orlikowski and others (eds), *Information Technology and Changes in Organizational Work* (Chapman and Hall, London 1996).

[164] Alain Pottage, 'The Materiality of What?' (2012) 39(1) Journal of Law and Society 167.

[165] Bill Doolin and Alan Lowe, 'To Reveal is to Critique: Actor-Network Theory and Critical Information Systems Research' (2002) 17(2) Journal of Information Technology 69.

on IS and sustainability[166] and for rapidly-changing applications of technology[167] but its lack of attention to broader social structures is probably best balanced by combining it with theories that explore these issues.[168] In particular, ANT is poor at dealing with institutions, open (re-purposable) information infrastructures, and interconnected actor-networks,[169] all of which are important in environmental regulation.

Researchers combine ANT/SCOT approaches with various critical social theories, particularly critical management theory.[170] The need for a critical perspective is particularly important in a study of power relationships, which is somewhat absent from the ANT perspective. It is therefore best supplemented by a Foucaldian theory.[171] Such a theory is perhaps best found in Scott's 'Seeing like a State', which puts forward a thesis that the modern state seeks to make its geography and its population 'legible' to administrators by standardising and simplifying the collection of facts. This requires the creation of new units of measurement, a process of counting and classification, and finally 'the creation of wholly new facts by aggregation, following the logic of the new units.'[172] This effort, according to Scott, is doomed to fail:

> The modern state, through its officials, attempts with varying success to create a terrain and a population with precisely those standardised characteristics that will be easiest to monitor, count, assess, and manage. The utopian, immanent, and continually frustrated goal of the mod-

[166]Fredrik Bengtsson and Pär Ågerfalk, 'Information Technology as a Change Actant in Sustainability Innovation: Insights From Uppsala' [2011] The Journal of Strategic Information Systems 96.

[167]Kathrin M Cresswell, Allison Worth, and Aziz Sheikh, 'Actor-Network Theory and Its Role in Understanding the Implementation of Information Technology Developments in Healthcare' (2010) 10:67 BMC Medical Informatics and Decision Making.

[168]Walsham (n 137) 472–473.

[169]Monteiro and Hanseth (n 163) 339.

[170]Howcroft, Mitev, and Wilson (n 48) 357–8.

[171]David Knights, Fergus Murray, and Hugh Willmott, 'Networking as Knowledge Work: A Study of Strategic Inter-Organizational Development in the Financial Services Industry' (1993) 30(6) Journal of Management Studies 975, 982.

[172]James C Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (Yale University Press 1998) 80.

> ern state is to reduce the chaotic, disorderly, constantly changing social reality beneath it to something more closely resembling the administrative grid of its observations.[173]

Sahay and Lewis apply Scott's idea of *mētis*[174] (local and practical knowledge) to the challenges of health information systems, claiming that

> ... public health information systems, by the nature of the contexts within which they operate; the existing structures of power relations; and the technologies of knowledge production that are used, primarily related to statistics, are inherently problematic as regards creating simplifications and legibility. Due to the multiple stakeholders involved, these systems are, by design, about disagreements.[175]

A similar analysis may apply to environmental regulation, an issue to which I will return in the analysis of the interviews which I conducted.[176]

Actor-Network Theory and Socio-Legal Studies

ANT has potential as a research method for socio-legal studies,[177] particularly for studies of regulation which demand 'an analysis that is not confined to rules and strategies, but also embraces organizations and practices that can constrain the behavior of those who encounter them.'[178] Examples of its application include studies of appeal court discourse,[179] the impact of the Trade Related Intellectual Property agreement (TRIPS) and pharmaceutical patents on health;[180] the French *Conseil*

[173] ibid, 81–2.

[174] ibid, 311-3.

[175] Sundeep Sahay and John Lewis, 'Strengthening Metis Around Routine Health Information Systems in Developing Countries' (2010) 6(3) Information Technologies and International Development 67, 72.

[176] See Section 8.4.8.

[177] Dave Cowan and Helen Carr, 'Actor-Network Theory, Implementation, and the Private Landlord' (2008) 35 Journal of Law and Society 149, 150; Ron Levi and Mariana Valverde, 'Studying Law By Association: Bruno Latour Goes to the Conseil d'État' (2008) 33(3) Law and Social Inquiry 805, 806.

[178] Emilie Cloatre and Robert Dingwall, '"Embedded Regulation:" The Migration of Objects, Scripts, and Governance' (2013) 7(3) Regulation and Governance 365, 371.

[179] Mariana Valverde, 'Authorizing the Production of Urban Moral Order: Appellate Courts and Their Knowledge Games' (2005) 39(2) Law and Society Review 419.

[180] Emilie Cloatre, 'TRIPS and Pharmaceutical Patents in Djibouti: an ANT Analysis of Socio-Legal Objects' (2008) 17(2) Social and Legal Studies 263.

d'Etat;[181] the evolution of the regulation of tobacco;[182] the Kyoto Protocol's Clean Development Mechanism;[183] the use of CCTV as a safety device;[184] the EU Passenger Name Record project;[185] the control of pharmaceuticals in an un-regulated market;[186] the interaction between law and space;[187] techno-regulation;[188] and the development of a Sentencing Information System.[189]

7.4.4 Actor-Network Theory and Critical Realism

Despite the use of social constructivist approaches, my fundamental theoretical approach in this thesis is critical realism (CR), which argues that

> ... there exists a reality totally independent of our representations of it; the reality and the 'representation of reality' operating in different domains.... [It] acknowledges that observation is value laden [and that] that our knowledge of reality is a result of social conditioning and thus cannot be understood independently of the social actors involved in the knowledge derivation process. However, it takes issue with the belief that the reality is a product of this knowledge derivation process.[190]

CR proposes that 'the world is composed not only of events and our experience or impressions, but also of underlying structures, powers, mechanisms, and tendencies, etc. that exist, whether or not detected, and govern or facilitate actual

[181] Bruno Latour, *The Making of Law* (Polity Press 2010).

[182] Catriona Rooke, Emilie Cloatre, and Robert Dingwall, 'The Regulation of Nicotine in the United Kingdom: How Nicotine Gum Came to be a Medicine, But Not a Drug' (2012) 39(1) Journal of Law and Society 39.

[183] Emilie Cloatre and Nick Wright, 'A Socio-legal Analysis of an Actor-world: The Case of Carbon Trading and the Clean Development Mechanism' [2012] Journal of Law and Society 76.

[184] Séverine Germain, Anne-Cécile Douillet, and Laurence Dumoulin, 'The Legitimization of CCTV as a Policy Tool: Genesis and Stabilization of a Socio-Technical Device in Three French Cities' (2012) 52(2) British Journal of Criminology 294.

[185] Rocco Bellanova and Denis Duez, 'A Different View on the "Making" of European Security: The EU Passenger Name Record System as a Socio-Technical Assemblage' (2012) 17(2) European Foreign Affairs Review 109.

[186] Cloatre and Dingwall (n 178).

[187] Kirsten Campbell, 'The City of Law' [2013] International Journal of Law in Context 192.

[188] Katja de Vries and Niels van Dijk, 'A Bump in the Road. Ruling Out Law From Technology' (2013) 25 Ius Gentium: Comparative Perspectives on Law and Justice 89.

[189] Hutton, 'From Intuition to Database' (n 149).

[190] Philip J Dobson, 'Critical Realism as an Underlying Philosophy for IS Research' in Mehdi Khosrow-Pour (ed), *Encyclopedia of Information Science and Technology* (Information Science Reference 2005).

events.'[191] Therefore, '[e]vents can be seen, but social mechanisms are not readily observable; they require theory and abstraction.'[192] CR permits the creation of alternative, liberating concepts in place of the vacuum left by constructivism.[193] Applied correctly, CR can provide guidance on how to go about the process of research.[194] It tends to rely on abductive or retroductive reasoning, moving from observation to the formulation of an explanatory theory.[195] CR has significant potential for information systems research.[196]

Although some question whether CR is a suitable basis for social research,[197] it can also support the methodological pluralism[198] which is required for good information systems research[199] and a judicious mixture of positivist and interpretivist approaches can transcend each approach's inherent weaknesses.[200] Critical realism presents a useful antidote to the excessive focus on social construction in much IS research, highlighting the importance of external structures in shaping the context in which individual actors interact and pointing towards a means of avoiding Foucault's removal of distinction between agents.[201]

---

[191] Tony Lawson, *Economics and Reality* (Routledge 2006) 21.

[192] Marianne Wikgren, 'Critical Realism as a Philosophy and Social Theory in Information Science?' (2005) 61(1) Journal of Documentation 11, 12.

[193] Carla Willig, 'Beyond Appearances: A Critical Realist Approach to Social Constructionist Work' in *Social Constructionist Psychology: A Critical Analysis of Theory and Practice* (Open University Press 1999) 38.

[194] Dobson (n 190).

[195] Bendik Bygstad and Bjørn Erik Munkvold, 'In Search of Mechanisms. Conducting a Critical Realist Data Analysis' in Cynthia Beath, Michael D Myers, and KK Wei (eds), *International Conference on Information Systems* (Association for Information Systems 2011) 2–3.

[196] Sven A Carlsson, 'Critical Realist Information Systems Research in Action' in Mike Chiasson and others (eds), *Researching the Future in Information Systems* (Springer 2011).

[197] Kevin Magill, 'Against Critical Realism' (1994) 18(3) Capital and Class 113.

[198] See Section 8.1.1.

[199] Arturo Vega and David Brown, 'Systems of Innovation, Multidisciplinarity, and Methodological Pluralism: A Realist Approach to Guide the Future of Information Systems Research and Practice' in Mike Chiasson and others (eds), *Researching the Future in Information Systems* (Springer 2011) 255.

[200] Markos Zachariadis, Susan Scott, and Michael Barrett, 'Exploring critical realism as the theoretical foundation of mixed-method research: evidence from the economics of IS innovations' (*Judge Business School Working Paper Series*, 2010) ⟨http://www.jbs.cam.ac.uk/fileadmin/user_upload/research/workingpapers/wp1003.pdf⟩ accessed 27 August 2014.

[201] Alaistair Mutch, 'Critical Realism and Information Systems: An Exploration' in *Seventh Annual BIT Conference* (1997).

Although critical realism is often seen as incompatible with ANT,[202] which is largely constructivist in its approach, only grudgingly accepting certain essentials as 'real',[203] the two can nonetheless be combined in a useful fashion. This requires recognising the role of non-human actors in social relations (while preserving an awareness of the specific feeling and reasoning characteristics of the human), drawing connections between the ANT notion of inscription and the CR idea of emergent properties.[204] Indeed, ANT approaches a CR perspective in attributing power to non-humans.[205]

7.5 Framework for Analysis

ANT is not a complete theory in the sense of providing a framework within which to create an explanation,[206] and Latour repudiates its use in this way.[207] Although there is no single theory or method that is sufficient by itself as a framework for this research, a consideration of existing writings from the sociological and information systems perspectives provides me with adequate means to begin the process. The Technology Enactment Framework is not sufficiently developed. An IE viewpoint sensitises us to an awareness of the importance of context, interaction between stakeholders and actors and the changing nature of information equilibriums. When supplemented with a Foucauldian understanding of the way in which power is applied and shaped by the symbolic interactions between groups and individuals (and the important ways in which ICT can formalise, routinize, or even ossify these), we begin to understand the need to look closely at the seemingly mundane details

[202] Dave Elder-Vass, 'Searching for Realism, Structure and Agency in Actor Network Theory' (2008) 59(3) Law and Society Review 455.

[203] Antonio Cordella and Maha Shaikh, 'From Epistemology to Ontology: Challenging the Constructed "Truth' of ANT' (*Department of Information systems, London School of Economics and Political Science*, 2006) ⟨http://is2.lse.ac.uk/wp/pdf/wp143.pdf⟩ accessed 19 May 2014, 15–6.

[204] Alistair Mutch, 'Actors and Networks or Agents and Structures: Towards a Realist View of Information Systems' (2002) 9(3) Organization 477.

[205] Whittle and Spicer (n 146) 614.

[206] Dolwick (n 119).

[207] Latour, *Reassembling the Social* (n 123) 146–7.

of systems. However, we must be careful to avoid a technologically deterministic perspective. These insights emphasise the choices and unexpected (sometimes unwelcome) outcomes that lurk behind the conventional rhetoric of inevitability and constant progress that underlies much of the development of ICT. They provide a context or framework within which to place the actors and their figurations, but not a means to trace their influence and influences.

According to Seale, social researchers have much to take from philosophy, social theory, methodological studies and practice. From relativists, we learn that all 'facts' are subjective understandings, and from realists, we should note that these 'factual' understandings have a very significant role in shaping the social and political context in which we operate. From social theory, we can gain the benefit of varied paradigms, frameworks, and methods in order to approach the same phenomenon in multiple ways, but we must seek to avoid complex, indeterminate work that does not reach some conclusions. From debates about methodology, we learn that blind adherence to mechanical rules relates to blinkered results but provides the opportunity for a self-critical inner dialogue which provides greater charity for engagement with public debate. Examples from practice provide us with models of how to, and how not to, carry out research.[208] Thus, Professor Rubin's criteria of clarity, persuasiveness, significance, and applicability[209] can be met.

There is a rich vein of scholarship under the general heading of SSK which yields insights in the interaction—indeed, the confluence and co-production—of society and technology. Technology is socially shaped or constructed and in order to trace the networks of power that this creates, it is necessary to pay close attention to the transformation and translation of messages of meaning and power between actors linked in a constantly-redeploying network.

---

[208] Clive Seale, 'Quality in Qualitative Research' in Clive Seale and others (eds), *Qualitative Research Practice* (Sage 2007).

[209] Edward L Rubin, 'On Beyond Truth: A Theory for Evaluating Legal Scholarship' (1992) 80 California Law Review 889.

Gherardi and Nicolini put forward what they call an 'ecological ANT', which focuses on

> ... the interdependency of activity and passivity. ... The conception of action is accordingly less focused on the model 'actors making thing to happen', and more ecological, in the sense of putting emphasis on the context, on the reciprocal change of actors and situations, and on the negotiated nature of social order (even when negotiations are not apparent). ... [T]his version of ANT is less heroic and more quotidian, in the dual sense of unremarkable and daily ...[210]

Larger fields of study, such as the one currently under examination, lend themselves better to this particular adaptation of ANT.[211] This method, used from a CR perspective and supported by the additional insights offered by IE and governmentality, provide me with a methodological toolbox sufficient to construct an understanding of the role of ICT in creating, maintaining, and destabilising power relationships in the routine interactions at the heart of regulatory activity and an overall framework for the analysis of the interviews.

[210] Gherardi and Nicolini (n 120) 304.
[211] ibid, 305.

Chapter 8

Working Out an Understanding of ICT in Practice: A Cross-Jurisdictional Exploration

8.1 Bringing Together the Strands of Research

> Every research project is, in some way, a project of "first impression", a de novo attempt to find the world through a new slice or with a new lens. Uncertainty and doubt will be the researcher's faithful companion.[1]

So it was with this project. The process was messy,[2] resembling Grady and Wallston's 'Garbage Can II' model, in which Martin's four elements of theories, methods, resources, and solutions[3] are supplemented by a consideration of problems, phenomena, personal concerns, and design.[4] Although both engage in forms of social research, the methodology of the systems analyst (which I was still to some extent when I started this project) and the methodology of the social scientist (which I am slowly and hesitantly becoming) are very different: the first begins (at least in aspiration) with a clear end in mind, giving rise to very definite areas of focus and precise questions, while the second is perhaps best to begin with little or no preconceptions and open questions, adjusting the focus of enquiry as the subject matter

[1] Patrick Schmidt and Simon Halliday, 'Beyond Methods—Law and Society in Action' in Patrick Schmidt and Simon Halliday (eds), *Conducting Law and Society Research: Reflections on Methods and Practices* (2009) 6.

[2] Herbert Kritzer, 'Research is a Messy Business: An Archeology of the Craft of Socio-Legal Research' in Simon Halliday and Patrick Schmidt (eds), *Conducting Law and Society Research: Reflections on Methods and Practices* (Cambridge University Press 2009).

[3] Joanne Martin, 'A Garbage Can Model of the Psychological Research Process' (1981) 25(2) American Behavioral Scientist 131.

[4] Kathleen E Grady and Barbara Strudler Wallston, *Research in Health Care Settings* (Sage 1988) 12–3.

becomes progressively clearer. The analyst assumes that if a complete system does not exist, it can be constructed; the social scientist should not forget that individuals and institutions are constructing and discarding incomplete systems all the time. The analyst aspires towards uniformity; the social scientist seeks out messiness, confusion, and incoherence. The analyst has (in theory, at least) structured methods of processing the information gathered through interviews and converting it to neat diagrams, flowcharts, and deployed procedures;[5] the social scientist can choose from a plethora of contradictory, incomplete, and confused array of systems, few of which seem particularly mechanical. The transition from one mindset to another was not always comfortable. It became clear that there was no 'right way' to conduct this project, as is often the case,[6] and pragmatic choices[7] needed to be made.

8.1.1 Pluralism in Environmental Law Scholarship

Fisher and others have considered the development of environmental law scholarship, which proceeds on 'ideals [of appropriate methods, open-mindedness, and dissemination] and [which] addresses the "special kinds of problems" that are discovered in the study of laws and legal systems that relate to the environment'.[8] These authors identify four different ways in which environmental scholars must be interdisciplinary: understanding the technical details of the problems that they study, study of scholarship on governance and regulation, the study of environmental law by other disciplines, and the development of a new discipline to deal with

[5] Of course, the reality of the analyst/developer at work is probably even more confused and contingent than the lawyer or sociologist. Brian Fitzgerald, 'The Use of Systems Development Methodologies in Practice: A Field Study' (1997) 7(3) Information Systems Journal 201; Joe Nandhakumar and David Eand Avison, 'The Fiction of Methodological Development: A Field Study of Information Systems Development' (1999) 12(2) Information Technology and People 176.

[6] Robert Galliers, 'Choosing Appropriate Information Systems Research Approaches: A Revised Taxonomy' in Robert D Galliers (ed), *Information Systems Research: Issues, Methods and Practical Guidelines* (Blackwell Scientific 1992) 145.

[7] Ole W Pedersen, 'Modest Pragmatic Lessons for a Diverse and Incoherent Environmental Law' (2013) 33(1) Oxford Journal of Legal Studies 103.

[8] Elizabeth Fisher and others, 'Maturity and Methodology: Starting a Debate About Environmental Law Scholarship' (2009) 21(2) Journal of Environmental Law 213, 217.

environmental problems.[9] This thesis strives to attain each of these ideals, while retaining an awareness of the difficulties which environmental scholarship faces without a 'singular methodological approach'.[10] Drawing inspiration from that article's call for greater reflection, sophistication, and methodological rigour in legal research, this thesis seeks to apply methods not often used in legal research but particularly appropriate to this problem, which is about the interaction between three sophisticated and dynamic systems: legal and regulatory systems, information and communications technology (ICT) systems, and society as a whole, in search of detailed insights and recommendations for better regulatory practice and future research. Pluralism does not, of course, mean 'anything goes' but flexibility[11] while keeping a focus on proper scientific rigour.[12]

I will therefore explain how the data for this study was gathered and how it is applied in order to construct and support both a theoretical framework and recommendations for reform.

8.1.2 Methodological Context

Qualitative semi-structured interviews were used in order to build a picture of how regulators use these new technologies and the issues they have identified, focusing on questions surrounding the rule of law and the solutions that are put in practice. This yields significant benefits over a conventional library-based, descriptive, and black letter approach as it offers an opportunity to access directly the experiences and learning of people 'on the ground'. However, it can only provide a limited picture of the overall complexity of the use of these technologies, which may vary

[9] ibid, 231–4.

[10] ibid, 227.

[11] Daniel Robey, 'Research Commentary: Diversity in Information Systems Research: Threat, Promise, and Responsibility' (1996) 7(4) Information Systems Research 400, 406; John Mingers, 'Combining IS Research Methods: Towards a Pluralist Methodology' (2001) 12(3) Information Systems Research 240, 243–6.

[12] Maurice Landry and Claude Banville, 'A Disciplined Methodological Pluralism for MIS Research' (1992) 2(2) Accounting, Management and Information Technologies 77, 88.

considerably from site to site, organization to organization, or jurisdiction to jurisdiction. There is also the risk of error in the empirical research itself or in its analysis. This possibility was reduced by reflection on the data gained from interviews, which in turn led to a shift in focus towards rule of law issues,[13] and reliance on the existing literature from the social sciences on the proper analysis of data.

Working out a good method to extract an understanding from the text of the interviews took time and effort. Given the breadth of the field of enquiry, the lack of contextualising literature, and the richness of the material collected from a generous sharing of perspectives by busy individuals, I wanted to explore these as deeply and thoroughly as possible and try to build a theoretical model that would give useful shape to an inchoate domain. This was a challenging task, particularly as the area under study is new, rapidly developing, and very under-theorised.

As Flanagan and others point out, '[o]ne reason the study of human and social dimensions of technology is so demanding is that the areas of knowledge and the methodologies it straddles are traditionally both far-flung and self-contained.'[14] We find ourselves in what Sassen calls an 'analytic borderland':

> a heuristic device that allows one to take what is commonly represented as a line separating two differences [here, ICT and law], typically seen as mutually exclusive, into a conceptual field—a third entity [here, e-regulation]—that requires its own empirical specification and theorization.[15]

Researching in these in-between spaces requires three significant points of focus: first, identifying the actual practices, which can be material, organizational or discursive, that are involved in the shift from one spatio-temporal order to another; second, paying attention to the specific empirical characteristics of the various cir-

[13] See Section 1.4.

[14] Mary Flanagan, Daniel Howe, and Helen Nissenbaum, 'Embodying Values in Technology: Theory and Practice' in Jeroen van den Hoven and John Weckert (eds), *Information Technology and Moral Philosophy* (Cambridge University Press 2008) 324.

[15] Saskia Sassen, *Territory, Authority, Rights: From Medieval to Global Assemblages* (Cambridge University Press 2006) 339.

cuits of activity that we are examining; and finally an awareness that a borderland is not a no-man's land, but in fact inhabited by actors that are already arranged in relation to each other by historical circumstances and contingencies.[16]

8.1.3 Integrating Fieldwork

The research went through three overlapping stages; first, a wide-ranging literature review on different aspects of the interaction between ICT and environmental regulation (ER). The essential enquiry that drove this review was 'what changes are connected to the increasing use of ICT in the work of environmental regulators?'. This raised issues around the internal functioning of the regulator, its interaction with the outside world, and the operation of the actors with which it was dealing. The dearth of existing literature and research clearly focused on this question made it increasingly obvious that in order to answer the questions raised in a satisfactory fashion would require empirical research. The initial focus was on efficiency and effectiveness: how regulators could best use ICT within their existing regulatory approaches. The intention was to explore this using a two track approach: quantitative studies focusing on the use of the provision of information as a way to drive behaviour change, and qualitative research using interviews with staff and regulators.

The second phase was identifying, contacting, and interviewing relevant individuals in regulatory agencies and finding locations for quantitative studies. While the initial contacts were to a certain extent opportunistic, taking advantage of existing relationships and chance meetings at conferences and other events, the individuals approached were all significantly involved in the use of ICT for regulatory purposes. As these interviews progressed, it became clear that a significant issue which had not been previously considered to any significant extent was the impact of the increased use of ICT on the distribution, allocation, and operation of power

[16] ibid, 385–6.

within the overall dynamic of the regulatory process. It also became clear that quantitative studies would not yield any significant contribution to knowledge, the time and resources required in order to assemble worthwhile experiments were beyond what was available, and many others were moving into this area undertaking significant studies, particularly in preparation for the widespread implementation of smart grids, leaving little space for more modest studies. This therefore lead to a reformulation and redirection of the research focus towards this issue of power and the underlying value of the rule of law.[17] In addition to the formal interviews, time was spent attending relevant conferences, speaking to individuals there, visiting law schools in the Netherlands and the United States of America, and organising a workshop on 'Information and Communications Technology for Environmental Regulation: Developing a Research Agenda'.[18]

The third phase was therefore a detailed analysis of the 14 interviews conducted. This is considered in more detail in Section 8.2 below.

8.1.4 Choosing Settings and Contexts

The empirical component of the research that underpins this thesis is semi-structured interviews with a variety of staff from regulatory agencies and environmental NGOs from a number of different jurisdictions and countries. These varied in size and scale from small to large and from local to national. Particular agencies and jurisdictions are not identified, as the interviews were conducted with a guarantee of anonymity, and some identifying details are omitted in the extracts used. Where extracts are used or references are made, the interviewees are referred to by a code such as 'REG05', which means 'interview with regulatory staff, number 5', or 'NGO01', which means 'interview with non-governmental agency staff, number 1'. My questions are printed in italics.

[17] See Section 1.4.

[18] ICT4ER, 'Information and Communications Technology for Environmental Regulation: Developing a Research Agenda' (2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

Efforts were made to access a representative range of staff, which ranged from middle management to senior roles within their respective agencies; some are highly technical and specialised in information and communications technologies, while others were in higher level, more policy-oriented positions. A total of 14 interviews were conducted, of which 12 were with regulatory staff and two were with staff in NGOs. It is difficult to know what number of interviews is sufficient for a project of this kind,[19] but 12 seems to be a reasonable number for a study involving a homogenous group such as this.[20]

The interviews did not raise significant ethical issues and therefore institutional review was not necessary, but data protection approval was sought and obtained. All interviews were conducted on the basis of fully informed consent, confirmed in advance by the provision of a short description of the study together with a consent form to be signed and returned by the interviewee.

Early attempts at more direct approaches to senior management in relevant organizations proved fruitless and I decided that existing contacts would yield better results. The initial identification of individuals for interview was conducted using a classic 'snowball' technique,[21] making use of contacts at conferences and other events in order to secure initial interviews and then referrals or introductions to other individuals. This was effective in ensuring a wide range of individuals who are willing to speak openly and candidly, but does have as a disadvantage that the sample is not very systematic. In particular, the low number of interviews with NGO staff means that conclusions regarding this particular group of actors require further study for thorough validation.

The intention of the interviews was to discover existing practices with regard

[19] Sarah Elsie Baker and Rosalind Edwards, 'How many qualitative interviews is enough?' (2012) ⟨http://eprints.ncrm.ac.uk/2273/4/how_many_interviews.pdf⟩ accessed 27 August 2014.

[20] Greg Guest, Arwen Bunce, and Laura Johnson, 'How Many Interviews Are Enough? An Experiment With Data Saturation and Variability' (2006) 18(1) Field Methods 59.

[21] Patrick Biernacki and Dan Waldorf, 'Snowball Sampling: Problems and Techniques of Chain Referral Sampling' (1981) 10(2) Sociological Methods and Research 141.

to ICT and environmental regulation and discuss the legal and policy implications of those. The interviews were semi-structured, proceeding from a set of questions which was often provided to the interviewees in advance (in order to allay the frequently-expressed concerns regarding the types of issues that I was likely to raise) but supplemented by more probing (and unprovided) questions which were raised as seemed appropriate during the discussion.[22] Some interviews followed this list of questions quite well, with the interviewee anticipating issues before they were actually raised, whereas others were more discursive or truncated due to lack of time. The questions began with simple issues,[23] in order to settle the interviewees into the process,[24] but as the interview progressed, more complex issues were raised. This allowed participants to put forward their own views, understandings, and meanings in a spontaneous and open-ended fashion, leaving space for both the interviewer and interviewee to explore issues at length as necessary, rather than constraining the discussion to predetermined categories and questions.

Conducting these types of elite interviews raises its own challenges.[25] The individuals that I wanted to speak to are busy and finalising arrangements for some interviews required flexibility and last-minute changes of plan on both sides. Fortunately, everyone that I spoke to was more than willing to facilitate me and seemed to enjoy the experience of speaking about their work as their initial unease and confusion about my topic faded. Although all were very generous with their time, and there were few of the problems that can be encountered in this type of fieldwork,[26] some interviews were conducted with a close eye on the clock, sometimes with a personal assistant marking time in the corner. Others went on for far longer than the

[22]For a list of questions, see Appendix A.

[23]Michael McConville and Wing Hong Chui, *Research Methods for Law* (Edinburgh University Press 2007) 76.

[24]Beth L Leech, 'Asking Questions: Techniques for Semistructured Interviews' (2002) 35(4) PS: Political Science and Politics 665.

[25]Joel D Aberbach and Bert A Rockman, 'Conducting and Coding Elite Interviews' (2002) 35(4) PS: Political Science and Politics 673.

[26]Jeffrey M Berry, 'Validity and Reliability Issues in Elite Interviewing' (2002) 35(4) PS: Political Science and Politics 679.

allocated or expected duration as interviewees had a great deal to say.

The purpose of interview analysis was first, to produce a phenomenological understanding of the application of ICT for environmental regulation from the perspective of staff in regulatory agencies and non-governmental organizations; and second, to produce an overall theory of the use of ICT in this context which could be used as the basis for further doctrinal and empirical research. This involved five cycles of coding, moving from descriptive to a combination of descriptive and interpretive, and finally to an interpretive, conceptual, and theoretical, researcher-led analysis.[27]

8.1.5 Ensuring Quality

Ensuring the quality of the research is a vital element. However, it is important to avoid a checklist approach to this goal,[28] or to assume that it is possible to enumerate a single set of criteria that will apply to all research.[29] Ultimately, validity is the responsibility of the researcher.[30] Attention to this important requirement is particularly complicated in the context of this particular project, where '[t]he new systems of knowledge engineering raise many questions about freedom, civil society, and democratic practice'.[31] This is a project with many possible starting points, many possible approaches, and many potential outcomes, particularly as 'the information age is [not] only to be analysed, or, indeed, is best understood as a *technological* revolution. Rather what is significant about *these* technologies is that they are *in-*

[27] A full history of coding cycles is in Appendix B.

[28] Rosaline S Barbour, 'Checklists for Improving Rigour in Qualitative Research: A Case of the Tail Wagging the Dog?' (2001) 322 British Medical Journal 1115.

[29] Martyn Hammersley, 'The Issue of Quality in Qualitative Research' (2007) 30(3) International Journal of Research and Method in Education 287.

[30] Mirka Koro-Ljungberg, 'Validity, Responsibility, and Aporia' (2010) 16(8) Qualitative inquiry 603.

[31] John Pickles, 'Representations in an Electronic Age: Geography, GIS and Democracy' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 20.

formation and communications technologies.'[32] What is under study, therefore, is a wide range of human interactions.

Law recommends that a study of 'the mechanics of power and organization ... should start with a clean slate.'[33] A particular methodological approach that seeks to achieve this laudable goal to the greatest extent possible is grounded theory (GT), in which 'theory-development does not come "off the shelf," but rather is generated or "grounded" in data from participants'.[34] However, GT has been critiqued over the decades since its development for being *too* rooted in data (and therefore limited by it), relying on an over-simplified process of induction, diverting attention from data towards procedures, and internally unclear from the outset.[35] It is not clear that GT in fact produces 'theory' (in the sense of a means of explaining observed data), whether it is grounded in the data or in the researcher's own biases and assumptions, and whether the final results are discovered or invented.[36] Seldén highlights that the ultimate source of theory lies 'within the researcher and is dependent on the extent to which he/she is widely read in scholarly matters.'[37] In addition, although GT is widely used in other fields, and 'offers the opportunity to gain real insight and understanding into a given area of legal study',[38] it does not seem to have gained much traction in socio-legal research.[39]

Therefore, although this study takes some inspiration from GT, it does not

[32]Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) 26 (emphasis in original).

[33]John Law, 'Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity' (1992) 5(4) Systems Practice 379, 380.

[34]John W Cresswell, *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (Sage 2007) 63.

[35]Gary Thomas and David James, 'Reinventing Grounded Theory: Some Questions About Theory, Ground and Discovery' (2006) 32(6) British Educational Research Journal 767, 768–9.

[36]ibid, 771–87.

[37]Lars Seldén, 'On Grounded Theory—with Some Malice' (2005) 61(1) Journal of Documentation 114, 126.

[38]Opi Outhwaite, Robert Black, and Angela Laycock, 'The Pursuit of Grounded Theory in Agricultural and Environmental Regulation: A Suggested Approach to Empirical Legal Study in Biosecurity' (2007) 29(4) Law and Policy 493, 522.

[39]ibid, 496; For an example, see Agnete Weis Bentzon and others, *Pursuing Grounded Theory in Law: South-North Experiences in Developing Women's Law* (Monde 1998).

follow its methods in a strict fashion. In particular, much of the literature review was completed before the empirical work began and the interviews relied on semi-structured questions which imposed a certain shape on the discussions which ensued. The approach is perhaps more akin to Thornberg's alternative of

> ... *informed grounded theory* [which] refers to a product of a research process as well as to the research process itself, in which both the process and the product have been thoroughly grounded in data by GT methods while being informed by existing research literature and theoretical frameworks.[40]

This incorporates the elements of GT that are appealing and useful, such as the generation of theory from data rather than pre-conceptions, but acknowledges the reality of those pre-conceptions. While the interviews proceeded on the basis of a general outline of questions,[41] suggested by the literature already read and the research questions, these were as open as possible and I made every attempt to refrain from imposing my own perspective or suggest responses to the interviewees.

8.2 Phases of Analysis

Interviews were digitally recorded and transcribed in full into a word processing file. This data was then analysed with the assistance of NVivo qualitative analysis software, which provided functionality enabling the rapid coding of portions of the text of interviews, essentially fragmenting what was said by the interviewees and the re-assembly of dominant patterns of meaning from these fragments. The software played a valuable support role as a repository for transcripts, interlinked notes and interpretative memos and enabled the creation of an audit trail in order to assist

[40] Robert Thornberg, 'Informed Grounded Theory' (2012) 56(3) Scandinavian Journal ofEducational Research 243, 249 (emphasis in original).

[41] See Appendix A.

in ensuring transparency.[42] It also saved a great deal of time,[43] particularly in the generation of visualizations of the analysis, although other software (iThoughtsX and Curio) were used for the final versions as they gave greater control over presentation.

8.2.1 Open Coding

At first, extracts from the interviews were coded in an open, exploratory fashion, using some a priori codes that were suggested by the interview questions, the interviewee's responses, and connections between issues raised across interviews. Subsequent codes developed from a combined approach of identifying issues that were persistently raised by interviewees and topics that are highlighted in the literature. This coding was then re-visited in order to prepare a more hierarchical, thematically-based understanding, including points of disagreement between interviewees. As power became a key question, many of the codes coalesced around this issue. Some codes also emerged from the still-ongoing literature review, such as the issues surrounding bias in software. These were not raised directly by interviewees but were important to the legal theory under consideration and therefore seem worth highlighting.

An example of a code that developed through the process is 'Social media is useful but difficult to manage'. This began as 'Loss of control of information' (with only one reference identified) and 'Social media' (with two references). In the second cycle of coding, the first code became part of the developing focus on 'Power', while the second was identified as an example of a 'Tool'. However, for the development of the Thematic Network Analysis, they were combined into their final name, under the general theme of 'Available ICT are adopted quickly', in the

[42] Jenine Beekhuyzen, Sue Nielsen, and Liisa von Hellens, 'The NVivo Looking Glass: Seeing the Data Through the Analysis' in *5th Conference on Qualitative Research in IT* (Queensland University of Technology, Griffith University, and the Australian National University 2010).

[43] Outhwaite, Black, and Laycock (n 38) 513.

sub-topic of 'Current use focuses on integration of data sources'.

In hindsight, although the use of a priori codes helped in starting the process, it channelled initial analysis somewhat too much, limiting later attempts to open up what was being said in the interviews. In addition, some of the theoretical codes, such as 'soft power', had no references: practitioners did not refer to some topics in obvious ways and I was reluctant to over-interpret what they said. Two processes assisting in overcoming these issues: the first was the realization in the middle of a story of internal conflict being told by an interviewee that questions of power were quite significant to understanding perceptions of the importance of ICT; the second was the use of visualization and diagramming in order to obtain a fresh perspective on the data. Coding using the theoretical frameworks also assisted greatly—although at the time it seemed to yield very little concrete results, it was in fact quite useful to focus on these gaps, directing my attention to the issues that were not being captured by theory and leading to the conclusion that the area under study is still in a significant state of flux.

8.2.2 Thematic Network Analysis

Coding then moved to the identification of themes. A theme 'captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set.'[44] Identifying these involved 'a constant moving back and forward between the entire data set, the coded extracts of data ..., and the analysis of the data'.[45] The codes generated were then used to generate a thematic network[46] (Figure 8.2 on page 310) in the hope of producing results with real rigour.[47]

[44] Virginia Braun and Victoria Clarke, 'Using Thematic Analysis in Psychology' (2006) 3(2) Qualitative Research in Psychology 77, 82.

[45] ibid, 86.

[46] Jennifer Attride-Stirling, 'Thematic Networks: An Analytic Tool for Qualitative Research' (2001) 1(3) Qualitative Research 385.

[47] James Thomas and Angela Harden, 'Methods for the Thematic Synthesis of Qualitative Research in Systematic Reviews' (2008) 8 BMC Medical Research Methodology 45, 7; Braun and

8.2.3 Use of Theoretical Frameworks as a Fresh Lens

According to Bazeley, it is important to go beyond themes when reporting on a qualitative study,[48] and initial versions of the thematic network were indeed unsatisfactory as a summary of the research findings. Once the first attempt at this process was complete, my focus shifted back to the theoretical frameworks discussed in the last chapter and the data was re-viewed through these lenses in the hope of unlocking further insights from the data. The third cycle was therefore an attempt to use the frameworks of Information Ecology (IE) and Actor-Network Theory (ANT) to highlight the role of technology in the functioning of the regulatory system. Building on that, a diagram was developed in order to distil my understanding of the context within which ICT is applied in the regulatory system.[49]

8.2.4 Visualizing Networks of Power

Exploring the thematic issues raised by the interviewees was a very useful way of building an understanding of their perception of the use of ICT within environmental regulation—an attempt, however incomplete, to use their words in order to see through their eyes.

However, my research approach is realist rather than social constructionist,[50] and it therefore seemed important to me to build from this and seek to assemble a picture of 'what is really going on'. On the basis that while individuals and groups may have their own perspectives on the consequences of ICT but that the large-scale deployment of this technology nonetheless constitutes a highly significant and increasingly inflexible structure for the regulatory process, I sought to model the new shape of the information-driven environmental regulator.[51] While this move

Clarke (n 44) 95–6.

[48] Pat Bazeley, 'Analysing Qualitative Data: More Than "Identifying Themes"' (2009) 2(2) Malaysian Journal of Qualitative Research 6, 6–7.

[49] See Figure 8.1.

[50] See Section 7.4.4.

[51] See Figure 8.3.

from social constructionism to realism may seem contradictory, I would argue that there is strength in this diversity as 'a richer understanding of a research topic will be gained by combining several methods together in a single piece of research or research program.'[52] This diagram also emerged 'early', in the second cycle of coding, during a period of confusion as to how to express the connections between issues that I was beginning to form but found difficult to describe verbally. Hurriedly sketched, it became a key reference point and explanatory device for my thinking, and an element which was refined over time.

8.2.5 Validating the Networks and Revisiting the Data

Ensuring that this interpretation, however individual and idiosyncratic, is nonetheless valid and grounded in the data is a key concern. I therefore abstracted the ideas that it contained to a high-level set of codes that focused on processes (generally ending in '-ing') and engaged in a period of focused coding to verify and refine this conceptualization, asking the question '*What abstract processes do the interviewees see as significant in the operation of these tools in practice?*'. To the initial list of codes,[53] I added 'Assisting', 'Communicating','Researching', 'Transacting', and 'Verifying'. Finally, I re-examined the transcripts, adding some fresh material from new interviews conducted during the third cycle of coding, in order to validate the three diagrams.

8.3 ICT in Environmental Regulation: An Information Ecology

What follows is an interpretation of the understandings and experiences expressed by the individuals interviewed for the empirical component of the research. It proceeds through three gradually increasing levels of detail in order to give a progressively fuller picture of the complexity which surrounds the use of ICT in ER.

[52] Mingers (n 11) 241.
[53] See Appendix B.4.

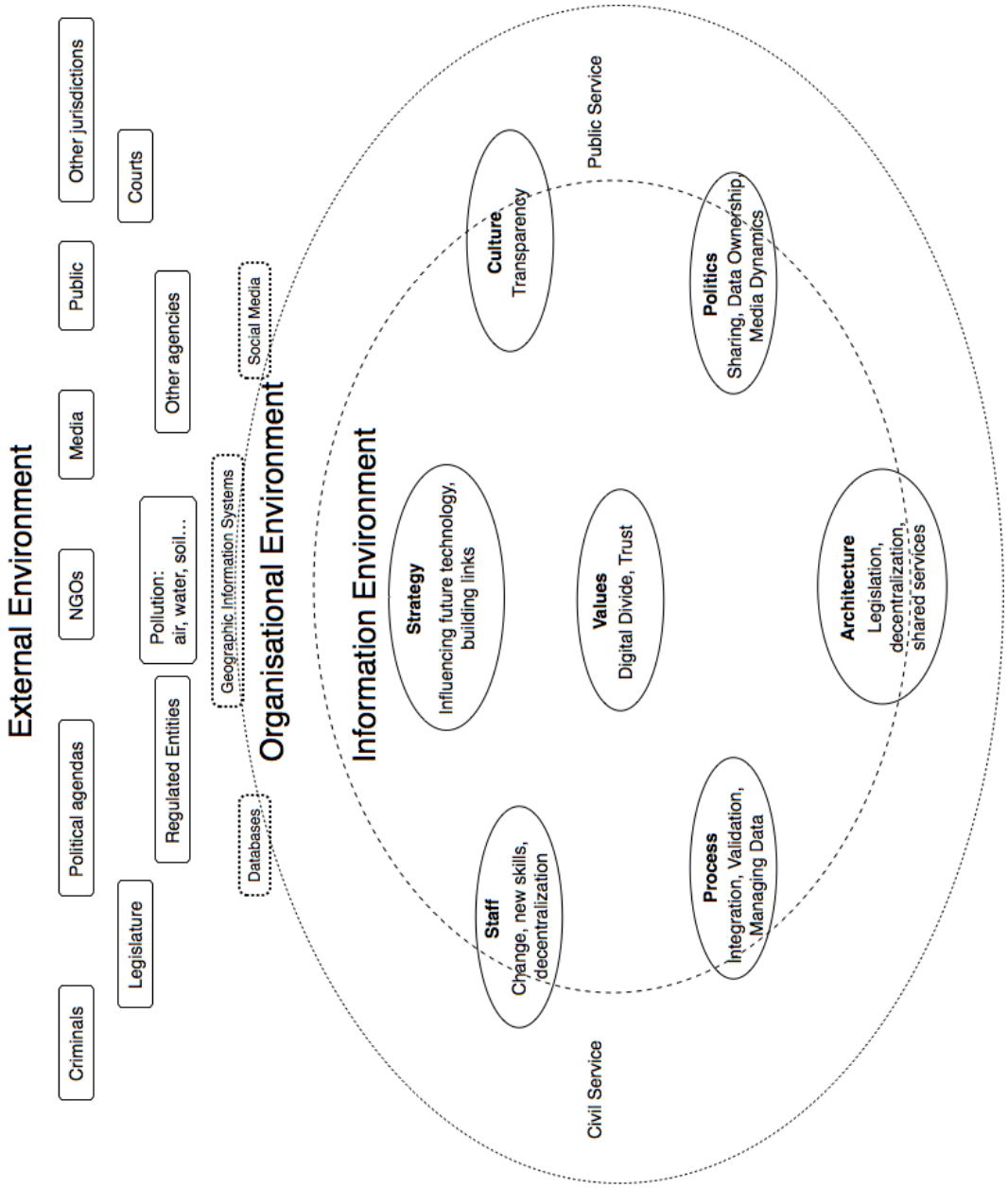
The first, and simplest, diagram draws upon the theory of information ecology (IE) which essentially seeks to build an understanding of an organization's use of, and relationship with, information from an internal point of view,[54] focusing on the 'human activities that are served by the technology.'[55] This initial 'information environment' is developed under particular headings such as 'strategy', 'staff' and 'culture', a list of categories based on the more developed version and visual representation of IE proposed by Davenport for use in business, and somewhat adapted for the public sector.[56] The information environment is placed in the context of an 'organizational environment'. The organization is then placed in the broader context of its external environment, by identifying the significant objects, concepts, and types of entities that it interacts with, and the informational tools that are used to manage, structure, and contain that interaction. An IE understanding of the application of ICT in ER is graphically represented in Figure 8.1 on page 305, and can be explained as follows: For an environmental regulator, the external environment is significant and complex, as might be expected. It is constituted by the issues that the legislation directs their attention to, such as pollution of the air, water, or soil; the legal system, particularly the legislature and to a lesser extent the courts; other agencies (including those in other jurisdictions); regulated firms; the general public (who may be important to the regulator but do not always reciprocate); and the media. Regulators will often try to work on a cross-agency basis, collaborating as required by law or sometimes across jursidictional boundaries, where that seems useful or sensible. ICT is a significant element in these efforts, between measuring and monitoring sensors, data exchange mechanisms, and public websites. Social media is becoming part of this outreach, while GIS enables the regulator to quantify, visualise, and integrate the complexity of what they must deal with. Regulators

[54] See Section 7.2.

[55] Bonnie A Nardi and Vicki L O'Day, *Information Ecologies: Using Technology With Heart* (MIT Press 2000) 50.

[56] Thomas H Davenport, *Information Ecology: Mastering the Information and Knowledge Environment* (Oxford University Press 1997) 34–9.

Figure 8.1: ICT in Environmental Regulation: An Information Ecology



are aware that this shift to online may leave some groups behind, such as farmers, the elderly, or the less well-off. The external environment also contains political agendas, such as efforts to improve regulatory structures and schemes (REG01).

Organizational structures will obviously vary between regulators but many had specific offices that dealt with ICT and information, going by different names. Other than this, however, and the blurring of boundaries between units alluded to above, ICT did not seem to have made much difference to internal structures.

The interviewees did not perceive ICT as having significantly changed the architecture of the regulatory system, either internally or externally. The primary element for many regulatory staff is the legislation, which creates the points of focus for them in considering their external environment, channels their measurement efforts, and provides the standards and targets that they are aiming to achieve. However, ICT is beginning to alter where and how the work gets done, with several talking about more sharing and collaborating (NGO02), 'shared services' (REG02), de-centralization of administrative work (REG04), and more porous administrative boundaries (REG11). Although several agencies were collaborating on specific projects or using administrative services hosted by another agency, there was no indication of out-sourcing to the private sector.

Broadly speaking, the culture within the organizations I dealt with seemed to be in favour of the open sharing of data with the public, with one interviewee (REG06) explicitly drawing this connection. This may be as much about reducing the time-consuming Freedom of Information (FOI) requests, but the willingness to open databases is nonetheless present.

Politics, ('with a small p'), came up as a background issue in the several discussions around the ownership and control of data. This was seen as a significant problem when information was shared between organizations or used by NGOs for campaigns. Agencies wanted to ensure that when they passed on data that implicitly measured their performance, they were not punished for what the numbers revealed.

Individuals wanted to be certain that their anonymity was preserved when documents and photographs that they had produced in order to substantiate their complaints could not be traced back to them. There was also an awareness of the media space into which data released under FOI or other transparency mandates went, and how rapidly that dynamic could change in ways unfavourable to an agency. Finally, one expressed concern about the long-term consequences of shared services: 'you can't help but wonder what you're going to be left with yourself' (REG11).

Processes and practices surrounding the use of ICT in environmental regulation focus on integration (moving 'from operating in an anecdotal environment into a database environment' (REG11)) and validation ('a huge amount of interpretation and data fixing and over and back' (REG12)). Regulators, with large resources, build bespoke systems; NGOs, with small budgets, use freely available Web-based services, such as Google Maps and Street View. Both groups do so for the same aim: to investigate and quantify complaints about environmental quality, and then to decide what action to take. Interviewees spoke of gathering, collating, and holding data. They also talked about the need to manage internal processes: sharing information and drafting documents between units, dealing with FOI requests, and preparing for litigation through discovery.

For staff, change is a significant issue. Although ICT has not been connected to significant structural change, staff find that administrative work is pushed out to front-line staff (REG04), and managers now see much better what work they are actually doing (REG12). Changing tools bring with them new skills requirements, something that both individuals and organizations struggle with. Familiarity with the power of software is now important in getting the day's work done, and some packages (particularly GIS and desktop publishing) are too complex to be used without specialised training (NGO02), and managers value those who are self-reliant with new technologies (REG02, REG05).

Strategy was not often mentioned in the interviews, and when it was, it was

either from a high-level manager (REG05) or in reference to a person at a high level (REG12). Most of the interviewees were at the middle levels of their respective organizational hierarchies and seemed to be focused on a one to three year time horizon. It is therefore difficult to draw any clear conclusions about the strategic thinking that surrounds ICT in environmental regulation from the limited data available.

The current use of ICT-based tools was very similar to what was discussed in Section 5.4, with interviewees highlighting the use of databases, GIS, environmental information systems, satellite observation, remote sensing, and online portals.

Values also did not come up for discussion often, although they were implicit in the discussion around the digital divide, the highlighting of particular consultation processes in social media, and trust in data sources (REG02, REG03, REG04, REG07, REG12). However, there is not sufficient data in the interviews to discuss the topic with any confidence.

8.4 ICT in Environmental Regulation: Significant Themes

The second, more complex, diagram is a thematic network analysis of the interviews. A thematic analysis, according to Braun and Clarke, is a 'method for identifying, analysing and reporting patterns (themes) within data'.[57] This allows for the data to be organised, described, and interpreted,[58] by the active identification by the researcher of 'themes', defined as 'something important about the data in relation to the research question' (not simply the topics most discussed, but those which seem most relevant to the question being studied).[59] It has been developed by Attride-Stirling to include the concept of 'networks'—a structure which assists in the depiction of the relationships between *basic* (lowest-order) premises, *organising*

[57] Braun and Clarke (n 44) 79.
[58] ibid, 79.
[59] ibid, 82.

themes (which summarise and group the basic themes) and *global* themes (which encapsulate the overall metaphors to be found in the text).[60] The resulting diagrams are best read from the centre outwards, with the central issue residing at the centre of the representation, less central (but still important) issues radiating from it, and then the basic claims at the edges of the diagram. However, they are constructed by building from the basic themes through the organising themes to the global theme, in an iterative fashion, with each set of themes being re-interpreted as the process continues.[61]

The thematic network is graphically represented in Figure 8.2 on page 310. This graphical representation can be explained as follows.

8.4.1 'It's absolutely central to everything we do really': The Importance of ICT

Reassuringly for me, ICT was seen by all interviewees as very important to their work and the functioning of their organization, with some calling it 'very important' (REG01), 'critical' (REG02), 'fundamental to the day-to-day' (REG03), 'essential' (REG04), 'crucial' (REG12, NGO02). As one put it, 'I don't think we could do our job without it' (REG06). Of course, given the adaptability of human beings, it is likely that a regulator denied access to ICT would find ways of doing its work, but it has clearly become an essential element of the short-term functioning of these organizations and is seen as key to the long-term success of their missions.[62]

8.4.2 'The human side is difficult': Human Responses Remain Significant

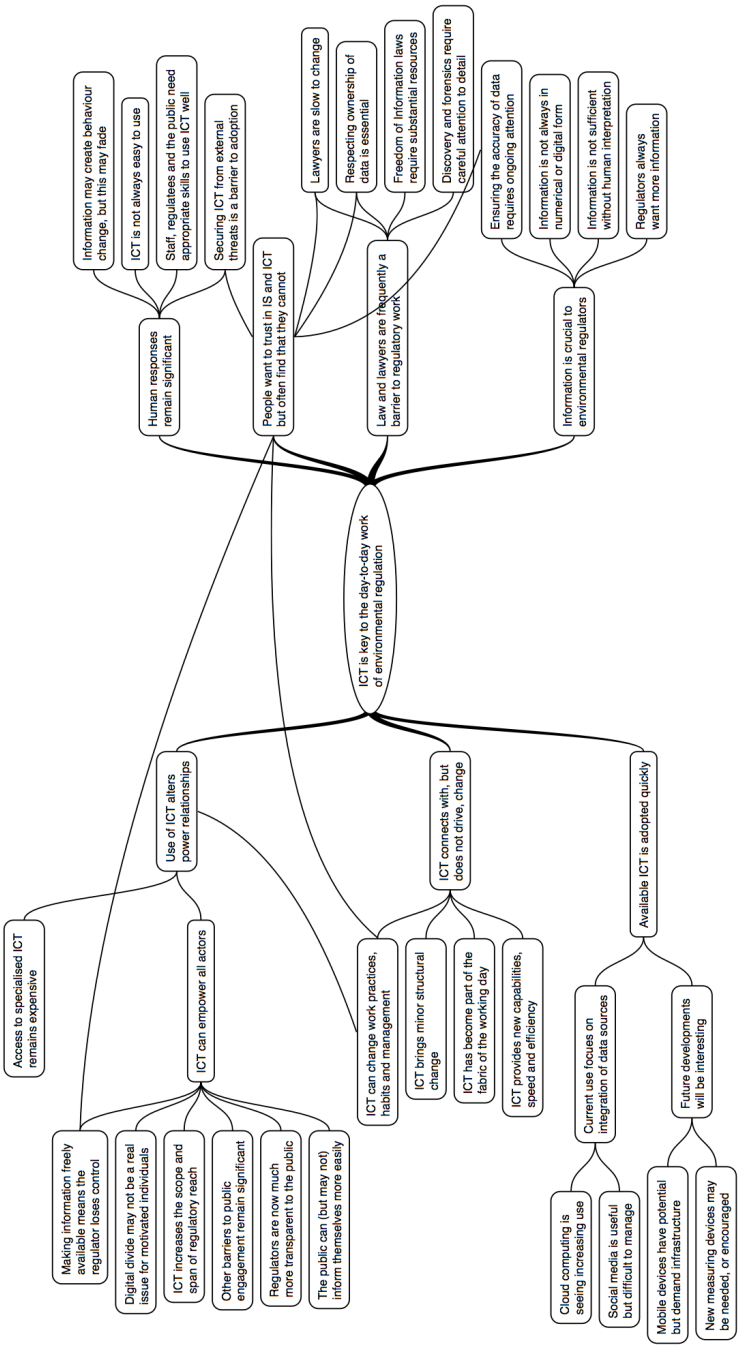
The regulator which makes heavy use of ICT does not become a machine. It is still staffed by and interacts with, ordinary human beings, who have varied agendas,

[60] Attride-Stirling (n 46) 387–8.

[61] ibid, 389.

[62] Compare Agar's claim that although computerization made a difference in some aspects of science, it is not necessarily as essential as it is often portrayed. Jon Agar, 'What Difference Did Computers Make?' (2006) 36(6) Social Studies of Science 869.

Figure 8.2: ICT in Environmental Regulation: Significant Themes



bounded rationality, and sometimes contradictory desires. Therefore, human factors emerged as significant in any study of the use of technology by regulators. Both internal and external audiences need to be persuaded that the new tools are useful and easy to use or they will not co-operate with them. Business people, farmers, and the general public were seen (sympathetically) as hating forms and overall take-up of particular systems can be quite low (REG04). Those seeking to achieve behaviour change in large organizations understood the key role of central management in making that change happen (REG10). One senior manager explained how public customers and internal staff resisted microchips in waste bins and a work scheduling database, largely out of concern about surveillance—a fear of 'Big Brother', although the interviewee did not completely understand the objection—'wherever Big Brother was heading I'm not really sure.' (REG11).

The technology itself is sometimes not easy to use. As one interviewee explained while discussing the efficiencies gained from a new expense accounting system,

> ... there was an awful lot of grouching about it because 'I wasn't expecting to have to do these certain sets of tasks' and not all systems are good. Some of them are not intuitive. (REG02)

Individuals may not have a technical or scientific training or orientation and one interviewee thought that this made a significant difference to the likelihood that ICT-based tools would be adopted (NGO01). One interviewee expressed a concern that ICT speeded the regulatory and policy-making process up too much, and there was a need to 'slow things down a bit in order to make sure that all factors can be taken into account' (REG08).

Finding talented people, ensuring they have appropriate skills, and the need to ensure that staff maintain and improve these, were also highlighted by some interviewees as significant issues. One interviewee mentioned how he had left one agency to come to his present employer because 'I didn't want to make manual

maps. I wanted to be where it was cutting edge stuff' (REG02) and the challenge which his agency faced: '... we are still dealing with an older workforce and trying to modernise and feeling the strain. We are going to feel that for another five to ten years' (REG02). At least one organization has responded to this issue by developing bespoke applications for mobile devices which are easier for their staff who are less IT skilled to use (REG12). The question of skills also arises when deciding how to communicate information to the public, who are not all equally skilled or scientifically aware. As one interviewee put it,

> ... we try to make data easy for the general public to understand, we have to recognise that the environment is complex and over-simplification of the environment can make things worse because very important issues may be hidden. (REG03).

There are also external challenges. As already highlighted by e-government researchers,[63] there are significant security concerns in the widespread adoption of ICT. Some regulators are unable to use the technology as widely as they would like because of security policies, and had devices in the field that were not connected directly to the agency network (REG03) or had to use personal devices in order to download data (REG10).

Interviewees were asked whether the provision of information can lead to greater environmental awareness, and thus to behaviour change. All felt that it could, with one saying that the effect could be 'startling' (NGO01) and most felt that this change in behaviour should last, although some felt this was a question outside their particular expertise (REG03). However, it is interesting to note that the one dissenting voice on this point was also the only person who had significant experience of running an informational regulation program:

> ... it can fade and that's why it's important and that's why we try to

[63] Peter Hernon, 'Trust in Government' in Peter Hernon, Rowena Cullen, and Harold C Relyea (eds), *Comparative Perspectives on E-Government: Serving Today and Building for Tomorrow* (Scarecrow Press 2006).

> do things like constant monthly reports, we put up posters around the building, constantly changing the report, the posters. (REG10).

8.4.3 'I would say that quality of the information is key': Information is Crucial to Environmental Regulators

Underlying the use of ICT for environmental regulation is the availability of data and information. All the interviewees were agreed that this was crucially important, without question or hesitation: 'It's essential. It's the evidence. All the relevant decisions, the forward planning, enforcement, and compliance needs. To have data available' (REG03).

Interviewees were asked whether or not they have had concerns regarding the accuracy, validity, or reliability of the information that they relied upon. This was an issue to which they had already directed their attention, and many regulators already had sophisticated schemes in place in order to verify and correct incoming information. These sometimes involved multiple levels of checking, and there was a general sense that the initial problems with data quality had been ironed out—although the question required ongoing monitoring, the most egregious issues had been solved. Nonetheless, NGOs were sceptical about the extent to which they could rely on government information ('consistent entry of data seems to be a weakness' (NGO01)) and talked about the need to approach data and portfolio gathering as one would peer-reviewed research (NGO02). This need for good scientific assessment was implicit in the persepctive of one regulator interviewee, who was quietly confident that the expertise of staff would ensure that bad information would be spotted before it caused harm (REG08).

Some interviewees highlighted how the availability of more data can help in spotting problems. Sometimes the lack of problems can itself be a signal that there is an issue to be investigated; this is seen as a local agency or unit not trying hard enough. Ensuring the accuracy of information requires an ongoing commitment

of substantial resources. However, paper-based systems were seen as significant sources of potential errors:

> I've worked in an exclusively paper environment and to gather information for returns and for information sharing is, it was impossible, you could never stand over it, because, you could never be sure that it was correct, accurate, up to date. (REG12)

Incompletely integrated ICT systems are not much better:

> Every year there is a sort of mad panic to get a report out on time. You're contacting all of the individual staff to get their spreadsheets and then feed into a central spreadsheet. And that manual process is a very tedious task. We start to get basic errors creeping into the data manipulation even though a lot has been done to correct those but the data is in the wrong column or something. (REG03)

All the individuals interviewed were clear that the use of information by itself was not sufficient, particular when the data was intended for public consumption: '... we've known that for quite a while that some information needs this context, there's interpretation, it needs some comment by a scientist for it to make sense by the broader public' (REG11). There needed to be a process of manipulation, interpretation, and decision-making by individuals overlaid on it. As one senior manager said, '[i]t's only data, it's interpreting the data and making the decisions based on the data is what actually gives you the management' (REG12). One discussed the need for greater statistical education of the public at large (REG03). It is of interest to note, however, that in some instances, the decision-making process itself is heavily supported by software, whether custom-built systems or spreadsheets used for, for example, risk analysis.

In addition, not all of the information that was needed was available in digital or numeric form. Individual interviewees mentioned various specific examples of data that was necessary for their work but was not easily amenable to computer processing: conversations with operators, photographs, odour complaints ('... for

example you can walk by a brewery and it can be quite strong but it's not objectionable. You can walk by a slaughterhouse and it can be the same strength and it can be incredibly objectionable.' (REG11)). One interviewee talked about how site inspections to measure macro-vertebrates can be a very simple and effective way of measuring water quality (REG11).

All interviewees were very clear that they could never have enough information—'More is better definitely.' (REG12). While there is academic commentary highlighting concerns regarding information overload,[64] those practicing in the field are hungry for more and more information. This does not mean that they are blind to the economic cost of continued gathering of information and one indicated that if they had sufficient information to satisfy a statutory obligation, they would be happy with that. However, there was a clear thirst for more data on the part of regulators, even without a clear reason to collect it—'the more information you have the better quality of decision you will make.' (REG12).

8.4.4 'There is something about the legal community, I found, that it is particularly challenging': Law and Lawyers Are Frequently a Barrier to Regulatory Work

The law, in the sense of legislation and regulatory frameworks, was generally perceived in a negative fashion by the interviewees.

There were significant concerns around what could generally be labelled as 'information governance',[65] such as what was labelled by one interviewee as 'the respectful use of data' and also questions around data protection and FOI legislation. A significant concern for agencies lower in the regulatory hierarchy is that information which they provide to those further up the ladder is not used as a stick

[64] Douadia Bougherara, Gilles Grolleau, and Naoufel Mzoughi, 'Is More Information Always Better? An Analysis Applied to Information-Based Policies for Environmental Protection' (2007) 10(3) International Journal of Sustainable Development 197.

[65] This term is used here to mean the processes that govern the legitimate uses of information by agencies, and is distinct from 'informational governance', which is discussed in Section 6.3.

to beat them with (REG06, REG08). This was not a surprise, but the extent to which participants in the regulatory system were taking it seriously and working out mechanisms to resolve it was unexpected. These ranged from agreements on how and when information could be used or changed to data and error-checking mechanisms:

> Who owns that data? Is it [this agency]? You have got latitude and longtitude that comes here and the [other agency] says it is here and when you plot it, it is not where they said it is. There is a data quality issue there and, you know, someone complains to their [public representative] that they have located my house next to a toxic waste site and I want to change that data but we can't change it because the [other agency] owns it. (REG02).

> The implementation of [one particular system] was a difficult thing to do because once we rolled it out and [other agencies] tried to upload their data they just kept, kept getting pushed back to them because it wouldn't pass validation and they didn't like the system. (REG11)

From the NGO perspective, a significant concern was ensuring that there was no connection between the provider and the data, as complainants were often keen to preserve their anonymity and metadata embedded in electronic files could disclose their identity, requiring the use of tools to strip these from documents which were to be submitted to officials or circulated via the Internet (NGO02). On a more positive note, one interviewee expressed a hope and expectation that when cross-agency data integration was put in place, inter-agency collaboration (which is often required either because of legislation or skills needs) would be much easier (REG12).

Those who were charged with responding to FOI requests took them very seriously, stressing the importance of systems that ensured that information was available when requested by the public and that answers were consistent over time (REG02). The scale of the challenge, and the extent to which ICT can assist in confronting it, were striking: one instance mentioned involved 1.5 million docu-

ments, which were sifted electronically to eliminate duplicates, which reduced the number to 250,000, of which 42,000 were released after redaction, a mammoth task which was seen as impossible within the timescale achieved without the assistance of technology. The move to making more information freely and openly available via the Web was seen as a significant boon here: 'Now, when people just go online, or if they just use a Freedom of Information Act request, we can just say, oh well, go to the website, you can look it up, it's all there' (REG07).

The particular requirements of the process of litigation, such as discovery and the chain of evidence, created significant practical problems for staff managing information technology. Discovery raised issues very similar to FOI—large volumes of documents to be gathered and filtered in a short space of time—and similar tools were applied (REG02). There were some doubts raised about the admissability of electronic records (particularly from remote sensing devices) in court (REG03), which was connected to the concerns about security and unauthorized access to devices. Others felt that legal challenge to these types of evidence were likely to emerge in the future, as they were only now beginning to be used (REG11).

Finally there was a perception that lawyers were sometimes slow to change:

> ... [T]here is something about the legal community I found, that it is particularly challenging. Maybe it is just a matter of trusting a computer versus a physical signature or something. It is a little bit of a black box, you get your answers. Are you sure you got the answers you asked for? It's a reluctant but happy customer at the end of the day. (REG02)

8.4.5 'We're, you know, just kind of scratching the surface': Available ICT are Adopted Quickly

Finally, there was some discussion around the tools that are used. ICT had always been a factor in the working lives of the individuals interviewed and many of the organizations concerned were new enough to have always made use of the technology. One remembered being one of the first in his organization to have a so-called

'portable' computer (which weighed 25 kilos) and having the good fortune to be shown how to get the most from it by a skilled colleague, with 'stunning' results: 'within 3 months we had converted a 6-month job into roughly a day and a half' (REG08).

The current use of ICT-based tools largely mirrored the discussion in Section 5.4, with databases, GIS, environmental information systems, satellite observation, remote sensing, online portals, and online consultation (which is increasingly being customized for the individual citizen) all being mentioned. NGOs are sometimes restricted by their budgets (NGO02). Integration was a key focus, with one interviewee in particular (REG11), speaking at length about a variety of projects which connected information from diverse sources and re-packaged it to make available in new ways, either for internal use (such as cross-cutting databases for different units) or to provide environmental information to the public on issues such as water quality.

There was some discussion about the emerging tools which are currently being deployed, such as mobile devices, social media and cloud computing.[66] Many, even small NGOs (NGO01 and NGO02), were making use of cloud computing and it was seen as a very useful way to integrate data from diverse agencies, to create interoperability between them (REG05) and to save money (REG02). The future is clearly going to be 'interesting' (REG04), with some talking about 'massive potential' (NGO01) from (for example) new remote water quality sensors, or 'real time or near real-time reporting' allowing for much more adaptive policy implementation or alteration (REG08) and others talking about more incremental improvements in the ways in which they use online consultation and ideas borrowed from social media to build more interactive means of outreach to the public (REG02).

[66]For speculation on these topics, see Christopher Theunissen, 'Contextual Issues Surrounding Portable and Interactive Technologies Within the Contemporary and Future Environment of E-Government and Informatisation' in JEJ Prins (ed), *Designing e-Government* (2nd edn, Kluwer 2007).

Mobile devices have interesting applications, not just for environmental regulation but also for health and safety (REG07). One talked about the idea of 'mobile first' (REG02) but another felt that even if more sophisticated smartphone-based sensors were available, the organization would not be able to use the resulting information in a meaningful way (REG07). Only two interviewees (REG03, REG10) felt that the tools they have are adequate; one other (REG05) was pushing the private sector to develop better tools.

Social media was viewed as useful but complex. Although only one interviewee, a senior manager, went into it at length (REG09), it was clear that the organization was making extensive use of these new communication channels but needed to be careful to develop clear policies, especially for more junior staff, learn from best practice, and manage the exposure which social media create:

> Our critics can really get to us very quickly. Like it or not, that's a great thing, but they can also use the tools to kind of go with their campaign and share with them what they like and they don't like about what the agency is doing. (REG09)

From the NGO perspective, it was seen as 'quite revolutionary', but challenging to use well, as the public preferred stories with imagery and a positive message which are often not what a campaigning organization wants to focus attention on (NGO02).

8.4.6 'It's not a driving factor I would say': ICT Connects With, But Does Not Drive, Change

ICT is deeply implicated in processes of change throughout regulatory entities. The picture of change that emerges from the interviews is not one of immediate, drastic, or radical change, with ICT as an 'evolutionary supporting notion' (REG08) and some interviewees were careful not to be deterministic in their thinking ('I'm a little wary of suggesting that we couldn't have done some things without it. We couldn't

have done some things as well without it.' (NGO01)) although the same interviewee also expressed the view that the success of an electronic newsletter in getting issues on the agenda of regulators could not be achieved by a paper-based circulation. Several interviewees discussed the increased capability to integrate data from diverse sources, share data across organizations, or open their internal databases to the public.

When interviewees were asked whether ICT had brought about structural change, the vast majority said that it had not brought any significant changes, something which is itself interesting given how essential they felt it was to their work. It is surprising that something so central to the day's work has not brought with it restructuring; this needs to be further investigated. In two instances, the widespread use of ICT predated the existence of the organization ('we were established instantly as an Internet organization' (NGO01)) and therefore ICT was always taken into account in structural decisions. Other interviewees in one particular organization pointed to the creation of a Chief Information Officer and related units, although others within that agency said that ICT had made no difference structurally. Another interviewee mentioned the use of ICT to push administrative work out from central pools to staff working nearer the edges of an organization ('admin-type tasks have become more sort of "do it yourself" systems' (REG04)). Perhaps the most significant change structurally, although one that will not show up on organizational charts or in reporting relationships is an increased porousness in the boundaries between units:

> ... it has lessened the boundaries if that makes any sense. For example, in the old system, I wrote a licence for a company and that's what I did. I wrote the licence and there it was. And then when I was finished writing my licence, I handed it over to you, you were in the [enforcement unit]. I wrote you a memo saying, this is the licence, here are the main things that you should look at, here is a map of the site, there you go, good luck.
>
> I mean now, in the actual writing of that licence, all the data's gath-

> ered and it's in the system ... the [enforcement unit] have a risk-based system that we were using for evaluating enforcement that now the licensing inspectors have access and they can have our working much more closely on the conditions that go into the licence but in addition to that, when the licence is complete the important paper process and when it is complete, all the information that they need is already in their system so there isn't any more handovers as we used to call as not only did we handover to enforcement but we also handed over to the monitoring part of the house so that handover is no longer happens ... the core business of the licensing office is licensing, the core business of enforcement is enforcement and the core business of monitoring is monitoring but those boundary parts have been ...
>
> *Q: More porous?*
>
> Yes. More streamlined ... (REG11)

The use of ICT itself had changed over time, becoming more embedded, more all-encompassing and clearly quite fundamental to the day-to-day operation of all of the organizations considered. For all of the interviewees, ICT had been part of the organization's tools as far as they could remember, but the extent of its use, its sophistication and its integration into their daily work had changed. One mentioned a mainframe computer which was about to be decommissioned and spoke of how data used to come in paper form and have to be manually entered by agency staff (REG07). Another talked about his first encounters with email in the late 1980s and with the World Wide Web in the early 1990s (REG06). A third mentioned how his agency had begun to post static maps showing their activity on the Web in 1983 (REG02) (although this was much more likely to be 1993). Now, all government interviewees who discussed their online presence were clearly relying heavily on dynamic, interactive, GIS-based systems to expose large volumes of data to the public, one talked at length about the use of ICT to manage public consultation and litigation processes (REG02), and a third discussed how all staff in his organization had received basic training in computer skills and developed their own databases and spreadsheets (REG12). The centrality of the computer to their working life was clear from the offices that I visited, where most had a computer to the side

of their desk, and some interviewees were very comfortable with interviews being conducted via voice-over-IP software such as Skype. As one interviewee said, 'most people now expect that email and the Internet is how their job is done.' (REG03).

ICT is a significant element in what occurs in the workplace and in the interaction of the regulators with their external environment. One interviewee, a senior manager, spoke at length about the conflict that followed the introduction of a new information system which gave him much more understanding of what work was being done in the field and his efforts to ensure productivity and accountability from his staff (REG12). Some interviewees pointed to ICT facilitating speedy completion of tasks, particularly more tedious work, in instances where ICT improved (but did not fundamentally change) the work carried out. In some instances, the regulator had engaged in a process of 'business process re-engineering', to make the most of the new capabilities which the technology brought (REG11). This gave the regulators new efficiencies and new capabilities. The process of generating and agreeing new policies, particularly, seemed to have been speeded up by the use of electronic communication between face-to-face meetings (REG08). Sometimes this was an explicit choice on the part of the regulator, in which they had undertaken a focused project to re-examine how their internal systems operated. However others, particularly the NGOs, seemed to be more opportunistic: limited by available skills and resources, greater efficiency and effectiveness emerged from the initiative of interested individuals rather than a top-down, management-driven project. Nonetheless, the ability to use online mapping to investigate complaints were significant time and money savers (NGO02). One talked about the diminishing returns that would set in:

> ... it doesn't really matter how much technology you put into some things, the underlying process of going out and inspecting something and identifying non-compliance won't really change ... so we need to temper our expectations in terms of business change ... (REG11)

It was clear that change has not halted: one senior interviewee thought that there were still 'enormous efficiency gains' to be made from data sharing (REG05).

8.4.7 'Having access to information gives me an awful lot more power': Use of ICT Alters Power Relationships

As the interviews progressed, a very significant issue which had not been sufficiently considered in the initial literature review or design of the empirical research was the impact of ICT on power relationships. Although the question was implicit in some of the questions asked, it came to the foreground in discussions, particularly in one interview where the interviewee recounted several tales of conflict within and without the organization (REG12).

Much has been said and written about the capacity of ICT to empower the individual, provide transparency into the organization, thereby creating a more open government and greater public engagement. Many of the interviewees felt positively about these issues. One NGO interviewee highlighted how email newsletters and graphically presented information enabled campaign information to be disseminated is a wide-ranging yet effective fashion (NGO01). Government employees focused on openness, transparency, and effectiveness as advantages brought by the technology. These group of interviewees were strongly of the view that ICT helped not only to inform the public but to better involve them, something which some organizations had taken steps to measure. However, regulatory staff seemed generally aware that this process was not deterministic, using phrases like 'I think it can do' (REG05), and one explaining at length that the technology was a potential not an inevitability:

> ... it's not necessarily the technology that makes a more engaged citizen, it's the use of the technology resulting in a result, you know producing a result, that's what, it's always about delivery, it's always about the service delivered at the end of the day. The technology is only a tool, but they're powerful tools. (REG12)

However, interviewees were somewhat more cautious in the long term and broader claims that they were willing to make this regard. The public were likely to become more informed, but not necessarily more engaged. One NGO interviewee highlighted how access to water quality information did not necessarily lead to more empowerment: 'What then, you know? Hopefully this will create a pressure on the authorities to do something about it but it's difficult' (NGO01). Regulatory staff were aware that information was not to be taken at face value: 'in associating [pollution release] data with water data you might be able to draw some pretty compelling statements [but] they may be completely wrong because of the way you've used the data' (REG06). A senior manager was aware that their organization was competing for public attention and concern with more immediate and pressing issues, such as the financial system, recession, and unemployment (REG05) and another asked a pertinent (but perhaps unanswerable) question: '... does that mean people are getting more and more information or are they just getting more selective about the information that they are getting?' (REG11).

A more senior interviewee was deeply concerned regarding the need for internal policies on the use of social media by agency staff and loss of control over their information once it was in the public domain:

> I think every time you release something you recognise that it can be used in lots of different ways and it will have both an effect that you will be very glad about, and an effect that you probably aren't so glad about. (REG09)

Three other issues which were highlighted in interviews but only later were clearly connected to power were questions of efficiency, trust, and disempowerment. One of the main drivers for the widespread adoption of ICT is efficiency which has obvious applications for the better use of resources by regulators, thus increasing the overall power and capacity to regulate—'ICT can be incredibly labour-saving, and it can help efficiency and effectiveness. It saves a lot of time doing routine

stuff.' (REG04). All interviewees were clear that ICT expanded the scope and span of the regulatory activities that they could engage in, and expected that this would increase with time :

> ... there's a lot more scope for us to apply a lot more ICT to, to make us work much better, much more efficiently than we can look across to, we can find lots and lots of application for technology. (REG11)

However, some highlighted issues with this, such as the difficulties in reaching less technically-oriented members of the regulated community, such as farmers (REG01).

Concerns regarding the disempowering impact of ICT were raised from time to time: questions of cost, issues of human resources and skills, and the need to ensure that the information was actually usable by the ordinary citizen. Nonetheless, one NGO interviewee did not see disempowerment is a significant issue (NGO01) and one interviewee highlighted how other barriers could prevent individuals from participating in the regulatory process (REG12).

8.4.8 'Trust is a Fundamental Thing': People Want to Trust in IS and ICT But Often Find They Cannot

Related to these questions of power, but also connected to the earlier discussion of 'information governance', is the role of trust, which emerged as important enough to become a theme in its own right. Trust in the information provided, in the way in which it was to be used and the intentions of other actors in the regulatory process was a key concern for many interviewees, with the sharing of data between regulated entities and the regulator seen as key in enabling real light-touch regulation (REG04). These negotiations about 'boundary objects'[67] are ongoing. Trust

[67] Susan Leigh Star and James R Griesemer, 'Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39' (1989) 19(3) Social Studies of Science 387, 393.

between agencies[68] and between the citizen and the State[69] have already been identified as significant by earlier researchers in e-government. Trust can be seen as fundamental to the legitimacy of the regulator, and therefore to the power which it can effectively exercise.[70] Some external individuals preferred to get access to 'raw' data and work with it themselves:

> ... a lot of people particularly those that are thinking about these problems more deeply, they don't necessarily want you to filter the data for them and for you to draw the conclusions. There is always a little bit of a mistrust element here. So, can you give me the data and I will mash it together and make it how I want so I can draw my own conclusions? (REG02)

However, internally, it seemed that there was significant reliance on information systems, on the data that they contained and on the ways in which they presented information:

> ... when you begin to boil things down to, you know, we have a risk score, and a risk score for a plant might be 400, this is what inspectors begin to interact with. They see your plant and it's a 400, and, and they take that as read and it comes back to the fact that it puts greater onus on the fact that all the contributing data systems that you've used and underlying data that you use, have to be correct because we've now taken an action based on that. (REG11)

These internal IS can also damage trust, as managers now have much more capacity to see through the organization, rendering previously opaque levels of administration transparent and thus viewing and manipulating the activities of staff at the coalface, who are not used to being surveilled by senior management, something which can lead to conflict (REG12).

---

[68] Theresa A Pardo, J Ramon Gil-Garcia, and G Brian Burke, 'Building Response Capacity Through Cross-Boundary Information Sharing: The Critical Role of Trust' in Paul Cunningham and Miriam Cunningham (eds), *Exploiting the Knowledge Economy: Issues, Applications, Case Studies* (IOS Press, Amsterdam 2006).

[69] Hernon (n 63); Jon Agar, *The Government Machine* (MIT Press 2003) 346.

[70] Rebecca M Bratspies, 'Regulatory Trust' (2009) 51 Arizona Law Review 575.

8.5 Viewing ICT in Environmental Regulation Through ANT

The third, and most complex, diagram is a visualization of the interview data through the lens of Actor-Network Theory (ANT). As has already been explained,[71] ANT is more of a sensitising device than a rigid theory or formalised method, but it provides a useful focus on questions of conflict. ANT requires an identification of controversies:

> It begins with an identification of actants (those which act and are acted upon). Then one follows the actants through a trajectory—a series of programs and anti-programs—until they become actors, acquiring a distinct and relatively stable character. Which actants have the opportunity to become actors? Those with programs that succeeded in combating anti-programs; or, alternatively, those with anti-programs that won, as in the stories of opposition and resistance. This success, suggests Latour, is due to association: the formation and stabilization of networks of actants, who can then present themselves as actor-networks.[72]

Reviewing the interview transcripts for instances of tension, disagreement, and negotiation of solutions allowed the identification of instances where seemingly carefully ordered and rational technology is both caught up in and creates the messy day-to-day reality of human interaction. These were initially captured in a table of examples. However, this made for somewhat disengaging reading. The interviews had not followed the common ANT template of exploring a particular story, which prevented the use of the more appealing framing device of a narrative exposition. One of the aims which I had for this research was to produce an overall understanding of the use of ICT for ER. The challenge that was presented by the choice of ANT as a sociological lens is that this method is generally used to analyse the story of how a particular controversy or incident developed, whereas my research had attempted to capture a general snapshot at a particular point in time, asking a

[71] See Section 7.4.3.

[72] Barbara Czarniawska and Tor Hernes, 'Constructing Macro Actors According to ANT' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 9.

wide-ranging and open set of questions in order to explore how ICT is currently being used in practice. Although it has ambitions to provide a universally-applicable theory of social, scientific, and technological change, transposing its methods from context to context is not straightforward.[73]

There was therefore a need for another means to present the issues identified in an integrated manner. Some of the early ANT literature uses Hobbes' metaphor of the Leviathan as a way to explain an actor-network.[74] Although Callon and Latour stress that a single metaphor will not suffice in order to capture the complexity of the meta-phenomena that they seek to study, describe, and explain, saying that these networks are 'at the same time machine, market, code, body, and war',[75] the notion of thinking of a heterogenous collection of technology, people, and procedures as functioning like a human body has been further developed in graphical form by Porsander by locating, for example, idea generation in the head, core activities in the torso, and foundational functions in the legs and feet.[76] This approach both helped in thinking about the use of ICT in ER and provided a useful means to present the findings and explain how the various elements of a regulator that relies heavily on ICT work together and the challenges that they face.

In addition, as the transcripts were re-examined using ANT as 'an analytical heuristic or sensitizing concept ... to make sense of complex observation',[77] it became clear that there was in fact a meta-narrative present: the shift from paper processing to the digital management of data by regulators. The stages of the ANT process could be seen throughout different instances. Each particular regu-

[73] Andrea Whittle and André Spicer, 'Is Actor Network Theory Critique?' (2008) 29(4) Organization Studies 611, 618.

[74] Michel Callon and Bruno Latour, 'Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So' in Karin Knorr-Cetina and Aaron Victor Cicourel (eds), *Advances in Social Theory and Methodology: Toward an Integration of Micro and Macro-Sociologies* (1981).

[75] ibid 294.

[76] Lena Porsander, '"My Name is Lifebuoy": An Actor-Network Emerging from an Action-Net' in Barbara Czarniawska and Tor Hernes (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005) 29–30.

[77] Whittle and Spicer (n 73) 619.

lator or individual had faced the processes of problematization, interessement, and enrolment/mobilization—in other words, framing an issue, coalition-building and joint action.[78] What was of most interest was that the interviewees rarely outlined an equilibrium position, where the conflicts and challenges had settled down to a mutually and widely understood shared perspective. This may simply be an artefact of the way in which the interviews were conducted, bearing in mind that the focus was not on specific stories, but may also be a consequence of the fact that this particular area of endeavour is one that is now in constant ferment, as is often the case in 'information infrastructures',[79] and that the consequences of ICT for ER are not completely worked through.

8.6 Visualising the Use of ICT for ER

As the initial ANT analysis did not yield sufficiently deep findings, I conducted further exploration of the data. The interview transcripts were re-analysed in order to identify whether any configurations of actants which could be labelled an actor-network could be detected. While the interviewees rarely spoke in terms of the use of ICT for ER as a complete system, a particular conceptual framework did emerge. The resulting representation is seen primarily from the perspective of the regulator, although doubtless those who are regulated may have a similar perception.

I must highlight that 'any attempt to fully model information in environmental protection is necessarily incomplete'.[80] In addition, the exposition that follows is my own interpretation of what was said, not the views of any particular individual or group. I am deliberately placing myself in the identification of the network in order to overcome one difficulty with ANT, that it 'views the researcher as agnostic

[78] See Section 7.4.3 for a more detailed explanation of this terminology.

[79] Antonio Cordella, 'Information Infrastructure: An Actor-Network Perspective' (2010) 2(1) International Journal of Actor-Network Theory and Technological Innovation 27.

[80] Douglas A Kysar and James Salzman, 'Foreword: Making Sense of Information for Environmental Protection' (2008) 86 Texas Law Review 1347, 1361.

(or detached)'.[81] In so doing, I rely heavily on the idea of a 'network of power', an ANT concept which Constantinides and Barrett explain as

> ... the close interdependencies between communities, large technical systems, body politics, and new technological developments and how these mobilize (spread and extend) each other's strength and durability ... These ... are open ended and not designed like systems. Rather, these networks are loosely organized and often imperfectly integrated in that each of the involved elements may be part of other networks at the same time.[82]

What follows is an attempt to bring together the diverse strands of application domains, problems, and constraints which I observed through the interviews, conference presentations, and other research during the lifetime of this project into a single model. There are layers of contradiction in a critical realist researcher putting forward a personal explanation as a way of dealing with a shortcoming in a social constructionist method, and I must therefore highlight the limits of this diagram. Its philosophical basis will not withstand close scrutiny and the metaphors it uses will break down if they are over-extended. However, it serves a limited purpose as a tool of exposition in order to move discussion forward and as a starting point for later studies to expand, support, or refute.

It should also be understood that each of the elements described in the following should be seen as a 'black box' (to use the ANT terminology), and could therefore be further opened, examined, and deconstructed. In addition, this explanatory conceit should not be taken as meaning that the application of ICT for ER has become a 'Leviathan'[83] which is either all-powerful or fixed for all time.

Following Porsander's example,[84] the resulting actor-network will be de-

[81] Kathrin M Cresswell, Allison Worth, and Aziz Sheikh, 'Actor-Network Theory and Its Role in Understanding the Implementation of Information Technology Developments in Healthcare' (2010) 10:67 BMC Medical Informatics and Decision Making, 8.

[82] Panos Constantinides and Michael Barrett, 'Large-Scale ICT Innovation, Power, and Organizational Change: The Case of a Regional Health Information Network' (2006) 42(1) Journal of Applied Behavioral Science 76, 81.

[83] Callon and Latour (n 74).

[84] Porsander (n 76).

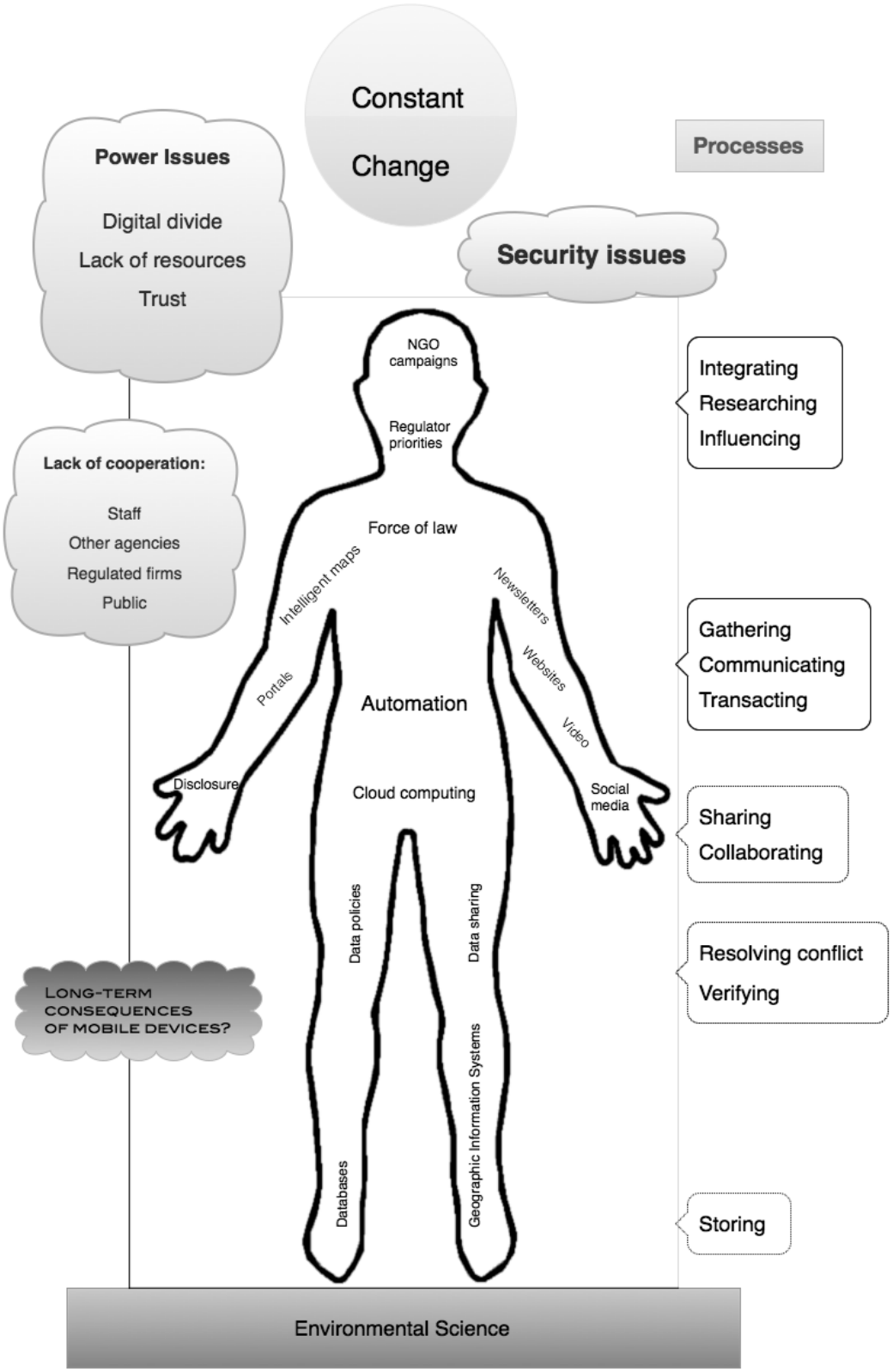
scribed in terms of the human body. This metaphor is chosen for ease of exposition and comprehension, not because any of the individuals interviewed used this particular organising principle as a way of explaining how they saw the use of ICT. Nonetheless, the visualization seems useful as it highlights how the regulatory system seeks to progress, to learn, to digest, to consider and decide, to influence, act, and control. The diagram shows one conception of how these processes fit together—the essential elements of the successful use of ICT for environmental regulation as seen by the interviewees. The tools that I mention are simply examples of these processes being enacted through particular technologies. The result is graphically represented in Figure 8.3 on page 332.[85]

The use of ICT for ER is grounded in environmental science[86] and stands on two 'feet': databases and Geographic Information Systems (GIS). Without these, very little of the remainder of the system would function, if at all. The 'legs' are the practice of data *sharing*, and related policies. Without these, the system is not able to make very much forward progress, as a truly comprehensive system of environmental regulation depends on a wide range of data which is not within the control of any single organization; and it seems from my interviews that many organizations are suspicious of other agencies and unwilling to share information without some guarantee that they can maintain control. These represent processes of *storing*, which may be for FOI purposes (REG01), returns from regulated entities (REG04), monitoring information (REG05), electronic discovery (REG05), or in GIS databases (REG11); *verifying*, which is a significant concern for all regulators ('everything that comes in does get validated' (REG03)); and *conflict resolution*, which is not mentioned as often but has clearly been highly significant in ensuring that data can continue to flow. As one senior manager put it,

[85]The body outline image is by Random user 39849958, is free of copyright restrictions, and was obtained from http://en.wikipedia.org/wiki/File:Outline-body.png.

[86]My thanks to Professor Muki Haklay for providing this insight.

Figure 8.3: ICT in Environmental Regulation: A Network of Power



> ... we have to be delicate in showing that we're not standing on their shoulders telling them what to do in a policeman-like way but rather standing alongside them seeking out best practices, best, more synergies, more cost efficiency, such that everyone benefits frankly. (REG08)

The torso of the body has three elements to it: the force of law, the power of automation and the generative power of cloud computing for *sharing* and *collaborating*. The force of law is what gives the system its strength, both by compelling external entities to reveal information and by ensuring that there are sanctions for non-compliance. However, it is interesting to note that interviewees did not directly discuss forcing individuals to comply. Issues around compliance and enforcement came up, and litigation was also mentioned from time to time, but there seemed little focus on the 'big stick' as a primary tool for regulation. Persuasion and information campaigns seemed to be the primary resort. Automation is what enables the system to process large amounts of data at a rapid and ongoing pace in such a way as to generate new insights, new causes for concern, and to give new impetus to regulatory campaigns. Cloud computing is a means for diverse systems to interact, enabling organizations to share data in a cheap and simple fashion. This involves processes of sharing, which can be active (with other agencies, mentioned by four interviewees) or passive (information posted on a website for people to peruse at their own initiative, mentioned by 10 interviewees); and collaborating with other agencies, which was only mentioned by two interviewees but may occur more often than this indicates.

The regulatory system has two arms: one strong and one weak. These involve processes of data *gathering*, and *communicating* information to the public, *transacting* with regulated entities or the public (for example, licensing applications or pollution complaints). Much of what is involved in these activities has been described in the discussion above and therefore this will not be repeated, but it is important to note that integration is a significant concern for the vast majority of interviewees, and is perhaps the key benefit which ICT brings to the daily work

of a regulatory agency. The strong arm is not the law, but the power to influence, an idea with clear resonances with concepts of governmentality.[87] It has 'intelligent maps' and online portals as its muscles and disclosure-based regulation as its hand. It is able to use the portals in order to collect and disseminate information, and implicitly control the entities that it regulates, while it uses the intelligent maps to bring together the data collected through the portals, through remote observation, and from other agencies in ways that give it significantly enhanced reach and power. The weaker arm is social media, including social networks, websites, emails newsletters, and online multimedia (such as video). All organizations are engaging in these, and they do achieve results, but not on the same scale as the integration between portals and GIS, and some interviewees expressed concern about the level (or lack) of control that they have over information which is disseminated through these means.

The 'head' of the body contains two elements: the regulator's own priorities, and external campaigns. This is where choices are made as to how the resources in the rest of the network are constructed and deployed, through processes of *integrating* information from diverse sources, *researching* environmental topics (which is a key activity for NGOs), and *seeking to influence* the behaviour of others. The regulator has its own values and sense of mission, often significantly informed by the legislative and institutional framework within which it operates (including the legal culture). NGOs can either seek to influence this implicitly and slowly, for example through social media, or explicitly and directly, for example through a legal challenge and judicial review. The processes that should occur here is *considering* and *deciding*, but it is interesting to note that interviewees rarely discussed the decision-making process directly. There were some allusions to the need to make decisions based on information (REG12 particularly highlighted this point several times) but little explicit discussion of how this is done. This may result from the in-

[87] See Section 7.3.

terview focus being on the technology rather than the decision-making process, but other human-focused issues (such as trust and conflict) were raised, often without prompting, and this leaves a puzzle to be explored in further research.

As this 'body' operates in its environment, it faces a number of significant external challenges, represented here as potential storm clouds. Staff may not co-operate, either deliberately or unconsciously, in that they may resist the deployment of new technology, but they may not have the skills to make the best use of it. Other agencies may not cooperate, whether they be regulatory or other elements within the civil and public service. Each agency has its own priorities, cultures, and resource challenges. The agency may also face security challenges, which may be real or imagined. Regardless, the need to ensure that competing devices are secure can often be a significant impediment to the application of new technology. The public may not cooperate with new initiatives, again either deliberately or unconsciously, because they fear the implications of new technology (such as the potential for surveillance) or simply because environmental protection is not sufficiently important for them to pay attention to what is being circulated via social media. Regulated entities may also not engage in the process, even if they are forced to do so through online portals. They may feel it is not in their best interests, they simply do not see the environment as sufficiently important, they are unaware of the regulatory burdens placed on them, or they do not have the required skills to engage properly with new technology.

All of this takes place within the context of constant change (one hopes improvement) of technology with new capabilities and challenges being rolled out on an ongoing basis. Some regulators deliberately engage with this process, spurring the commercial sector to develop new tools to meet their needs, and many regulators seemed to be at the cutting edge in terms of the deployment of technology, sometimes ahead of their peers in the private sector. The new possibilities of the widespread availability of mobile devices are unclear as regulators are still integrat-

ing these into their workflows.

Other than some discussion of the digital divide, issues relating to the rule of law and natural justice were not explicitly raised by interviewees. The next, and final, chapter considers how we should respond to this absence.

Part IV

Conclusions and Implications

Chapter 9

Protecting the Rule of Law in E-Regulation

9.1 Introduction

This chapter concludes the thesis, bringing together the diverse issues that have been discussed—the various aspects of the rule of law as an issue in an increasingly digitized regulatory process, and the lack of attention which this receives from practitioners—and suggests possible solutions and avenues for future research. The chapter begins with a brief summary of the principal concerns of the thesis. It attempts to answer the principal research question. It then builds on this conclusion to put forward practical suggestions which could overcome the challenges of respecting the rule of law in the development of information and communications technology (ICT) systems for environmental regulation (ER), such as the application of design criteria that respect human rights; opening government software and databases to the greatest extent possible; increasing the 'digital literacy' of lawyers, regulators, and policy-makers so that they understand the issues raised; and greater decentralization and reflexivity in the development of ICT. It also proposes future avenues of research.

9.2 The Rule of Law and E-Regulation

The research question which this thesis seeks to answer is:

Does the increased use of ICT in environmental regulation redistribute

power (whether express or implicit) within that system, and does this raise rule of law issues?

From the research conducted, which comprised a review of literature from the disciplines of law, information systems, and science and technology studies and the empirical fieldwork, my conclusion is that it does.

I have identified a significant issue which is not being adequately addressed by academic commentators or policy-makers: the absence of consideration of the rule of law in the increasing development of ICT in government and regulation. Through an example of Indian land registry reform, I have highlighted how new systems that seem well-intentioned or benign may in fact reinforce existing disparities of power or hide an agenda of disempowerment. I have directed attention to the new development of so-called 'ambient law' (a world of interconnected devices and sensors that monitor, measure, and control individual behaviour in accordance with regulatory rules) and argued that this raises difficulties for the notion of the rule of law, particularly as scholarship focuses far too much on the public forum of the courtroom. I argue that it should look instead at the hidden, mundane routine of regulatory schemes and processes as a more significant factor in the daily life of the ordinary citizen. I have summarised the academic literature on information infrastructures, e-government, and e-governance and proposed a new area of study, *e-regulation*, which merits careful attention in the context of an increasingly 'informated' bureaucracy. I have provided brief summaries of regulatory theory and the development of ICT, both generally and in ER.

A significant point of connection between the last two narratives is the ideology of modernization, with its tools of quantification, rational decision-making, and central control, coming together in movements such as New Public Management and Digital Era Governance. Closely related to the importance of these developments is the growth of the ability of science and information to facilitate regulatory initiatives and to be put to use as tools for corporate and individual behaviour change, ideas

with considerable force but significant issues in practice. The (perhaps unbridgeable) gap between scientific models and full understanding of the natural world, together with the local, contingent, and unpredictable nature of human responses to external intervention raise questions about the ultimate realisability of the project of modernization. It seems impossible to measure precisely all of the factors relevant to a policy initiative, and what works well in one location, industry, or culture may be dysfunctional in another.

I have therefore provided a more holistic understanding of the application of ICT in the practice of environmental regulation with particular reference to the rule of law. Connected to this, and using the methods of Information Ecology and Actor-Network Theory, I have presented an analysis of 14 interviews with staff in regulatory agencies and NGOs. The results highlight the importance of questions of power, trust, and change.

From this conclusion, three significant issues emerge. First, digital computer systems—what I call, following Hanseth and Monteiro,[1] 'institutional information infrastructures' (IIIs)[2]—can become inescapable, inflexible systems of classification and codification, either directly producing outcomes or subtly orienting regulators towards particular decisions in ways that are often invisible, impenetrable, and impossible to query after the fact: 'according to the model ... ', 'the computer says ... ', 'the computer won't let me ... '. It is therefore vital to 'get it right first time', as far as possible.

Second, as ER becomes more holistic and relies increasingly on non-traditional methods (moving away from command-and-control), and ICT is a significant tool for the integration of information which this requires, there is a clear need to ensure that policy-makers are conscious of the hidden agendas that can be deliberately or unwittingly imported into a seemingly 'objective' software package.

[1] Ole Hanseth and Eric Monteiro, 'Understanding Information Infrastructure' (1998) ⟨http://heim.ifi.uio.no/oleha/Publications/bok.pdf⟩ accessed 27 August 2014.

[2] See Section 3.2.1.

Finally, the increasing reliance on scientific models as an essential element in ER underlines the need to ensure transparency in this regard. Ironically, the use of transparency-based schemes for ER—so-called 'informational regulation' or regulation by disclosure—may in fact obscure this transparency by making it unclear to the regulated community exactly what behaviour is disapproved of and what the desired outcomes are. Careful attention to design details is essential in order to avoid damage to the rule of law.

9.3 Configuring the Networked State

While it may be true that e-government and e-governance can bring 'a massive improvement in our quality of life and sustainability',[3] there are no guarantees. For example, Haklay highlights the gap between claims of democratization in neogeography (the use of geography by non-experts) and the reality that it 'has merely opened up the collection and use of this information to a larger section of the affluent, educated, and powerful part of society.'[4] Expansive statements about ICT should be examined critically,[5] watching for the hidden contingencies,[6] the commercial interests that may drive e-government agendas,[7] the suppression of alternatives by those with power,[8] and the prosaic reality that computers cannot transcend perennial po-

[3]Gianluca Misuraca, 'Futuring E-Government: Governance and Policy Implications for Designing an ICT-Enabled Knowledge Society' in Tomasz Janowski (ed), *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance (ICEGOV '09)* (Association for Computing Machinery 2009) 87.

[4]Mordechai Haklay, 'Neogeography and the Delusion of Democratisation' (2013) 45(1) Environment and Planning A 55, 66.

[5]Kees Boersma, Albert Meijer, and Pieter Wagenaar, 'Unraveling and Understanding the E-Government Hype' in Albert Meijer, Kees Boersma, and Pieter Wagenaar (eds), *ICTs, Citizens and Governance: After the Hype!* (IOS Press 2009).

[6]Michael R Curry, 'GIS and the Inevitability of Ethical Inconsistency' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 76.

[7]Howard Veregin, 'Computer Innovation and Adoption in Geography: A Critique of Conventional Technological Models' in John Pickles (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995) 105–6.

[8]Richard E Sclove, *Democracy and Technology* (Guildford Press 1995) 103.

litical problems but only support us in our efforts to rise to these challenges.[9]

Unfortunately, much of the discussion that surrounds ICT, and the consequences of its widespread adoption, is not based on a thoughtful understanding of its social construction, history, and the availability of alternatives but proceed instead in 'a general sense of acquiescence to innovation.'[10] However, we should not over-react and leap into the error of simplistic or negative thinking about these new developments. ICT can bring with it many positive outcomes, as the enthusiastic perspectives expressed by my interviewees underline.[11] Dystopian and utopian views of the information society are not mutually exclusive.[12]

Another binary mindset that must be discarded is the assumption that law is embodied in only one medium, that of text,[13] and that this is our only concern. The reality is that laws are embodied and expressed in 'scripts' inscribed into technological artefacts and these are increasingly managed by software—for example, geographical information systems, pollution release and transfer registries, and pollution trading systems. It is therefore necessary for lawyers to learn how software functions and information systems are designed.[14] Hildebrandt argues that

> ... if we do not embody legal norms in new technological devices and infrastructures, we may reach the end of law. At the same time ... if we do embody legal norms in technological devices we may still reach the end of the *rule of* law.[15]

As we build more complex systems of e-regulation, we must be conscious that

[9] Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (University Of Chicago Press 2010) 262.

[10] Kevin Robins and Frank Webster, *Times of the Technoculture: From the Information Society to the Virtual Life* (Routledge 2004) 74.

[11] See Section 8.4.1.

[12] Debra Howcroft and Brian Fitzgerald, 'From Utopia to Dystopia: The Twin Faces of the Internet' in Tor J Larsen, Linda Levine, and Janice I DeGross (eds), *Information Systems: Current Issues and Future Changes, Proceedings of IFIP WG8.2* (1998).

[13] Katja de Vries and Niels van Dijk, 'A Bump in the Road. Ruling Out Law From Technology' (2013) 25 Ius Gentium: Comparative Perspectives on Law and Justice 89.

[14] Mireille Hildebrandt, 'Prefatory Remarks on Human Law and Computer Law' in *Human Law and Computer Law: Comparative Perspectives* (Springer 2013) 5.

[15] Mireille Hildebrandt, 'Technology and the End of Law' in *Facing the Limits of the Law* (Springer 2009) 443 (emphasis in original).

there are at least two routes to the dystopia of technology which controls behaviour without regard to basic human rights and the rule of law. The first is the deployment of means of surveillance and control that have been developed without regard to legal rules (thereby rendering the law meaningless and powerless). The second is the unreflective adoption of ICT-based tools that embody an overly-simplistic implementation of regulatory regimes, without consideration of the deeper norms that underpin the legitimacy and survival of law as a means of social ordering, or perhaps as a deliberate attempt to evade these principles. Either are undesirable from the perspective of fundamental democratic values.

The power of law embodied only in the technology of text has severe limitations as a means to control the uses (and abuses) of information in an ICT-mediated environment, a conclusion with echoes of systems theory,[16] and therefore limits must be built into the tools; but as any system of laws can be both oppressive and protective, simply building law into the tools will not suffice as a safeguard. There must be specific and nuanced enquiries into the consequences of regulation through technology.[17] ICT is not simply supportive or destructive of the rule of law. There is a complex interrelationship between the two.[18]

Unpacking this relationship requires an awareness of three important considerations. First, there are 'constitutional objections and political resistance'[19] to the changes that are necessary in order to take the best advantage of the new capabilities afforded by ICT. Second, commercial interests place considerable pressure on government to invest in these new technologies.[20] Finally, what later transpire to be quite significant transformations of the 'common world' are often invisible at the

[16] See Section 4.3.3.

[17] Hildebrandt, 'Technology and the End of Law' (n 15) 461–4.

[18] Christine Bellamy and John A Taylor, *Governing in the Information Age* (Open University Press 1998) vi.

[19] ibid, 63.

[20] Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976) 63.

time.[21]

Teubner highlights the undesirability of 'the bureaucratization of the world'.[22] I would also emphasise the undesirability of an unthinking digitization of bureaucracy. Morison stresses how '[i]deas of separation of powers, rule of law and basic principles of legality do not seem to have troubled the information systems engineers.'[23] A system that automates decision-making undermines fundamental notions of constitutional, democratic government.[24] While as yet this only applies in limited circumstances (such as income tax calculations), these developments may alter the constitutional arrangements that are fundamental to a functioning democracy[25] and, in the particular context that we are focusing on, in the protection of the environment. As Brownsword says, '[i]f we value the rule of law, we need to be able to rescue and recycle it even in non-normative regulatory environments [where we are more subject to the rule of technology]',[26] particularly through a healthy relationship between actors in the system,[27] and an open debate.[28]

9.3.1 Design Criteria for ICT that Respects the Rule of Law

We therefore need to have proper regard to essential values throughout the design of ICT-based systems. A number of scholars have put forward criteria for assess-

[21] Langdon Winner, 'Technologies as Forms of Life' in *The Whale and the Reactor* (University of Chicago Press 1986) 9.

[22] Gunther Teubner, 'Juridification: Concepts, Aspects, Limits, Solutions' in Robert Baldwin, Colin Scott, and Christopher Hood (eds), *A Reader on Regulation* (Oxford University Press 1988) 389.

[23] John Morison, 'Modernising Government and the E-Government Revolution: Technologies of Government and Technologies of Democracy' in Nicholas Bamforth and Peter Leyland (eds), *Public Law in a Multi-Layered Constitution* (Hart Publishing 2003) 179.

[24] Dag Wiese Schartum, 'Developing eGovernment Systems—Legal, Technological and Organizational Aspects' (2010) 56 Scandinavian Studies in Law 125, 143.

[25] Noel Cox, 'Constitutional Responses to Paradigmatic Shifts in Technology' (2007) ⟨http://works.bepress.com/noel_cox/2/⟩ accessed 19 May 2014.

[26] Roger Brownsword, 'Lost in Translation: Legality, Regulatory Margins, and Technological Management' (2011) 26 Berkeley Technology Law Journal 1321, 1361.

[27] ibid, 1363.

[28] ibid, 1364.

ing the development of e-government,[29] normative,[30] or democratic technologies.[31] Although these lists are good starting points, it is important to avoid a checklist-oriented or after-the-fact verification of compliance. A simple enumeration of high-level principles is not useful by itself, and therefore my commentary will proceed in two stages: first, a synthesis of these criteria, and second, a more practical trio of suggestions to deal with the three issues highlighted above.

The principles put forward by Bannister, Koops, and Sclove can be summarised into three main themes:

A Bigger Picture Bannister stresses the need for holistic thinking, incremental progress and a long-term perspective;[32] the last point is also made repeatedly by Sclove.[33]

Learning from the Past Bannister highlights the importance of 'learning from the past and learning from the best'.[34]

Respect for Rights, Rules, and Principles Koops writes at length about the primacy of human rights, moral values and the rule of law,[35] while Sclove is concerned with avoiding authoritarianism, supporting democracy, and empowering individuals and groups.[36] To this, I would add the importance of building relationships of trust, an issue mentioned repeatedly by interviewees.[37]

To the three issues of untransparent systems, unaware developers and unclear

[29]Frank Bannister and Regina Connolly, 'Forward to the Past: Lessons for the Future of E-Government from the Story so Far' (2012) 17(3) Information Polity 211, 222.

[30]Bert-Jaap Koops, 'Criteria for Normative Technology: The Acceptability of "Code as Law" in Light of Democratic and Constitutional Values' in Roger Brownsword and Karen Yeung (eds), *Regulating Technologies* (Hart Publishing 2008) 169.

[31]Richard E Sclove, 'Making Technology Democratic' in James Brook and Iain A Brook (eds), *Resisting the Virtual Life: The Culture and Politics of Information* (City Lights Books 1995) 92–3.

[32]Bannister and Connolly (n 29) 222.

[33]Sclove, 'Making Technology Democratic' (n 31) 93.

[34]Bannister and Connolly (n 29) 222.

[35]Koops, 'Criteria for Normative Technology' (n 30) 169.

[36]Sclove, 'Making Technology Democratic' (n 31) 92–3.

[37]See Section 8.4.8.

regulatory schemes, I put forward three possible solutions: open software code; increasing digital literacy amongst lawyers and policy-makers; and more participatory technology design and assessment.

9.3.2 Open Source Code

A key element in implanting the rule of law in IIIs is making available the source code of systems developed by and for the government and regulator.[38] This may prove difficult in the context of increasing protection of intellectual property for corporations and the heavy use of outsourcing by the state,[39] but is nonetheless important as a first step in creating a context in which the citizen can truly know and understand how she is being governed. We cannot be entirely certain of the content of computer programs we did not write ourselves;[40] reviewing the code will assist somewhat in enhancing accountability and transparency.

However, this principle has limits.[41] First, not all code should be open—some (particularly that related to security, compliance, and enforcement)—must remain closed in order to function.[42] Second, even if the code is open, it may not be legible—many individuals cannot read or write computer code,[43] there is disagreement as to whether we can or should all learn how to write software,[44] and some languages are less transparent than others.[45]

Nonetheless, as government becomes more digital, it becomes easier to open

[38]Danielle Keats Citron, 'Open Code Governance' [2008] University of Chicago Legal Forum 355, 357.

[39]L Jean Camp, 'Varieties of Software and the Implications for Effective Democratic Government' in Christopher Hood and David Heald (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006) 193.

[40]Ken Thompson, 'Reflections on Trusting Trust' (1984) 27(8) Communications of the ACM 761.

[41]Camp (n 39) 183.

[42]ibid, 184.

[43]Helen Margetts, 'Transparency and Digital Government' in Christopher Hood and David Heald (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006) 201.

[44]Esther Shein, 'Should Everybody Learn to Code?' (2014) 57(2) Communications of the ACM 16.

[45]Camp (n 39) 187.

its processes up to public scrutiny.[46] We should as a minimum use open standards.[47] This will allow legal researchers to act on on the calls that have been made by scholars in disciplines such as media studies[48] for analysis of the institutional implications of algorithms.

9.3.3 Increasing Digital Literacy

Information systems scholars highlight the need for ethical consideration of emerging ICTs,[49] and ensure that scientists, technologists, and engineers are educated and trained in an ethical awareness, on the basis that

> [a]chieving technical design that soundly incorporates values requires not only competence in the technical arts and sciences, but also a reflective understanding of the relevant values and how these values function in the lives of people and possibly groups affected by the systems in question.[50]

However, this training should not end with technologists, but should extend to all involved in the policy process.[51] Law-makers and policy-makers will often plead or claim ignorance of the inner workings of ICT systems.[52] This lack of understanding is particularly unfortunate, given the extent to which a detailed understanding

[46] Margetts, 'Transparency and Digital Government' (n 43) 199.

[47] Jay Kesan and Rajiv Shah, 'Open Standards in Electronic Governance: Promises and Pitfalls' in Tomasz Janowski and Theresa A Pardo (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (ICEGOV '08)* (Association for Computing Machinery 2008) 180.

[48] Philip M Napoli, 'The Algorithm as Institution: Toward a Theoretical Framework for Automated Media Production and Consumption' (*Fordham University Schools of Business Research Paper*, 2013) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2260923⟩ accessed 27 August 2014; David Beer, 'Power Through the Algorithm? Participatory Web Cultures and the Technological Unconscious' (2009) 11(6) New Media and Society 985.

[49] Bernd Carsten Stahl, 'IT for a Better Future: How to Integrate Ethics, Politics and Innovation' (2011) 9(3) Journal of Information, Communication and Ethics in Society 140.

[50] Mary Flanagan, Daniel Howe, and Helen Nissenbaum, 'Embodying Values in Technology: Theory and Practice' in Jeroen van den Hoven and John Weckert (eds), *Information Technology and Moral Philosophy* (Cambridge University Press 2008) 324.

[51] Dag Wiese Schartum, 'Dirt in the Machinery of Government—Legal Challenges Connected to Computerized Case Processing in Public Administration' (1994) 2 International Journal of Law and Information Technology 327, 344.

[52] Helen Margetts, 'The Automated State' (1995) 10 Public Policy and Administration 88, 101.

of systems, technologies, and processes are vital in comprehending the social, ethical, and political questions which ICT raises,[53] if not perhaps also 'government, governance and the wider polity'.[54] This underlines the potential benefits, both for law and for society, of a detailed exploration of the consequences of ICT and information systems for government and bureaucracy, and the need to explore how to protect basic values in the so-called information age.

Hildebrant and Koops discuss this issue in the context of what they call 'Ambient Law',[55] which they define as 'technically embedded norms intended to influence human behaviour'.[56] They highlight the need to 'build bridges' from technologists to lawyers and politicians and ensure that the latter have the required level of 'digital literacy', as the translation of legal rules into technologically-mediated regulation will alter the nature of those rules.[57]

9.3.4 'Governance on the Inside'

The more decisions are driven by databases and software, the more those decisions are likely to fail to meet Galligan's requirement that individuals are included in decisions that affect them, and can contribute their perspective,[58] as ICT requires standardizing inputs and processes well in advance, leaving little room for individuality and special cases. However, this can be avoided or at least reduced by choosing more collaborative and communitarian development of IIIs, thus enabling a more inclusive range of capacities.

Gil-Garcia discusses the development of what he calls 'smart states', which he

[53] Helen Nissenbaum, 'How Computer Systems Embody Values' (2001) 34(3) Computer 120, 118.

[54] John A Taylor, 'The Information Polity: Towards a Two Speed Future?' (2012) 17(3) Information Polity 227, 228.

[55] See Section 2.2.3.

[56] Mireille Hildebrandt and Bert-Jaap Koops, 'The Challenges of Ambient Law and Legal Protection in the Profiling Era' (2010) 73(3) Modern Law Review 428, 454.

[57] ibid, 456.

[58] Denis James Galligan, *Due Process and Fair Procedures: A Study of Administrative Procedures* (Clarendon Press 1996) 70.

defines as

> [s]ensors, virtualizations, geographic information technologies, social media applications, and other elements ... [which] function like a brain to manage the resources and capabilities of government, but also the participation of social actors, the physical infrastructure, and the machines and equipment using that infrastructure.[59]

This vision has a certain appeal, and is undoubtedly becoming a reality, but the focus on technology obscures the important place and contribution of the individual and the group, who may be marginalised and disempowered. As a counterpoint, I would suggest Paquet's notion of a 'smart community'[60] which does not rely on ICT but instead on

> ... an ensemble of mechanisms, instruments, and perspectives, generally subsumed under the labels of collective intelligence and social learning. These are the basic forces that make the community smart as a community, and ever smarter as it continues to learn.[61]

Fostering the development of smarter communities can be achieved in three ways. First, decentralized computing power and expertise.[62] Second, participatory design can create a space for critical practice in the development of IIIs.[63] Stahl suggests that participatory technology assessment can bring more minds to bear on the issues raised by the introduction of new ICT and give the final outcome of the deliberative process more legitimacy.[64] Finally, Smith and Stirling propose what they call 'governance on the inside', which is a reflective mode of operation that acknowledges the distinct, divergent, and sometimes incommensurable perspectives

[59]J Ramon Gil-Garcia, 'Towards a Smart State? Inter-Agency Collaboration, Information Integration, and Beyond' (2012) 17(3) Information Polity 269, 274–5.

[60]Gilles Paquet, 'Smart Communities and the Geo-Governance of Social Learning' (2001) 31(2) Optimum Online 33, 33.

[61]ibid, 33.

[62]James N Danziger and others, *Computers and Politics: High Technology in American Local Governments* (Columbia University Press 1982) 3.

[63]Peter M Asaro, 'Transforming Society By Transforming Technology: The Science and Politics of Participatory Design' (2000) 10(4) Accounting, Management and Information Technologies 257.

[64]Bernd Carsten Stahl, 'What Future? Which Technology? On the Problem of Describing Relevant Futures' in Mike Chiasson and others (eds), *Researching the Future in Information Systems* (Springer 2011).

that individuals may have on socio-technical systems and their role in sustainability.[65]

9.4 Future Research

In order for lists of criteria, such as those discussed above,[66] to be more than shallow checklists for empty compliance, they must be implemented and embedded in a way that is both sophisticated and nuanced. The depth of understanding that is needed in order to achieve this requires significant research on the approaches, attitudes, and experience of ICT professionals, seeking to understand how they percieve, implement, and monitor adherence to abstract ideals such as equality, fairness, and the rule of law. The list of potential projects is significant. Other disciplines, such as information systems, information security, or sociology, would probably prioritize other topics and issues. Here, however, I present examples of the types of projects that could assist in this, from the perspective of law:

- Content analysis of government ICT strategy documents from a variety of jurisdictions to explore the extent to which they reflect an awareness of the rule of law.

- A detailed exploration of the rules, protocols and processes that govern the sharing of data between government agencies and regulators, and the extent to which they share with each other, would shed considerable light on how trust between diverse organizations can be constructed, and how legal rules (legislation, contract, and codes of practice) can strengthen this.

- A detailed exploration of the ways in which government uses ICT to respond to freedom of information law, either through pre-emptively putting informa-

[65] Adrian Smith and Andy Stirling, 'Moving Outside or Inside? Objectification and Reflexivity in the Governance of Socio-Technical Systems' (2007) 9(3-4) Journal of Environmental Policy and Planning 351, 363.

[66] See Section 9.3.1.

tion online or to streamline the process of replying to individual requests, and to what extent new technological capabilities should be reflected in legislative schemes for making government information public.

- A consideration of the interaction between 'ambient intelligence', real-time reporting, and adaptive policy implementation.

- Follow-on empirical research on the application of ICT for environmental regulation, particularly participant observation of a public sector software development project team, applying a rule of law analysis.

- Smith and Stirling's 'governance on the inside' framework contains significant promise but, as the authors acknowledge,[67] it requires more detailed case studies for elaboration and refinement,[68] as does Stahl's participatory technology assessment.[69]

- Similarly, detailed case studies of the role of ICT in ER, similar to the work of Allen and others on Fisheries and Oceans Canada,[70] would greatly assist in developing an understanding of the issues which are raised by changes in work practices.[71]

---

[67] Smith and Stirling (n 65) 368.

[68] See, for examples, Janet Stephenson and others, 'Energy Cultures: A Framework for Understanding Energy Behaviours' (2010) 38 Energy Policy 6120; Pierre Delvenne, Catherine Fallon, and Sébastien Brunet, 'Parliamentary Technology Assessment Institutions as Indications of Reflexive Modernization' (2011) 33 Technology in Society 36; Michael Decker and Torsten Fleischer, 'Participation in 'Big Style': First Observations at the German Citizens' Dialogue on Future Technologies' (2012) 9(1-2) Poiesis and Praxis 81; Andrew Switzer, Luca Bertolini, and John Grin, 'Transitions of Mobility Systems in Urban Regions: A Heuristic Framework' (2013) 15(2) Journal of Environmental Policy and Planning 141.

[69] Stahl, 'What Future?' (n 64) 107.

[70] Barbara Allen and others, 'The Organizational Culture of Digital Government: Technology, Accountability and Shared Governance' in Alexei Pavlichev and G David Garson (eds), *Digital Government: Principles and Best Practices* (IGI Global 2004) 82.

[71] See, for examples, Ian Goodwin, 'The Internet, Organisational Change and Community Engagement: The Case of Birmingham City Council' (2005) 23(4) Prometheus 367; Bob Stea and G Harindranath, 'Public Sector ICT Management Strategy and Its Impact on E-Government: A Case Study' in *ECIS 2006 Proceedings* (Association for Information Systems 2006).

- Collaborative work between educators in law, information systems, and information technology to ensure that there is a cross-fertilization of awareness between these disciplines, particularly focused around questions of the rule of law and respect for human rights.

- Collaborative work between researchers in law and information systems or information technology in order to educate other lawyers, law-makers and policy-makers on the issues which ICT raises for the rule of law.

9.5 Conclusion

Conducting this research and embedding these criteria in decision-making regarding the development of ICT and IIIs for ER (and many other, if not all, forms of e-government) would serve a vital purpose: ensuring that fundamental constitutional principles such as the rule of law are clearly and explicitly taken into account by scientists and engineers when they design and build the systems that will determine how we measure and manage the world that we live in. In this way, the 'information age' does not need to be a repetition of existing patterns of power relationships but can instead open a more constructive dialogue about, and understanding of, the mundane work of government.

Appendices

Appendix A

Questionnaire

This appendix lists the questions which were used as a guideline for the semi-structured interviews.

A.1 Introductory Questions

What is the role of your organization in environmental regulation?

Can you describe your work?

When did your organization begin to use ICT for its work?

Has the use of ICT within your organization changed over time?

How does your organization use ICT for its work now?

How important is ICT in your organization?

A.2 Impact of ICT on Work and Organization

In your opinion, has ICT changed the way in which you do your work?

In your opinion, has ICT changed the way in which your organization is structured?

Can you think of any examples?

A.3 'Information' in Environmental Regulation

Is information important in your work?

In your view, what are the benefits and issues that arise from using ICT to process the information that your organization collects?

In your view, what are the benefits and issues that arise from using ICT to present the information that your organization processes to others?

Is the information that you capture made public? How is this done?

A.4 ICT and Span of Control

In your experience, does ICT help or hinder your organization in the scope and span of the regulatory activities that it can engage in?

In your experience, what are the benefits and issues that arise from using ICT to identify environmental problems?

A.5 ICT and Public Engagement

In your experience, can ICT lead to greater transparency and accountability for an organization such as yours?

A.6 ICT as a Tool for Behaviour Change

In your opinion, can ICT help individuals to become more aware of the environmental consequences of their actions?

Appendix B

Coding Cycles

This appendix lists the concepts to which specific portions of text from the semi-structured interview transcriptions were coded during the analysis phase. Each table represent a phase in the cycles of coding, demonstrating the continuous engagement with the data collected during fieldwork. Concepts with very high or very low numbers of references coded to them were either investigated more closely or ignored, as seemed appropriate.

B.1 Open Codes

Table B.1: Open Codes

Name	Sources	References
Behaviour change fading	1	1
Behaviour change not fading	3	3
Benefits from the use of ICT	5	5
Big data	2	5
Burden on regulated community	1	1
Business process re-engineering	2	5
Change management	1	1
Changes in methods of working	2	6
Changes in the use of ICT	7	18

Changes to regulatory schemes	1	1
Citizen science	2	3
Closing remarks	4	4
Cloud computing	1	2
Concerns about the accuracy, reliability, or consistency of information	7	11
Consultation process	1	2
Cost	1	1
Current use of ICT	7	20
Data not sufficient to prove causation	1	2
Data not sufficient without human interpretation	1	2
Data quality programmes	1	1
Dealing with public input	1	1
Difficulties with the use of ICT	4	6
Digital divide	1	2
Ease of use of information	5	8
Effectiveness of ICT as a tool for behaviour change	1	2
Efficiency	3	4
Environmental justice	3	4
Environmental movement	1	1
Freedom of information legislation	2	7
Future developments in the use of ICT	4	8
Hidden agendas	1	1
Human error	3	5
Human factors	4	12

ICT as a factor in drafting new legislation	1	2
ICT as a factor in structural change	5	7
ICT as a purely positive intervention	1	1
ICT as a tool for behaviour change	6	11
ICT as a tool for environmental awareness	6	7
ICT as an exclusionary device	4	5
ICT changing methods of work	5	7
ICT facilitating speed	1	2
ICT improving but not changing methods of working	2	2
ICT not a factor in structural change	2	2
Importance of data	1	1
Importance of ICT	7	8
Importance of information	3	5
Importance of science	2	2
Information available in numerical form	2	2
Information governance	1	3
Information made available to the public	3	3
Information not available in digital form	4	4
Information not made available to the public	1	1
Input from the public	2	3
Lasting behaviour change	1	1
Lawyers slow to change	1	1
Legal constraints	1	1
Limits of ICT as a capture tool	1	1
Litigation	2	3

Loss of control of information	1	1
More engaged public	6	9
More informed public	6	10
Multi-level governance	2	2
Needs for new measuring devices	2	3
Negative response to ICT systems	1	1
No need for new measuring devices	2	2
Ongoing, insoluble issues	1	2
Open data	3	5
Open government	1	1
Public app development	2	2
Regulators pushing external innovation	1	2
Respectful use of data	2	4
Responses by staff to changes in ICT systems	2	5
Role of interviewee	5	6
Role of organization	4	4
Scope and span of regulatory activities	7	8
Security issues constraining adoption	1	2
Skills required	1	3
Slogans	1	1
Smartphones	1	1
Social media	2	5
Too much information	4	4
Toxics Release Inventory	1	1
Transparency through ICT	6	16
Trust	2	4

Use of external contractors	1	1
Using ICT to identify environmental problems	2	2

B.2 Hierarchical Codes

Table B.2: Hierarchical Codes

Name	Sources	References
Change	1	1
Business process re-engineering	2	5
Changes in the use of ICT	10	21
New capabilities	5	9
Structural change	0	0
ICT as a factor in structural change	8	13
ICT not a factor in structural change	7	7
Work practices	12	54
Change management	3	12
ICT facilitating speed	2	3
ICT improving but not changing methods of working	3	3
Responses by staff to changes in ICT systems	4	8
Closing remarks	5	5
Data and Information	0	0
Big data	3	6
Concerns over accuracy	11	24
Data not sufficient to prove causation	1	3
Importance of information	7	9
Importance of science	2	2
Information not always in numerical form	8	9
Negative response to ICT	2	4
Never too much information	8	8
Not sufficient without human interpretation	5	9

Human factors	5	13
Behaviour change	11	22
Behaviour change fading	1	1
Behaviour change not fading	8	8
ICT as a purely positive intervention	1	1
Difficulties with the use of ICT	5	8
Environmental awareness via ICT	9	11
Hidden agendas	1	1
Human error	3	5
Insoluble issues	1	2
Security	2	3
Skills	7	21
ICT in the Regulatory Process	0	0
Importance of ICT	12	16
Legal issues	0	0
Data protection	1	2
Environmental justice	3	4
FOI	4	10
ICT-aware legislation	3	4
Information governance	4	6
Lawyers slow to change	2	2
Legislative constraints	1	1
Litigation issues	4	5
Respectful use of data	2	5
Miscellaneous	0	0
Good quotes	6	14
Role of interviewee	8	9

Role of organization	7	7
Slogans	1	1
Power	3	4
Barriers other than ICT	1	1
Behavioral power	0	0
Hard power	1	1
Soft power	0	0
Benefits from the use of ICT	8	13
Transparency through ICT	11	30
Using ICT to identify problems	5	5
Digital divide	1	2
ICT excluding individuals	10	12
Empowerment	4	5
Access to information	1	1
More engaged public	10	15
More informed public	11	21
Individualised interactions	1	1
Loss of control of information	4	8
NGO use of ICT	1	14
ICT as tool for NGO-public communication	1	3
Problematising software	0	0
Algorithm-driven regulation	1	3
Bias in software	4	5
Errors in software	1	2
Reliance on models	2	6
Values in software	3	5
Public engagement	1	1

Citizen science	2	3
Consultation process	4	8
Ease of use of information	7	12
Environmental movement	2	2
Information made available to the public	10	22
Information not made available to the public	3	3
Multi-level governance	5	7
Open data	3	5
Open government	1	1
Public app development	2	2
Regulation by disclosure	1	1
Toxics Release Inventory	1	1

B.3 Thematic Network Analysis

Table B.3: Thematic Network Analysis

Name	Sources	References
Available ICT are adopted quickly	0	0
Current use focuses on integration of data sources	14	36
Cloud computing is seeing increasing use	5	6
Social media is useful but difficult to manage	4	11
Future developments will be interesting	7	12
Mobile devices have potential but demand infrastructure	2	3
New measuring devices may be needed, or encouraged	6	7

ICT an element in everyone's career	5	6
Human responses remain significant	5	13
Difficulties with the use of ICT	10	30
Information may create behaviour change, but this may fade	14	33
Securing ICT from external threats is a barrier to adoption	2	3
Staff, regulatees, and the public need appropriate skills to use ICT well	7	26
ICT connects with, but does not drive, change	3	3
ICT brings minor structural change	14	21
ICT changes work practices, habits, and management	14	50
ICT has become part of the fabric of the working day	10	21
ICT provides new capabilities, speed, and efficiency	7	12
ICT is key to the day-to-day work of environmental regulation	13	18
Information is crucial to environmental regulators	1	1
Ensuring the accuracy of data requires ongoing attention	13	27
Information is not always in numerical or digital form	8	9
Information is not sufficient without human interpretation	7	11
Regulators always want more information	9	9

Law and lawyers are frequently a barrier to regulatory work	0	0
Discovery and forensics require careful attention to detail	4	5
Freedom of Information laws require substantial resources	4	10
Lawyers are slow to change	2	2
Respecting ownership of data is essential	8	14
People want to trust in IS and ICT but often find that they cannot	8	18
Use of ICT alters power relationships	3	4
Access to specialised ICT and skills remains expensive	9	22
ICT can empower all actors	11	18
Digital divide may not be a real issue for motivated individuals	13	18
ICT increases the scope and span of regulatory reach	12	15
Making information freely available means the regulator loses control	4	8
Other barriers to public engagement remain significant	11	17
Regulators are now much more transparent to the public	13	32
The public can (but may not) inform themselves more easily	12	22

B.4 Focused Codes

Table B.4: Focused Codes

Name	Sources	References
Assisting	6	8
Changing	2	2
Collaborating	3	6
Collating	7	9
Communicating	12	27
Considering	0	0
Forcing	0	0
Gathering	6	10
Influencing	8	15
Integrating	12	31
Researching	4	6
Resolving conflict	4	6
Sharing	11	20
Storing	6	12
Transacting	5	8
Verifying	7	14

Bibliography

6 P, *E-Governance: Styles of Political Judgement in the Information Age Polity* (Palgrave Macmillan 2004).

Abbot C, *Enforcing Pollution Control Regulation* (Hart 2009).

Abbott KW and Snidal D, 'Strengthening International Regulation Through Transnational New Governance: Overcoming the Orchestration Deficit' (2009) 42 Vanderbilt Journal of Transnational Law 501.

Aberbach JD and Rockman BA, 'Conducting and Coding Elite Interviews' (2002) 35(4) PS: Political Science and Politics 673.

Ackerman BA and Stewart RB, 'Reforming Environmental Law' [1985] Stanford Law Review 1333.

Adelman DE, 'Scientific Activism and Restraint: The Interplay of Statistics, Judgment, and Procedure in Environmental Law' (2003) 79 Notre Dame Law Review 497.

— 'The Art of the Unsolvable: Locating the Vital Center of Science for Environmental Law and Policy' (2007) 37 Environmental Law 935.

Afsah S, Blackman A, and Ratunanda D, 'How Do Public Disclosure Pollution Control Programs Work? Evidence From Indonesia' (*Resources for the Future Discussion Paper,* 2000) ⟨http://core.kmi.open.ac.uk/download/pdf/9308153.pdf⟩ accessed 27 August 2014.

Agar J, *The Government Machine* (MIT Press 2003).

— 'What Difference Did Computers Make?' (2006) 36(6) Social Studies of Science 869.

Agrawal A, *Environmentality: Technologies of Government and the Making of Subjects* (Duke University Press 2005).

Akrich M, 'The De-Scription of Technical Objects' in Bijker WE and Law J (eds), *Shaping Technology/Building Society* (MIT Press 1992).

— 'Les objets techniques et leurs utilisateurs, de la conception à l'action' (1993) 4 Raisons Pratique 35.

Allan TR, *Constitutional Justice: A Liberal Theory of the Rule of Law* (Oxford University Press 2001).

Allen B and others, 'The Organizational Culture of Digital Government: Technology, Accountability and Shared Governance' in Pavlichev A and Garson GD (eds), *Digital Government: Principles and Best Practices* (IGI Global 2004).

Alpar P and Olbrich S, 'Legal Requirements and Modelling of Processes in E-Government' (2005) 3(3) Electronic Journal of E-Government 107.

Andersen KV, 'Reengineering Public Sector Organisations Using Information Technology' in Heeks R (ed), *Reinventing Government in the Information Age: International Practice in IT-enabled Public Sector Reform* (Routledge 1999).

Archer N, 'M-Government and E-Government: Transformative Relationships' in Scholl HJ (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010).

Arino O, Fernandez-Prieto D, and Volden E, 'Healing the Earth - Earth Observation Supporting International Environmental Conventions' (2006) 128 ESA Bulletin 52.

Arnold CA, 'Fourth-Generation Environmental Law: Integrationist and Multimodal' (2011) 35 William and Mary Environmental Law and Policy Review 771.

Asaro PM, 'Transforming Society By Transforming Technology: The Science and Politics of Participatory Design' (2000) 10(4) Accounting, Management and Information Technologies 257.

Aschbacher J, 'Monitoring Environmental Treaties Using Earth Observation' [2002] Verification Yearbook 172.

Attride-Stirling J, 'Thematic Networks: An Analytic Tool for Qualitative Research' (2001) 1(3) Qualitative Research 385.

Avgerou C, *Information Systems and Global Diversity* (Oxford University Press 2002).

Ayres I and Braithwaite J, *Responsive Regulation: Transcending the Deregulation Debate* (Oxford University Press 1992).

Ayres I, Raseman S, and Shih A, 'Evidence From Two Large Field Experiments That Peer Comparison Feedback Can Reduce Residential Energy Usage' (2013) 29(5) Journal of Law, Economics, and Organization 992.

Bae H, Wilcoxen P, and Popp D, 'Information Disclosure Policy: Do State Data Processing Efforts Help More Than the Information Disclosure Itself?' (2010) 29(1) Journal of Policy Analysis and Management 163.

Bailey I, *New Environmental Policy Instruments in the European Union: Politics, Economics and the Implementation of the Packaging Waste Directive* (Ashgate 2003).

Baker SE and Edwards R, 'How many qualitative interviews is enough?' (2012) ⟨http://eprints.ncrm.ac.uk/2273/4/how_many_interviews.pdf⟩ accessed 27 August 2014.

Baldwin R, *Rules and Government* (Clarendon Press 1995).

— 'Regulation After "Command and Control"', in Hawkins K (ed), *The Human Face of Law* (Clarendon Press 1997).

— 'Is Better Regulation Smarter Regulation?' [2005] Public Law 485.

Baldwin R and Black J, 'Really Responsive Regulation' (2008) 71 Modern Law Review 59.

Baldwin R, Cave M, and Lodge M, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012).

Bamberger KA, 'Technologies of Compliance: Risk and Regulation in a Digital Age' (2010) 88 Texas Law Review 669.

Bamberger KA, 'Technology's Transformation of the Regulatory Endeavor' (2011) 26 Berkeley Technology Law Journal 1315.

Banakar R and Travers M, 'Law, Sociology and Method' in Banakar R and Travers M (eds), *Theory and Method in Socio-Legal Research* (Hart 2005).

Bankowski Z, 'Law, Love and Computers' (1996) 1(1) Edinburgh Law Review 25.

Bannister F, 'Deep E-Government: Beneath the Carapace' in Scholl HJ (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010).

Bannister F and Connolly R, 'Forward to the Past: Lessons for the Future of E-Government from the Story so Far' (2012) 17(3) Information Polity 211.

Barbour RS, 'Checklists for Improving Rigour in Qualitative Research: A Case of the Tail Wagging the Dog?' (2001) 322 British Medical Journal 1115.

Barker J and Downing H, 'Word Processing and the Transformation of the Patriarchal Relations of Control in the Office' (1981) 2 Education and the State 229.

Barocas S, Hood S, and Ziewitz M, 'Governing Algorithms: A Provocation Piece' (2013) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2245322⟩ accessed 27 August 2014.

Bateson G, *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (University of Chicago Press 1972).

Bazeley P, 'Analysing Qualitative Data: More Than "Identifying Themes"' (2009) 2(2) Malaysian Journal of Qualitative Research 6.

Beekhuyzen J, Nielsen S, and von Hellens L, 'The NVivo Looking Glass: Seeing the Data Through the Analysis' in *5th Conference on Qualitative Research in IT* (Queensland University of Technology, Griffith University, and the Australian National University 2010).

Beer D, 'Power Through the Algorithm? Participatory Web Cultures and the Technological Unconscious' (2009) 11(6) New Media and Society 985.

Beierle TC, 'Discussing the Rules: Electronic Rulemaking and Democratic Deliberation.' (*Resources for the Future Discussion Paper*, 2003) ⟨http://purl.umn.edu/10681⟩ accessed 19 May 2014.

Bekkers V, 'Is There a Future for E-Government? Looking beyond the explanitory emptiness of the e-government concept' (2011) ⟨https://www.scss.tcd.ie/disciplines/information_systems/egpa/docs/2011/Paper%20-%20Bekkers.pdf⟩ accessed 27 August 2014.

Bekkers V and Homburg V, 'E-Government as an Information Ecology: Backgrounds and Concepts' in Bekkers VJJM and Homburg VMF (eds), *Information Ecology of E-Government: E-Government as Institutional and Technological Innovation in Public Administration* (IOS Press 2005).

— 'The Myths of E-Government: Looking Beyond the Assumptions of a New and Better Government' (2007) 23(5) The Information Society 373.

Bekkers V, 'Information and Communication Technology and the Redefinition of the Functional and Normative Boundaries of Government' in van Heffen O, Kickert WJM, and Thomassen J (eds), *Governance in Modern Society: Effects, Change and Formation of Government Institutions* (Kluwer Academic Publishers 2000).

Bell J, 'Discretionary Decision-Making: A Jurisprudential View' in Hawkins K (ed), *The Uses of Discretion* (Clarendon Press 1992).

Bell S and Hindmoor A, *Rethinking Governance: The Centrality of the State in Modern Society* (Cambridge University Press 2009).

Bellamy C, 'The Politics of Public Information Systems' in Garson GD (ed), *Handbook of Public Information Systems* (2nd edn, Marcel Dekker, Inc 2000).

Bellamy C and Taylor JA, *Governing in the Information Age* (Open University Press 1998).

Bellanova R and Duez D, 'A Different View on the "Making" of European Security: The EU Passenger Name Record System as a Socio-Technical Assemblage' (2012) 17(2) European Foreign Affairs Review 109.

Bengtsson F and Ågerfalk P, 'Information Technology as a Change Actant in Sustainability Innovation: Insights From Uppsala' [2011] The Journal of Strategic Information Systems 96.

Beniger JR, *The Control Revolution: Technological and Economic Origins of the Information Society* (Harvard University Press 1986).

Benjamin S and others, 'Bhoomi: "E-Governance", or, an Anti-Politics Machine Necessary to Globalize Bangalore?' (2007) ⟨http://casumm.files.wordpress.com/2008/09/bhoomi-e-governance.pdf⟩ accessed 19 May 2014.

Benjamin SM, 'Evaluating E-Rulemaking: Public Participation and Public Institutions' (2006) 55 Duke Law Journal 893.

Bennear LS and Olmstead SM, 'The Impacts of the "Right To Know": Information Disclosure and the Violation of Drinking Water Standards' (2008) 56(2) Journal of Environmental Economics and Management 117.

Bennear LS, 'Strategic Response to Regulatory Thresholds: Evidence from the Massachusetts Toxics Use Reduction Act' (2005) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=776504⟩ accessed 19 May 2014.

— 'Are Management-Based Regulations Effective? Evidence From State Pollution Prevention Programs' (2007) 26(2) Journal of Policy Analysis and Management 327.

Bentzon AW and others, *Pursuing Grounded Theory in Law: South-North Experiences in Developing Women's Law* (Monde 1998).

Berry JM, 'Validity and Reliability Issues in Elite Interviewing' (2002) 35(4) PS: Political Science and Politics 679.

Bevan G and Hood C, 'What's Measured is What Matters: Targets and Gaming in the English Public Health Care System' (2006) 84(3) Public Administration 517.

Bhatnagar S, *E-Government: From Vision to Implementation—A Practical Guide with Case Studies* (Sage 2004).

Biber E, 'The Problem of Environmental Monitoring' (2011) 83 University of Colorado Law Review 1.

Biernacki P and Waldorf D, 'Snowball Sampling: Problems and Techniques of Chain Referral Sampling' (1981) 10(2) Sociological Methods and Research 141.

Bing J, 'Code, Access and Control' in Klang M and Murray A (eds), *Human Rights in the Digital Age* (Glasshouse Press 2005).

Bingham L, 'The Rule of Law' (2007) 66(1) Cambridge Law Journal 67.

Birkinshaw P, 'Freedom of Information and Openness: Fundamental Human Rights' (2006) 58 Administrative Law Review 177.

— 'Transparency as a Human Right', in Hood C and Heald D (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006).

Björkskog CA and others, 'Energylife: Pervasive Energy Awareness for Households' in *Proceedings of the 12th ACM International Conference Adjunct Papers on Ubiquitous Computing* (Association for Computing Machinery 2010).

Black J, 'New Institutionalism and Naturalism in Socio-Legal Analysis: Institutionalist Approaches to Regulatory Decision Making' (1997) 19(1) Law and Policy 51.

— 'Talking About Regulation' [1998] Public Law 77.

— 'Decentring Regulation: Understanding the Role of Regulation and Self Regulation in a "Post-Regulatory" World' (2002) 54 Current Legal Problems 103.

Bloomfield BP, 'The Role of Information Systems in the UK National Health Service: Action At a Distance and the Fetish of Calculation' (1991) 21(4) Social Studies of Science 701.

Bloomfield BP and Coombs R, 'Information Technology, Control and Power: The Centralization and Decentralization Debate Revisited' (1992) 29(4) Journal of Management Studies 459.

Bloomfield BP and others, 'Introduction: The Problematic of Information Technology and Organization' in Bloomfield BP and others (eds), *Information Technology and Organizations: Strategies, Networks, and Integration: Strategies, Networks, and Integration* (Oxford University Press 1997).

Bloor D, 'Anti-Latour' (1999) 30 Studies in History and Philosophy of Science 81.

Boersma K, Meijer A, and Wagenaar P, 'Unraveling and Understanding the E-Government Hype' in Meijer A, Boersma K, and Wagenaar P (eds), *ICTs, Citizens and Governance: After the Hype!* (IOS Press 2009).

Bosselman F, 'What Lawmakers Can Learn From Large-Scale Ecology' (2002) 17 Journal of Land Use and Environmental Law 207.

Bougherara D, Grolleau G, and Mzoughi N, 'Is More Information Always Better? An Analysis Applied to Information-Based Policies for Environmental Protection' (2007) 10(3) International Journal of Sustainable Development 197.

Bovens M and Loos E, 'The Digital Constitutional State: Democracy and Law in the Information Society' (2002) 7(4) Information Polity 185.

Bovens M and Zouridis S, 'From Street-Level to System-Level Bureaucracies: How Information and Communication Technology is Transforming Administrative Discretion and Constitutional Control' (2002) 62(2) Public Administration Review 174.

Bowker G, 'Information Mythology and Infrastructure' in Bud-Frierman L (ed), *Information Acumen: The Understanding and Use of Knowledge in Modern Business* (Routledge 1994).

Bowker GC, 'Biodiversity Datadiversity' (2000) 30(5) Social Studies of Science 643.

Bowker GC and Star SL, *Sorting Things Out: Classification and Its Consequences* (MIT Press 1999).

Bowker G and Star SL, 'Knowledge and Infrastructure in International Information Management: Problems of Classification and Coding' in Bud-Frierman L (ed), *Information Acumen: The Understanding and Use of Knowledge in Modern Business* (Routledge 1994).

Boyd DR, 'Sustainability Law: (R)Evolutionary Directions for the Future of Environmental Law' (2004) 14 Journal of Environmental Law and Practice 357.

Boyd W, 'Ways of Seeing in Environmental Law: How Deforestation Became an Object of Climate Governance' [2010] Ecology Law Quarterly 101.

Bratspies RM, 'Regulatory Trust' (2009) 51 Arizona Law Review 575.

Braun V and Clarke V, 'Using Thematic Analysis in Psychology' (2006) 3(2) Qualitative Research in Psychology 77.

Brekke C and Solberg AHS, 'Oil Spill Detection By Satellite Remote Sensing' (2005) 95(1) Remote Sensing of Environment 403.

Bretschneider S, 'Management Information Systems in Public and Private Organizations: An Empirical Test' [1990] Public Administration Review 536.

— 'Information Technology, E-Government, and Institutional Change' (2003) 63(6) Public Administration Review 738.

Brey P, 'Social Constructivism for Philosophers of Technology: A Shopper's Guide' (1997) 2(3-4) Society for Philosophy and Technology.

Brown I and Korff D, 'Foreign Surveillance: Law and Practice in a Global Digital Environment' [2014] European Human Rights Law Review 243.

Brown JS and Duguid P, *The Social Life of Information* (Harvard Business School Press 2000).

Brownsword R, 'Lost in Translation: Legality, Regulatory Margins, and Technological Management' (2011) 26 Berkeley Technology Law Journal 1321.

Brownsword R and Yeung K, 'Regulating Technologies: Tools, Targets and Thematics' in Brownsword R and Yeung K (eds), *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing 2008).

Brynjarsdottir H and others, 'Sustainably Unpersuaded: How Persuasion Narrows Our Vision of Sustainability' in Konstan JA, Chi EH, and Höök K (eds), *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2012).

Brynjolfsson E and Hitt LM, 'Beyond Computation: Information Technology, Organizational Transformation and Business Performance' (2000) 14(4) Journal of Economic Perspectives 23.

Budd L, 'The Limits of Post-Lisbon Governance in the EU' in Budd L and Harris L (eds), *E-Governance: Managing or Governing?* (Routledge 2008).

Bullinga M, 'Intelligent Government: Invisible, Automatic, Everywhere' [2004] The Futurist 32.

Burnham D, *The Rise of the Computer State. The Threat to Our Freedoms, Our Ethics and Our Democratic Process* (Random House 1983).

Burov V, Patarakin E, and Yarmakhov B, 'Lawmaking in Democracy 2.0 Paradigm: The Shift for the New Forms of Lawmaking' in Estevez E and Janssen M (eds), *ICEGOV '11: Proceedings of the 5th International Conference on Theory and Practice of Electronic Governance* (Association for Computing Machinery 2011).

Buzbee W and others, *Regulatory Underkill: The Bush Administration's Insidious Dismantling of Public Health and Environmental Protections* (Center for Progressive Regulation 2005).

Bygstad B and Munkvold BE, 'In Search of Mechanisms. Conducting a Critical Realist Data Analysis' in Beath C, Myers MD, and Wei KK (eds), *Interna-*

tional Conference on Information Systems (Association for Information Systems 2011).

Callon M, 'Some Elements of a Sociology of Translation' in Law J (ed), *Power, Action and Belief* (Routledge 1986).

— 'Society in the Making: The Study of Technology as a Tool for Sociological Analysis', in Bijker WE, Hughes TP, and Pinch TJ (eds), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Open University Press 1987).

Callon M and Latour B, 'Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So' in Knorr-Cetina K and Cicourel AV (eds), *Advances in Social Theory and Methodology: Toward an Integration of Micro and Macro-Sociologies* (1981).

Camp LJ, 'Varieties of Software and the Implications for Effective Democratic Government' in Hood C and Heald D (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006).

Campbell K, 'The City of Law' [2013] International Journal of Law in Context 192.

Campbell-Kelly M and Aspray W, *Computer: A History of the Information Machine* (Westview Press 2004).

Carlsson SA, 'Critical Realist Information Systems Research in Action' in Chiasson M and others (eds), *Researching the Future in Information Systems* (Springer 2011).

Carolan E, *The New Separation of Powers: A Theory for the Modern State* (Oxford University Press 2009).

Carr NG, *The Big Switch: Rewiring the World, From Edison to Google* (WW Norton and Company 2008).

Carson R, *Silent Spring* (Houghton Mifflin 1962).

Carver S and others, 'Public Participation, GIS, and Cyberdemocracy: Evaluating On-line Spatial Decision Support Systems' (2001) 28(6) Environment and Planning B: Planning and Design 907.

Case DW, 'The Law and Economics of Environmental Information as Regulation' (2001) 31(7) Environmental Law Reporter 10773.

— 'Corporate Environmental Reporting as Informational Regulation: A Law and Economics Perspective' (2005) 76 University of Colorado Law Review 379.

Castells M, *The Rise of the Network Society: The Information Age: Economy, Society, and Culture* (John Wiley and Sons 2011).

Caudill DS and Curley DE, 'Strategic Idealizations of Science to Oppose Environmental Regulation: A Case Study of Five TMDL Controversies' (2009) 57 Kansas Law Review 251.

Ceruzzi PE, *A History of Modern Computing* (2nd edn, MIT Press 2003).

Chadwick A and May C, 'Interaction between States and Citizens in the Age of the Internet: "e-Government" in the United States, Britain, and the European Union' (2003) 16(2) Governance 271.

Chamberlain A and others, 'Understanding Mass Participatory Pervasive Computing Systems for Environmental Campaigns' (2014) 18(7) Personal Ubiquitous Computing 1775.

Chen J, 'Webs of Life: Biodiversity Conservation as a Species of Information Policy' (2004) 89 Iowa Law Review 495.

Cicuendez Perez J and others, 'The Efficiency of Using Remote Sensing for Fisheries Enforcement: Application to the Mediterranean Bluefin Tuna Fishery' (2013) 147 Fisheries Research 24.

Citron DK, 'Open Code Governance' [2008] University of Chicago Legal Forum 355.

— 'Technological Due Process' (2008) 85 Washington University Law Review 1249.

Clarke J, 'Governance Puzzles' in Budd L and Harris L (eds), *E-Governance: Managing or Governing?* (2009).

Clegg SR, *Frameworks of Power* (Sage 1989).

Clifton S.-J, 'A Dangerous Obsession' (2009) ⟨http://www.foe.co.uk/sites/default/files/downloads/dangerous_obsession.pdf⟩ accessed 27 August 2014.

Cloatre E, 'TRIPS and Pharmaceutical Patents in Djibouti: an ANT Analysis of Socio-Legal Objects' (2008) 17(2) Social and Legal Studies 263.

Cloatre E and Dingwall R, '"Embedded Regulation:" The Migration of Objects, Scripts, and Governance' (2013) 7(3) Regulation and Governance 365.

Cloatre E and Wright N, 'A Socio-legal Analysis of an Actor-world: The Case of Carbon Trading and the Clean Development Mechanism' [2012] Journal of Law and Society 76.

Coglianese C, 'E-Rulemaking: Information Technology and the Regulatory Process' (2004) 56 Administrative Law Review 353.

— 'Information Technology and Regulatory Policy: New Directions for Digital Government Research' (2004) 22(1) Social Science Computer Review 85.

— 'Weak Democracy, Strong Information: The Role of Information Technology in the Rulemaking Process', in Mayer-Schönberger V and Lazer D (eds), *From Electronic Government to Information Government: Governing in the 21st Century* (MIT Press 2007).

Coglianese C, Zeckhauser RJ, and Parson E, 'Seeking Truth for Power: Informational Strategy and Regulatory Policy Making' (2004) 89 Minnesota Law Review 277.

Cohen JE, *Configuring the Networked Self: Law, Code, and the Play of Everyday Practice* (Yale University Press 2012).

Cohen MA, 'Information as a Policy Instrument in Protecting the Environment: What Have We Learned?' (2001) 31(4) Environmental Law Reporter 10425.

Cohn M, 'Fuzzy Legality in Regulation: The Legislative Mandate Revisited' (2001) 23(4) Law and Policy 469.

Cole DH, *Pollution and Property: Comparing Ownership Institutions for Environmental Protection* (Cambridge University Press 2002).

Colley J and others, 'Exploring Energy Monitoring in the Wild' (2011) ⟨http://de2011.computing.dundee.ac.uk/wp-content/uploads/2011/10/Exploring-energy-monitoring-in-the-wild.pdf⟩ accessed 27 August 2014.

Collins HM and Yearley S, 'Epistemological Chicken' in Pickering A (ed), *Science as Practice and Culture* (University of Chicago Press 1992).

Committee on Science for EPA's Future, *Science for Environmental Protection: The Road Ahead* (The National Academies Press 2012).

Concannon HMG, 'Using Information Technology to Assist Tribunal Decision-Making' (1996) 3(2) Journal of Social Security Law 59.

Connery N and Hodnett D, *Regulatory Law in Ireland* (Tottel Publishing 2009).

Conservation International, 'Tropical Ecology, Assessment and Monitoring Network' ⟨http://www.teamnetwork.org⟩ accessed 27 August 2014.

Consolvo S, Landay JA, and McDonald DW, 'Designing for Behavior Change in Everyday Life' (2009) 405 Computer 100.

Constantinides P and Barrett M, 'Large-Scale ICT Innovation, Power, and Organizational Change: The Case of a Regional Health Information Network' (2006) 42(1) Journal of Applied Behavioral Science 76.

Corbett C, 'The Future of Digital Government' in Pavlichev A and Garson GD (eds), *Digital Government: Principles and Best Practices* (IGI Global 2004).

Corbett J, 'Using Information Systems to Improve Energy Efficiency: Do Smart Meters Make a Difference?' (2013) 15(5) Information Systems Frontiers 747.

Corbett JM and Keller CP, 'Empowerment and Participatory Geographic Information and Multimedia Systems: Observations From Two Communities in In-

donesia' (2004) 2(2) Information Technologies and International Development 25.

Cordella A, 'Information Infrastructure: An Actor-Network Perspective' (2010) 2(1) International Journal of Actor-Network Theory and Technological Innovation 27.

Cordella A and Iannacci F, 'Information systems in the public sector: The e-Government enactment framework' (2010) 19(1) Journal of Strategic Information Systems 52.

Cordella A and Shaikh M, 'Actor Network Theory and After: What's New for is Research' in *European Conference on Information Systems* (AIS 2003).

— 'From Epistemology to Ontology: Challenging the Constructed "Truth' of ANT' (*Department of Information systems, London School of Economics and Political Science*, 2006) ⟨http://is2.lse.ac.uk/wp/pdf/wp143.pdf⟩ accessed 19 May 2014.

Corrigan R, *Digital Decision Making* (Springer 2007).

Cotterrell R, 'Interdisciplinarity: The Expansion of Knowledge and the Design of Research' (1979) 11(3) Higher Education Review 47.

— 'Law in Social Theory and Social Theory in the Study of Law', in Sarat A (ed), *The Blackwell Companion to Law and Society* (Blackwell Publishing Ltd 2004).

Cowan D and Carr H, 'Actor-Network Theory, Implementation, and the Private Landlord' (2008) 35 Journal of Law and Society 149.

Cox N, 'The Relationship Between Law, Government, Business and Technology' (2006) 8 Duquesne Business Law Journal 31.

— 'Constitutional Responses to Paradigmatic Shifts in Technology' (2007) ⟨http://works.bepress.com/noel_cox/2/⟩ accessed 19 May 2014.

Craglia M and others, 'Digital Earth 2020: Towards the Vision for the Next Decade' (2012) 5(1) International Journal of Digital Earth 4.

Craig P, 'Formal and Substantive Conceptions of the Rule of Law: An Analytical Framework' [1997] Public Law 467.

Craik N, *The International Law of Environmental Impact Assessment: Process, Substance and Integration* (Cambridge University Press 2008).

Cramer BW, 'The Human Right to Information, the Environment and Information About the Environment: From the Universal Declaration to the Aarhus Convention' (2009) 14(1) Communication Law and Policy 73.

Cresswell JW, *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (Sage 2007).

Cresswell KM, Worth A, and Sheikh A, 'Actor-Network Theory and Its Role in Understanding the Implementation of Information Technology Developments in Healthcare' (2010) 10:67 BMC Medical Informatics and Decision Making.

Croley SP, 'Theories of Regulation: Incorporating the Administrative Process' (1998) 98 Columbia Law Review 1.

Cullen R, 'Defining Transformation: An E-Government or E-Governance Paradigm?' in Scholl HJ (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010).

Culver K, 'How the New ICTs Matter to the Theory of Law' (2004) 17 Canadian Journal of Law and Jurisprudence 255.

— 'E-Government as a New Frontier for Legal Theory', in Anttiroiko A.-V and Mälkiä M (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

Curry MR, 'GIS and the Inevitability of Ethical Inconsistency' in Pickles J (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995).

Curtin DM, 'Citizens' Fundamental Right of Access to EU Information: An Evolving Digital Passepartout?' (2000) 37 Common Market Law Review 7.

Czarniawksa B, 'How Institutions Are Inscribed in Technical Objects and What it May Mean in the Case of the Internet' in Contini F and Lanzara GF (eds),

ICT and Innovation in the Public Sector: European Studies in the Making of E-Government (Palgrave Macmillan 2009).

Czarniawska B and Hernes T, 'Constructing Macro Actors According to ANT' in Czarniawska B and Hernes T (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005).

Danziger JN and others, *Computers and Politics: High Technology in American Local Governments* (Columbia University Press 1982).

Dao V, Langella I, and Carbo J, 'From Green to Sustainability: Information Technology and an Integrated Sustainability Framework' (2011) 20(1) The Journal of Strategic Information Systems 63.

Darby S, 'The effectiveness of feedback on energy consumption: A Review for Defra of the literature on metering, billing and direct displays' (2006) ⟨http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf⟩ accessed 19 May 2014.

Dator J, 'Communication Technologies and the Future of Courts and Law' in Muller S and others (eds), *The Law of the Future and the Future of Law: Volume II* (Torkel Opsahl Academic EPublisher 2012).

Davenport TH, *Information Ecology: Mastering the Information and Knowledge Environment* (Oxford University Press 1997).

Davidson DJ and Frickel S, 'Understanding Environmental Governance: A Critical Review' (2004) 17(4) Organization and Environment 471.

Davies L and Mitchell G, 'The Dual Nature of the Impact of IT on Organizational Transformations' in Baskerville R and others (eds), *Proceedings of the IFIP WG8. 2 Working Conference on Information Technology and New Emergent Forms of Organizations: Transforming Organizations with Information Technology* (North-Holland Publishing Co 1994).

Davis E, 'Information Everywhere' in Scammell A (ed), *I in the Sky: Visions of the Information Future* (Fitzroy Dearborn 2000).

Davis KC, *Discretionary Justice: A Preliminary Inquiry* (University of Illinois Press 1971).

de Búrca G and Scott J, 'Introduction: New Governance, Law and Constitutionalism' in de Búrca G and Scott J (eds), *Law and New Governance in the EU and the US* (Hart Publishing 2006).

de Leeuw J and others, 'The Function of Remote Sensing in Support of Environmental Policy' (2010) 2(7) Remote Sensing 1731.

de Sherbinin A and Giri C, 'Remote sensing in support of multilateral environmental agreements: what have we learned from pilot applications?' (Rio de Janeiro, 2001) ⟨http://sedac.ciesin.columbia.edu/rs-treaties/adesherbinin_riopaper.pdf⟩ accessed 27 August 2014.

de Sherbinin A, Kline K, and Raustiala K, 'Remote Sensing Data: Valuable Support for Environmental Treaties' (2002) 44(1) Environment 20.

de Sherbinin AM, 'Remote sensing in support of ecosystem management treaties and transboundary conservation' (2005) ⟨http://sedac.ciesin.columbia.edu/rs-treaties/laguna.html⟩ accessed 19 May 2014.

de Silva L, 'Environmental E-Governance' in Janowski T and Pardo TA (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (icegov '08)* (Association for Computing Machinery 2008).

de Vries K and van Dijk N, 'A Bump in the Road. Ruling Out Law From Technology' (2013) 25 Ius Gentium: Comparative Perspectives on Law and Justice 89.

Dean M, 'Putting the Technological Into Government' (1996) 9(3) History of the Human Sciences 47.

— *Governmentality: Power and Rule in Modern Society* (Sage 1999).

Decker M and Fleischer T, 'Participation in 'Big Style': First Observations at the German Citizens' Dialogue on Future Technologies' (2012) 9(1-2) Poiesis and Praxis 81.

Delvenne P, Fallon C, and Brunet S, 'Parliamentary Technology Assessment Institutions as Indications of Reflexive Modernization' (2011) 33 Technology in Society 36.

Demmke C, 'Implementation of Environmental Policy and Law in the United States and the European Union' in Vig NJ and Faure MG (eds), *Green Giants?: Environmental Policies of the United States and the European Union* (MIT Press 2004).

Denecken S, 'Environmental Compliance Management' in Minier P and Susini A (eds), *Proceedings of the 18th International Conference Informatics for Environmental Protection: Enviroinfo 2004* (Editions du Tricorne 2004).

Desrosières A, *The Politics of Large Numbers: A History of Statistical Reasoning* (Harvard University Press 1998).

Dicey AV, *The Law of the Constitution* (MAssociation for Computing Machineryillan 1924).

Diez E and McIntosh BS, 'Organisational Drivers for, Constraints on and Impacts of Decision and Information Support Tool Use in Desertification Policy and Management' (2011) 26(3) Environmental Modelling and Software 317.

DiMento JFC and Ingram H, 'Science and Environmental Decision Making: The Potential Role of Environmental Impact Assessment in the Pursuit of Appropriate Information' (2005) 45 Natural Resources Journal 283.

Dingwerth K and Eichinger M, 'Tamed Transparency: How Information Disclosure Under the Global Reporting Initiative Fails to Empower' (2010) 10(3) Global Environmental Politics 74.

Dobson PJ, 'Critical Realism as an Underlying Philosophy for IS Research' in Khosrow-Pour M (ed), *Encyclopedia of Information Science and Technology* (Information Science Reference 2005).

Dolwick J, '"The Social" and Beyond: Introducing Actor-Network Theory' (2009) 4(1) Journal of Maritime Archaeology 21.

Donovan K, 'Seeing Like a Slum: Towards Open, Deliberative Development' (2012) 13(1) Georgetown Journal of International Affairs 97.

Doolin B, 'Information Technology as Disciplinary Technology: Being Critical in Interpretive Research on Information Systems' (1998) 13(4) Journal of Information Technology 301.

Doolin B and Lowe A, 'To Reveal is to Critique: Actor-Network Theory and Critical Information Systems Research' (2002) 17(2) Journal of Information Technology 69.

Doremus H, 'Scientific and Political Integrity in Environmental Policy' (2008) 86 Texas Law Review 1600.

— 'Institutional Architecture and Information Flow' (*Information and Communications Technology for Environmental Regulation: Developing a Research Agenda*, Galway, 2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

Driesen DM, 'Sustainable Development and Market Liberalism's Shotgun Wedding: Emissions Trading Under the Kyoto Protocol' (2008) 83 Indiana Law Journal 21.

Dudley SE, 'It is Time to Reevaluate the Toxic Release Inventory' (2004) 12 Missouri Environmental Law and Policy Review 1.

Dunleavy P, 'Governance and State Organization in the Digital Era' in Mansell R and others (eds), *The Oxford Handbook of Information and Communication Technologies* (Oxford University Press 2007).

Dunleavy P and Hood C, 'From Old Public Administration to New Public Management' (1994) 14(3) Public Money and Management 9.

Dunleavy P and Margetts H, 'The Second Wave of Digital Era Governance' [2010] Philosophical Transactions A.

Dunleavy P and others, 'New Public Management is Dead—Long Live Digital-Era Governance' (2006) 16(3) Journal of Public Administration Research and Theory 467.

— *Digital Era Governance: IT Corporations, the State and E-Government* (Oxford University Press 2008).

Dutton WH and Kraemer KL, *Modeling as Negotiating: The Political Dynamics of Computer Models in the Policy Process* (Ablex Publishing Corporation 1985).

Edgerton D, *The Shock of the Old: Technology and Global History Since 1900* (Profile Books 2008).

Edwards D and Thomas JC, 'Developing a Municipal Performance-Measurement System: Reflections on the Atlanta Dashboard' (2005) 65(3) The Reflective Practitioner 369.

Edwards PN, 'From "Impact" to Social Process: Computers in Society and Culture' in Jasanoff S and others (eds), *Handbook of Science and Technology Studies* (Sage 1994).

Eggers WD, *Government 2.0: Using Technology to Improve Education, Cut Red Tape, Reduce Gridlock, and Enhance Democracy* (Rowman and Littlefield 2007).

Elder-Vass D, 'Searching for Realism, Structure and Agency in Actor Network Theory' (2008) 59(3) Law and Society Review 455.

Erling UM, 'Approaches to Integrated Pollution Control in the United States and the European Union' (2001) 15 Tulane Environmental Law Journal 1.

Ernevi A, Palm S, and Redström J, 'Erratic Appliances and Energy Awareness' (2007) 20(1) Knowledge Technology and Policy 71.

Esty DC, 'Environmental Protection in the Information Age' (2004) 79 New York University Law Review 115.

European Commission, 'Openness in the Community' (Communication) COM (1993) 258 final.

European Commission, 'Public Access to the Institutions' Documents' (Communication) COM (1993) 191 final.

European Commission, 'Information and Communication Technologies in Development. The Role of ICTs in EC Development Policy.' (Communication) COM (2001) 770 final.

European Commission for Democracy through the Law, *Report on the Rule of Law* (2011).

Fallon Jr RH, '"The Rule of Law" as a Concept in Constitutional Discourse' (1997) 97 Columbia Law Review 1.

Farber DA, 'Triangulating the Future of Reinvention: Three Emerging Models of Environmental Protection' [2000] University Of Illinois Law Review 61.

— 'Bringing Environmental Assessment Into the Digital Age', in Holder J and McGillivray D (eds), *Taking Stock of Environmental Assessment: Law, Policy and Practice* (Routledge-Cavendish 2007).

Faulkner A, Lange B, and Lawless C, 'Introduction: Material Worlds: Intersections of Law, Science, Technology, and Society' (2012) 39(1) Journal of Law and Society 1.

Feldman M and Pentland B, 'Organizational Routines and the Macro-Actor' in Czarniawska B and Hernes T (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005).

Fenster M, 'The Opacity of Transparency' (2006) 91 Iowa Law Review 885.

Ferlie E and others, *The New Public Management in Action* (Oxford University Press 1996).

Fine JD and Owen D, 'Technocracy and Democracy: Conflicts Between Models and Participation in Environmental Law and Planning' (2004) 56 Hastings Law Journal 901.

Finger M, 'E-Gov and Public Sector Reform: What Roles for Government in E-Government?' in Janowski T and Davies J (eds), *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance (icegov '09)* (Association for Computing Machinery 2009).

Finger M and Langenberg T, 'Electronic Governance' in Anttiroiko A.-V and Mälkiä M (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

Finger M and Pécoud G, 'From E-Government to E-Governance? Towards a Model of E-Governance' (2003) 1(1) Electronic Journal of e-Government 1.

Fisher E, 'Drowning By Numbers: Standard Setting in Risk Regulation and the Pursuit of Accountable Public Administration' (2000) 20 Oxford Journal of Legal Studies 109.

Fisher E, Pascual P, and Wagner WE, 'Understanding Environmental Models in Their Legal and Regulatory Context' (2010) 22(2) Journal of Environmental Law 251.

Fisher E and others, 'Maturity and Methodology: Starting a Debate About Environmental Law Scholarship' (2009) 21(2) Journal of Environmental Law 213.

Fitzgerald B, 'The Use of Systems Development Methodologies in Practice: A Field Study' (1997) 7(3) Information Systems Journal 201.

Flanagan M, Howe D, and Nissenbaum H, 'Embodying Values in Technology: Theory and Practice' in van den Hoven J and Weckert J (eds), *Information Technology and Moral Philosophy* (Cambridge University Press 2008).

Fletcher GP, *Basic Concepts of Legal Thought* (Oxford University Press 1996).

Foth M and others, 'Pervasive Computing and Environmental Sustainability: Two Conference Workshops' (2009) 8(1) IEEE Pervasive Computing 78.

Foucault M, *Discipline and Punish: The Birth of the Prison* (Pantheon 1977).

Fountain JE, 'The Virtual State: Toward a Theory of Federal Bureaucracy in the 21st Century' in Kamarck EC and Nye JS (eds), *Democracy.com? Governance in a Networked World* (Hollis Publishing 1999).

Fountain JE, *Building the Virtual State: Information Technology and Institutional Change* (Brookings Institution Press 2001).

Freeman J and Farber DA, 'Modular Environmental Regulation' (2005) 54(4) Duke Law Journal 795.

Fremont J, 'Computerized Administrative Decision Making and Fundamental Rights' (1994) 32 Osgoode Hall Law Journal 817.

Friedman B and Nissenbaum H, 'Bias in Computer Systems' (1996) 14(3) ACM Transactions on Information Systems 330.

Frissen PHA, *Politics, Governance and Technology: A Postmodern Narrative on the Virtual State* (Edward Elgar 1999).

Fuller DO, 'Tropical Forest Monitoring and Remote Sensing: A New Era of Transparency in Forest Governance?' (2006) 27(1) Singapore Journal of Tropical Geography 15.

Fuller LL, *The Morality of Law* (2nd edn, Yale University Press 1969).

Fung A, Graham M, and Weil D, *Full Disclosure: The Perils and Promise of Transparency* (Cambridge University Press 2007).

Fung A and O'Rourke D, 'Reinventing Environmental Regulation From the Grassroots Up: Explaining and Expanding the Success of the Toxics Release Inventory' (2000) 25(2) Environmental Management 115.

Gabrynowicz JI, *The Land Remote Sensing Laws and Policies of National Government: A Global Survey* (National Center for Remote Sensing, Air, and Space Law 2007).

Galliers R, 'Choosing Appropriate Information Systems Research Approaches: A Revised Taxonomy' in Galliers RD (ed), *Information Systems Research: Issues, Methods and Practical Guidelines* (Blackwell Scientific 1992).

Galligan DJ, *Discretionary Powers: A Legal Study of Official Discretion* (Oxford University Press 1990).

Galligan D, 'Public Law' in Thomas PA (ed), *Socio-Legal Studies* (Dartmouth, Aldershot 1997).

Galligan DJ, *Due Process and Fair Procedures: A Study of Administrative Procedures* (Clarendon Press 1996).

Gamberini L and others, 'Tailoring Feedback to Users' Actions in a Persuasive Game for Household Electricity Conservation' in Bang M and Ragnemalm EL (eds), *Persuasive Technology. Design for Health and Safety* (Springer 2012).

Gasco M, 'Civil Servants' Resistance Toward E-Government Development' in Anttiroiko A.-V and Mälkiä M (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

Gellings CW, *The Smart Grid: Enabling Energy Efficiency and Demand Response* (Fairmont Press 2009).

Georgiadou Y and Stoter J, 'Studying the Use of Geo-Information in Government—A Conceptual Framework' (2010) 34(1) Computers, Environment and Urban Systems 70.

Georgiadou Y and others, 'Sensors, Empowerment, and Accountability: A Digital Earth View From East Africa' (2011) 4(4) International Journal of Digital Earth 285.

Germain S, Douillet A.-C, and Dumoulin L, 'The Legitimization of CCTV as a Policy Tool: Genesis and Stabilization of a Socio-Technical Device in Three French Cities' (2012) 52(2) British Journal of Criminology 294.

Gerrard MB and Herz ME, 'Harnessing Information Technology to Improve the Environmental Impact Review Process' (2003) 12 New York University Environmental Law Journal 18.

Gherardi S and Nicolini D, 'Actor-Networks: Ecology and Entrepreneurs' in Czarniawska B and Hernes T (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005).

Giles C, 'Next Generation Compliance' [2013] The Environmental Forum 22.

Gil-Garcia JR, 'Towards a Smart State? Inter-Agency Collaboration, Information Integration, and Beyond' (2012) 17(3) Information Polity 269.

Giupponi C, 'Decision Support Systems for Implementing the European Water Framework Directive: The Mulino Approach' (2007) 22(2) Environmental Modelling and Software 248.

Gleick J, *The Information* (Fourth Estate 2012).

GoodGuide, 'Scorecard' (2014) ⟨http://www.scorecard.org⟩ accessed 27 August 2014.

Goodhart CAE, *Monetary Theory and Practice: The UK Experience* (MAssociation for Computing Machineryillan 1984).

Goodwin I, 'The Internet, Organisational Change and Community Engagement: The Case of Birmingham City Council' (2005) 23(4) Prometheus 367.

Goth G, 'Turning Data Into Knowledge' (2010) 53(11) Communications of the ACM 13.

Gouldson A, 'Risk, Regulation and the Right to Know: Exploring the Impacts of Access to Information on the Governance of Environmental Risk' (2004) 12(3) Sustainable Development 136.

Gouveia C and Fonseca A, 'New Approaches to Environmental Monitoring: The Use of ICT to Explore Volunteered Geographic Information' (2008) 72(3-4) GeoJournal 185.

Gouveia C and others, 'Promoting the Use of Environmental Data Collected By Concerned Citizens Through Information and Communication Technologies' (2004) 71(2) Journal of Environmental Management 135.

Grabosky PN, 'Beyond the Regulatory State' (1994) 27(2) Australian and New Zealand Journal of Criminology 192.

Grady KE and Wallston BS, *Research in Health Care Settings* (Sage 1988).

Graham M, 'Information as risk regulation: Lessons from experience' (2001) ⟨http://www.transparencypolicy.net/assets/information.pdf⟩ accessed 27 August 2014.

— *Democracy By Disclosure: The Rise of Technopopulism* (Brookings Institution Press 2002).

Greenawalt K, *Law and Objectivity* (Oxford University Press 1992).

Greenfield A, *Everyware: The Dawning Age of Ubiquitous Computing* (New Riders Publishing 2006).

Grimmelikhuijsen S, 'A Good Man But a Bad Wizard. About the Limits and Future of Transparency of Democratic Governments' (2012) 17(3) Information Polity 293.

Grimmelmann J, 'Regulation By Software' (2005) 114(7) Yale Law Journal 1721.

Grint K and Woolgar S, *The Machine At Work: Technology, Organisation and Work* (Polity Press 1997).

Grönlund Å, 'Electronic Government' in Anttiroiko A.-V and Mälkiä M (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

— 'The Rise and Fall (?) of Participatory Electronic Information Infrastructures', in Mayer-Schönberger V and Lazer D (eds), *Governance and Information Technology: From Electronic Government to Information Government* (MIT Press 2007).

Groothuis M, 'Applying ICTs in Juridical Decision Making By Government Agencies' in Annttiroiko A.-V and Mälkiä M (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

Groothuis MM and Svensson JS, 'Expert System Support and Juridical Quality' in Breuker J, Leenes R, and Winkels R (eds), *Proceedings of Jurix* (Foundation for Legal Knowledge Based Systems 2000).

Gross KL and Mittelbach GG, 'What Maintains the Integrity of Science: An Essay for Nonscientists' (2008) 58 Emory Law Journal 341.

Guest G, Bunce A, and Johnson L, 'How Many Interviews Are Enough? An Experiment With Data Saturation and Variability' (2006) 18(1) Field Methods 59.

Gunningham N, 'Environment Law, Regulation and Governance: Shifting Architectures' (2009) 21(2) Journal of Environmental Law 179.

— 'The New Collaborative Environmental Governance: The Localization of Regulation' (2009) 36(1) Journal of Law and Society 145.

Gunningham N, Kagan RA, and Thornton D, 'Social License and Environmental Protection: Why Businesses Go Beyond Compliance' (2004) 29(2) Law and Social Inquiry 307.

Günther O, *Environmental Information Systems* (Springer-Verlag 1997).

Günther O, Radermacher FJ, and Riekert W.-F, 'Environmental Monitoring: Models, Methods, and Systems' in Avouris NM and Page B (eds), *Environmental Informatics—Methodology and Applications of Environmental Information Processing* (Kluwer Academic 1995).

Haklay M, 'Neogeography and the Delusion of Democratisation' (2013) 45(1) Environment and Planning A 55.

Haklay ME, 'Public Environmental Information Systems: Challenges and Perspectives' (PhD thesis, Department of Geography, University College London 2002).

— 'The Contradictions of Access to Environmental Information and Public Participation in Decision Making', in *Nordic Environmental Social Science 2009* (2009).

Hamilton JT, *Regulation Through Revelation: The Origin, Politics, and Impacts of the Toxics Release Inventory Program* (Cambridge University Press 2005).

— *Conserving Data in the Conservation Reserve: How a Regulatory Program Runs on Imperfect Information* (RGG Press 2010).

Hammersley M, 'The Issue of Quality in Qualitative Research' (2007) 30(3) International Journal of Research and Method in Education 287.

Hancher L and Moran M, 'Organizing Regulatory Space' in Baldwin R, Scott C, and Hood C (eds), *A Reader on Regulation* (Oxford University Press 1989).

Hankey S and Ó Clunaigh D, 'Rethinking Risk and Security of Human Rights Defenders in the Digital Age' (2013) 5(3) Journal of Human Rights Practice 535.

Hanseth O and Monteiro E, 'Understanding Information Infrastructure' (1998) ⟨http://heim.ifi.uio.no/oleha/Publications/bok.pdf⟩ accessed 27 August 2014.

Harlow C and Rawlings R, *Law and Administration* (Cambridge University Press 1997).

Harman J, 'Environmental Regulation in the 21st Century' (2004) 6 Environmental Law Review 141.

Harris TM and others, 'Pursuing Social Goals Through Participatory GIS: Redressing South Africa's Historical Political Ecology' in Pickles J (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995).

Hawkins K, *Environment and Enforcement: Regulation and the Social Definition of Pollution* (Clarendon 1984).

Heeks R, 'Reinventing Government in the Information Age' in Heeks R (ed), *Reinventing Government in the Information Age: International Practice in IT-Enabled Public Sector Reform* (Routledge 1999).

Heinzerling L, 'Selling Pollution, Forcing Democracy' (1995) 14 Stanford Environmental Law Journal 300.

Henman P, *Governing Electronically: E-Government and the Reconfiguration of Public Administration, Policy, and Power* (Palgrave Macmillan 2010).

Henríquez BP, 'Information Technology: The Unsung Hero of Market-Based Environmental Policies' (2004) Fall/Winter Resources 9.

Hernon P, 'Trust in Government' in Hernon P, Cullen R, and Relyea HC (eds), *Comparative Perspectives on E-Government: Serving Today and Building for Tomorrow* (Scarecrow Press 2006).

Hernon P and Cullen R, 'E-Government: Transforming Government' in Hernon P, Cullen R, and Relyea HC (eds), *Comparative Perspectives on E-Government: Serving Today and Building for Tomorrow* (Scarecrow Press 2006).

Herrick CN, 'Objectivity Versus Narrative Coherence: Science, Environmental Policy, and the US Data Quality Act' (2004) 7(5) Environmental Science and Policy 419.

Herz M, 'Using Social Media in Rulemaking: Possibilities and Barriers' (*Cardozo Legal Studies Research Paper*, 2013) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2371406⟩ accessed 27 August 2014.

Heusser FI, 'Understanding Open Government Data' (2012) ⟨http://www.od4d.org/wp-content/uploads/2012/10/OGD-Paper-1-DRAFT-20120618.pdf⟩ accessed 19 May 2014.

Hey T, 'The Next Scientific Revolution' (2010) 88(11) Harvard Business Review 56.

Hildebrandt M, 'Technology and the End of Law' in *Facing the Limits of the Law* (Springer 2009).

— 'Prefatory Remarks on Human Law and Computer Law', in *Human Law and Computer Law: Comparative Perspectives* (Springer 2013).

Hildebrandt M and Koops B.-J, 'A Vision of Ambient Law' (*Future of Identity in Information Society*, 2007) ⟨http://www.fidis.net/resources/fidis-deliverables/profiling/d79-a-vision-of-ambient-law/⟩ accessed 27 August 2014.

— 'The Challenges of Ambient Law and Legal Protection in the Profiling Era' (2010) 73(3) Modern Law Review 428.

Hilson C, *Regulating Pollution: A UK and EC Perspective* (Hart 2000).

Hilty LM, Seifert EK, and Treibert R, *Information Systems for Sustainable Development* (IGI Global 2005).

Hirsch DD, 'Globalization, Information Technology, and Environmental Regulation: An Initial Inquiry' (2001) 20 Virginia Environmental Law Journal 57.

Hirsch DD, 'Symposium Introduction: Second Generation Policy and the New Economy' (2001) 29 Capital University Law Review 1.

Hodge SH, 'Satellite Data and Environmental Law: Technology Ripe for Litigation Application' (1996) 14 Pace Environmental Law Review 691.

Holder J and Lee M, *Environmental Protection, Law and Policy: Text and Materials* (Cambridge University Press 2007).

Holmström J and Robey D, 'Inscribing Organizational Change With Information Technology' in Czarniawska B and Hernes T (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005).

Hood C, 'A Public Management for All Seasons?' (1991) 69(1) Public Administration 3.

Hood CC and Margetts HZ, *The Tools of Government in the Digital Age* (Palgrave Macmillan 2007).

Hood C, Rothstein H, and Baldwin R, *The Government of Risk: Understanding Risk Regulation Regimes* (Oxford University Press 2001).

Houck O, 'Tales From a Troubled Marriage: Science and Law in Environmental Policy' (2003) 302 Science 1926.

Howard PN and others, 'Opening Closed Regimes: What Was the Role Of Social Media During the Arab Spring?' (2011) ⟨http://pitpi.org/index.php/2011/09/11/opening-closed-regimes-what-was-the-role-of-social-media-during-the-arab-spring/⟩ accessed 19 May 2014.

Howarth W, 'The Progression Towards Ecological Quality Standards' (2006) 18(1) Journal of Environmental Law 3.

Howcroft D and Fitzgerald B, 'From Utopia to Dystopia: The Twin Faces of the Internet' in Larsen TJ, Levine L, and DeGross JI (eds), *Information Systems: Current Issues and Future Changes, Proceedings of IFIP WG8.2* (1998).

Howcroft D, Mitev N, and Wilson M, 'What We May Learn From the Social Shaping of Technology Approach' in Willcocks LP and Mingers J (eds), *Social*

Theory and Philosophy for Information Systems (John Wiley and Sons, Ltd 2004).

Howells G, 'The Potential and Limits of Consumer Empowerment By Information' (2005) 32(3) Journal of Law and Society 349.

Hunn N, 'Smart Metering is FCUKED' (2013) ⟨http://www.nickhunn.com/smart-metering-is-fcuked/⟩ accessed 19 May 2014.

Huppert D and Knapp G, 'Technology and Property Rights in Fisheries Management' in Anderson TL and Hill PJ (eds), *The Technology of Property Rights* (Rowman and Littlefield 2001).

Hutton N, 'Sentencing, Rationality, and Computer Technology' [1995] Journal of Law and Society 549.

— 'From Intuition to Database: Translating Justice' (2013) 17(1) Theoretical Criminology 109.

ICT4ER, 'Information and Communications Technology for Environmental Regulation: Developing a Research Agenda' (2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

Introna LD, *Management, Information and Power* (MAssociation for Computing Machineryillan London 1997).

Ison TG, '"Administrative Justice", Is It Such a Good Idea?' in Harris M and Partington M (eds), *Administrative Justice in the 21st Century* (Hart Publishing 1999).

Ito A, *Legal Aspects of Satellite Remote Sensing* (Martinus Nijhoff Publishers 2011).

Jackson S, 'Water Models and Water Politics: Design, Deliberation, and Virtual Accountability' in *Proceedings of the 2006 International Conference on Digital Government Research* (Digital Government Society of North America 2006).

Jansen A and Løvdal E, 'Can ICT Reform Public Agencies?' in Wimmer MA and others (eds), *Electronic Government 8th International Conference (EGOV 2009)* (Springer 2009).

Jasanoff S, *The Fifth Branch: Science Advisers as Policymakers* (Harvard University Press 1994).

— 'Just Evidence: The Limits of Science in the Legal Process' (2006) 34(2) Journal of Law, Medicine and Ethics 328.

Joerges B and Czarniawska B, 'The Question of Technology, or How Organizations Inscribe the World' (1998) 19(3) Organization Studies 363.

Johnson JA, 'From Open Data to Information Justice' in *Midwest Political Science Association Annual Conference* (2013).

Johnson J, 'Mixing Humans and Nonhumans Together: The Sociology of a Door-Closer' [1988] Social Problems 298.

Jones J, 'Regulatory Design for Scientific Uncertainty: Acknowledging the Diversity of Approaches in Environmental Regulation and Public Administration' (2007) 19(3) Journal of Environmental Law 347.

Jordan A, Wurzel KW, and Zito A, 'The Rise of "New" Policy Instruments in Comparative Perspective: Has Governance Eclipsed Government?' (2005) 53(3) Political Studies 477.

Jordan A, Wurzel RKW, and Zito AR, 'Comparative Conclusions—"New" Environmental Policy Instruments: An Evolution or a Revolution in Environmental Policy?' (2003) 12(1) Environmental Politics 201.

— '"New" Instruments of Environmental Governance: Patterns and Pathways of Change' (2003) 12 Environmental Politics 1.

Kagan RA, *Regulatory Justice: Implementing a Wage-Price Freeze* (Russell Sage Foundation 1978).

Kallinikos J, 'Farewell to Constructivism: Technology and Context-Embedded Action' in Avgerou C, Ciborra C, and Land F (eds), *The Social Study of Informa-*

tion and Communication Technology: Innovation, Actors and Contexts (Oxford University Press 2004).

Kallinikos J, *The Consequences of Information: Institutional Implications of Technological Change* (Edward Elgar Publishing 2006).

— *Governing Through Technology: Information Artefacts and Social Practice* (Palgrave Macmillan 2011).

Karkkainen BC, 'Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?' (2001) 89 Georgetown Law Journal 257.

— 'Environmental Lawyering in the Age of Collaboration' [2002] Wisconsin Law Review 555.

— 'Information-Forcing Environmental Regulation' (2005) 33 Florida State University Law Review 861.

Karkkainnen B, 'Keynote: "You manage what you measure": Information, Incentives, and the Architecture of Environmental Regulation' (*Information and Communications Technology for Environmental Regulation: Developing a Research Agenda*, Galway, 2013) ⟨http://ict4er.org/ict4er-2013/⟩ accessed 19 May 2014.

Keohane RO and Nye Jr JS, 'Power and Interdependence in the Information Age' [1998] Foreign Affairs 81.

Kernaghan K and Gunraj J, 'Integrating Information Technology Into Public Administration: Conceptual and Practical Considerations' (2004) 47(4) Canadian Public Administration 525.

Kerret D, 'Don't Judge a Book By Its Cover: Use of an Analytic Framework and Empirical Data in Analyzing Environmental Policy Tools' (2012) 42 Environmental Law Reporter 10078.

Kesan J and Shah R, 'Deconstructing Code' (2004) 6 Yale Journal of Law and Technology 277.

— 'Open Standards in Electronic Governance: Promises and Pitfalls', in Janowski T and Pardo TA (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (ICEGOV '08)* (Association for Computing Machinery 2008).

Kettl DF, 'Public Administration At the Millennium: The State of the Field' (2000) 10(1) Journal of Public Administration Research and Theory 7.

Khanna M, Quimio WRH, and Bojilova D, 'Toxics Release Information: A Policy Tool for Environmental Protection' (1998) 36(3) Journal of Environmental Economics and Management 243.

Kim G.-H, Trimi S, and Chung J.-H, 'Big-Data Applications in the Government Sector' (2014) 57(3) Communications of the ACM 78.

King JL and Kraemer KL, 'Models, Facts, and the Policy Process: The Political Ecology of Estimated Truth' in Goodchild MF, Parks BO, and Steyaert LT (eds), *Environmental Modeling With GIS* (Oxford University Press 1993).

Kingston S, 'Environment' (2010) 59(4) International and Comparative Law Quarterly 1129.

Klijn EH, 'New Public Management and Governance: A Comparison' in Levi-Faur D (ed), *The Oxford Handbook of Governance* (Oxford University Press 2012).

Kline K and Raustiala K, 'International Environmental Agreements and Remote Sensing Technologies' in *Workshop on Remote Sensing and Environmental Treaties: Building More Effective Linkages* (Socioeconomic Data and Applications Center 2000).

Knights D and Murray F, *Managers Divided: Organisation Politics and Information Technology Management* (Wiley 1994).

Knights D, Murray F, and Willmott H, 'Networking as Knowledge Work: A Study of Strategic Inter-Organizational Development in the Financial Services Industry' (1993) 30(6) Journal of Management Studies 975.

Koehler DA and Spengler JD, 'The Toxic Release Inventory: Fact or Fiction? A Case Study of the Primary Aluminum Industry' (2007) 85(2) Journal of Environmental Management 296.

Konar S and Cohen MA, 'Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions' (1997) 32(1) Journal of Environmental Economics and Management 109.

Koops B.-J, 'Criteria for Normative Technology: The Acceptability of "Code as Law" in Light of Democratic and Constitutional Values' in Brownsword R and Yeung K (eds), *Regulating Technologies* (Hart Publishing 2008).

— 'Law, Technology, and Shifting Power Relations' [2009] Berkeley Technology Law Journal 973.

Korac-Kakabadse A and Korac-Kakabadse N, 'Information Technology's Impact on the Quality of Democracy: Re-Inventing the "Democratic Vessel"' in Heeks R (ed), *Reinventing Government in the Information Age: International Practice in it-Enabled Public Sector Reform* (Routledge 1999).

Koro-Ljungberg M, 'Validity, Responsibility, and Aporia' (2010) 16(8) Qualitative inquiry 603.

Kourti N and others, 'Integrating Remote Sensing in Fisheries Control' (2005) 12(5) Fisheries Management and Ecology 295.

Kraemer KL, *Datawars: The Politics of Modeling in Federal Policymaking* (Columbia University Press 1987).

Kraemer KL and Dedrick J, 'Computing and Public Organizations' (1997) 7(1) Journal of Public Administration Research and Theory 89.

Kraemer KL and Dutton WH, 'The Interests Served By Technological Reform: The Case of Computing' (1979) 69(4) Boston University Law Review 80.

Kraemer KL and King JL, 'Computers and the Constitution: A Helpful, Harmful or Harmless Relationship?' (1987) 47(1) Public Administration Review 93.

— 'Information Technology and Administrative Reform: Will E-Government be Different?' (2006) 2(1) International Journal of Electronic Government Research 1.

Kraft ME, Stephan M, and Abel TD, *Coming Clean: Information Disclosure and Environmental Performance* (MIT Press 2011).

Krier JE and Montgomery WD, 'Resource Allocation, Information Cost and the Form of Government Intervention' (1973) 13 Natural Resources Journal 89.

Kritzer H, 'Research is a Messy Business: An Archeology of the Craft of Socio-Legal Research' in Halliday S and Schmidt P (eds), *Conducting Law and Society Research: Reflections on Methods and Practices* (Cambridge University Press 2009).

Kuriyama I, 'Supporting Multilateral Environmental Agreement With Satellite Earth Observation' (2005) 21(2) Space Policy 151.

Kuznetsov S and Paulos E, 'Upstream: Motivating Water Conservation With Low-Cost Water Flow Sensing and Persuasive Displays' in Mynatt E and others (eds), *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2010).

Kysar DA and Salzman J, 'Foreword: Making Sense of Information for Environmental Protection' (2008) 86 Texas Law Review 1347.

Labelle R, 'ICTs for e-Environment: Guidelines for Developing Countries, with a Focus on Climate Change' (2008) ⟨http://www.itu.int/ITU-D/cyb/app/docs/itu-icts-for-e-environment.pdf⟩ accessed 19 May 2014.

Landry CJ, 'The Role of Geographic Information Systems in Water Rights Management' in Anderson TL and Hill PJ (eds), *The Technology of Property Rights* (Rowman and Littlefield 2001).

Landry M and Banville C, 'A Disciplined Methodological Pluralism for MIS Research' (1992) 2(2) Accounting, Management and Information Technologies 77.

Lanzara GF, 'Building Digital Institutions: ICT and the Rise of Assemblages in Government' in Contini F and Lanzara GF (eds), *ICT and Innovation in the Public Sector: European Studies in the Making of E-Government* (Palgrave Macmillan 2009).

Lanzarone GA and Zanzi A, 'Monitoring Gas and Water Consumption Through ICTs for Improved User Awareness' (2010) 13(1) Information, Communication and Society 121.

Lash S, *Critique of Information* (Sage 2002).

Lathrop D and Ruma L (eds), *Open Government: Collaboration, Transparency, and Participation in Practice* (O'Reilly Media 2010).

Latin H, 'Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and "Fine-Tuning" Regulatory Reforms' (1985) 37 Stanford Law Review 1267.

Latin HA, Tannehill GW, and White RE, 'Remote Sensing Evidence and Environmental Law' (1976) 64(6) California Law Review 1300.

Latour B, 'The Powers of Association' [1986] Sociological Review 264.

— 'Technology is Society Made Durable', in Law J (ed), *A Sociology of Monsters: Essays on Power, Technology and Domination* (Routledge 1992).

— 'On Recalling ANT', in *Actor Network Theory and After* (Wiley 1999).

— *Reassembling the Social: An Introduction to Actor-Network Theory* (Oxford University Press 2005).

— *The Making of Law* (Polity Press 2010).

Laudon KC, *Computers and Bureaucratic Reform: The Political Functions of Urban Information Systems* (Wiley 1974).

— *Dossier Society: Value Choices in the Design of National Information Systems* (Columbia University Press 1986).

LaVigne M, 'Electronic Government: A Vision of a Future That is Already Here' (2002) 52 Syracuse Law Review 1243.

Law J, 'Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity' (1992) 5(4) Systems Practice 379.

Lawson T, *Economics and Reality* (Routledge 2006).

Lazarus RJ, 'The Greening of America and the Graying of United States Environmental Law: Reflections on Environmental Law's First Three Decades in the United States' (2001) 20 Virginia Environmental Law Journal 75.

Lee AS, 'Thinking About Social Theory and Philosophy for Information Systems' in *Social Theory and Philosophy for Information Systems* (John Wiley and Sons 2004).

Lee E, 'Information Disclosure and Environmental Regulation: Green Lights and Gray Areas' (2010) 4(3) Regulation and Governance 303.

Lee J, 'The Era of the Computer Judge' (1995) 2 UCL Jurisprudence Review 249.

Lee N and Brown S, 'Otherness and the Actor Network: The Undiscovered Continent' (1994) 37(6) American Behavioral Scientist 772.

Lee R, 'Socio-Legal Research—what's the Use' in Thomas PA (ed), *Socio-Legal Studies* (Dartmouth, Aldershot 1997).

Leech BL, 'Asking Questions: Techniques for Semistructured Interviews' (2002) 35(4) PS: Political Science and Politics 665.

Lenk K and Traunmüller R, 'Broadening the Concept of Electronic Government' in Prins JEJ (ed), *Designing e-Government* (2nd edn, Kluwer 2007).

Lessig L, *Code: And Other Laws of Cyberspace, Version 2.0* (Basic Books 2006).

Levi R and Valverde M, 'Studying Law By Association: Bruno Latour Goes to the Conseil d'État' (2008) 33(3) Law and Social Inquiry 805.

Levine ME and Forrence JL, 'Regulatory Capture, Public Interest, and the Public Agenda: Toward a Synthesis' (1990) 6 Journal of Law, Economics, and Organization 167.

Liebow D, 'DWI Source Code Motions After Underdahl' (2010) 11 Minnesota Journal of Law, Science and Technology 853.

Lipsky M, *Street-Level Bureaucracy: Dilemmas of the Individual in Public Services* (Russell Sage Foundation 2010).

Lobel O, 'The Renew Deal: The Fall of Regulation and the Rise of Governance in Contemporary Legal Thought' (2004) 89 Minnesota Law Review 262.

Löfgren K, 'The Governance of E-Government' (2007) 22(3) Public Policy and Administration 335.

Losee RM, 'A Discipline Independent Definition of Information' (1997) 48(3) Journal of the American Society for Information Science and Technology 254.

Luke TW, 'On Environmentality: Geo-Power and Eco-Knowledge in the Discourses of Contemporary Environmentalism' [1995] Cultural Critique 57.

Lukes S, *Power: A Radical View* (2nd edn, Palgrave Macmillan 2005).

Lum R, 'The Disconnect Between Civic Hacking and Democracy' (2013) ⟨http://thethirdera.com/the-disconnect-between-civic-hacking-and-democracy/⟩ accessed 19 May 2014.

Lyndon ML, 'Information Economics and Chemical Toxicity: Designing Laws to Produce and Use Data' (1989) 87 Michigan Law Review 1795.

Lyster R, 'The Effect of a Constitutionally Protected Right to Just Administrative Action' in Harris M and Partington M (eds), *Administrative Justice in the 21st Century* (Hart Publishing 1999).

Macauley MK and Brennan T, *Enforcing Environmental Regulation: Implications of Remote Sensing Technology* (Resources for the Future 1998).

MacKenzie D and Wajcman J, 'Introductory Essay' in MacKenzie D and Wajcman J (eds), *The Social Shaping of Technology* (Open University Press 1985).

MacLauchlan HW, 'Public Service Law and the New Public Management' in Taggart M (ed), *The Province of Administrative Law* (Hart Publishing 1997).

Macrory R, 'Environmental Regulation as an Instrument of Constitutional Change' in Jowell J and Oliver D (eds), *The Changing Constitution* (5th edn, Oxford University Press 2004).

— 'Environmental Law: Shifting Discretions and the New Formalism', in Macrory R (ed), *Regulation, Enforcement and Governance in Environmental Law* (Hart Publishing 2010).

— 'Regulating in a Risky Environment', in Macrory R (ed), *Regulation, Enforcement and Governance in Environmental Law* (Hart Publishing 2010).

Macrory R and Purdy R, 'The Use of Satellite Images as Evidence in Environmental Actions in Great Britain' (2001) 51 Droit et Ville 72.

Magill K, 'Against Critical Realism' (1994) 18(3) Capital and Class 113.

Majone G, 'The Rise of the Regulatory State in Europe' (1994) 17(3) West European Politics 77.

— 'The New European Agencies: Regulation By Information' (1997) 4(2) Journal of European Public Policy 262.

Malette S, 'Foucault for the Next Century: Eco-Governmentality' in Binkley S and Capetillo J (eds), *A Foucault for the 21st Century: Governmentality, Biopolitics and Discipline in the New Millennium* (Cambridge Scholars Publishing 2009).

Maniatopoulos G, 'E-Government Movements of Organizational Change: A Social Shaping Approach' in *4th International Critical Management Studies Conference: Critique and Inclusivity: Opening the Agenda* (2005).

Marche S and McNiven J, 'E-Government and E-Governance: The Future Isn't What it Used to be' (2003) 20(1) Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration 74.

Margetts H, 'The Automated State' (1995) 10 Public Policy and Administration 88.

— *Information Technology in Government: Britain and America* (Routledge 1999).

— 'Transparency and Digital Government', in Hood C and Heald D (eds), *Transparency: The Key to Better Governance?* (Oxford University Press 2006).

Margetts H and Dunleavy P, 'The Second Wave of Digital-Era Governance: A Quasi-Paradigm for Government on the Web' (2013) 371 Philosophical Trans-

actions of the Royal Society A: Mathematical, Physical and Engineering Sciences.

Markowitz KJ, 'Legal Challenges and Market Rewards to the Use and Acceptance of Remote Sensing and Digital Information as Evidence' (2002) 12 Duke Environmental Law and Policy Forum 219.

Markowitz KJ, Reeves MR, and Jamar SD, 'A View From Space' in *Digital Earth Applications in Environmental Resource Management* (The Washington College of Law at American University 2001).

Martin J, 'A Garbage Can Model of the Psychological Research Process' (1981) 25(2) American Behavioral Scientist 131.

Mashaw JL, *Bureaucratic Justice: Managing Social Security Disability Claims* (Yale University Press 1983).

Mathur P, 'Environmental Communication in the Information Society: The Blueprint From Europe' (2009) 25 The Information Society 119.

Maxwell JA, *Qualitative Research Design: An Interactive Approach* (Sage 1996).

Mayer-Schönberger V, 'Demystifying Lessig' [2008] Wisconsin Law Review 713.

Mayer-Schönberger V and Lazer D, 'From Electronic Government to Information Government' in Mayer-Schönberger V and Lazer D (eds), *Governance and Information Technology: From Electronic Government to Information Government* (MIT Press 2007).

McConville M and Chui WH, *Research Methods for Law* (Edinburgh University Press 2007).

McCracken R and Jones G, 'The Aarhus Convention' [2003] Journal of Planning and Environment Law 802.

McDonagh M, *Freedom of Information Law* (Thomson Round Hall 2006).

McDonald L, 'The Rule of Law in the "New Regulatory State"' (2004) 33 Common Law World Review 197.

McGarity TO, 'Hazardous Air Pollutants, Migrating Hot Spots, and the Prospect of Data-Driven Regulation of Complex Industrial Complexes' (2008) 86 Texas Law Review 1445.

McLean C and Hassard J, 'Symmetrical Absence/Symmetrical Absurdity: Critical Notes on the Production of Actor-Network Accounts' (2004) 41(3) Journal of Management Studies 493.

Melville NP, 'Information Systems Innovation for Environmental Sustainability' (2010) 34(1) MIS Quarterly 1.

Meneklis V and Douligeris C, 'Technological Integration: Evidence of Processes of Structuring in Governmental Organizations' in Janowski T and Pardo TA (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (ICEGOV '08)* (Association for Computing Machinery 2008).

Metcalfe L and Richards S, *Improving Public Management* (Sage 1990).

Michael DN, 'On Coping With Complexity: Planning and Politics' [1968] Daedalus 1179.

Miller JG, 'A Generational History of Environmental Law and Its Grand Themes: A Near Decade of Garrison Lectures' (2001) 19 Pace Environmental Law Review 501.

Miller P and Rose N, 'Governing Economic Life' (1990) 19(1) Economy and Society 1.

— *Governing the Present* (Polity Press 2008).

Mingers J, 'Combining IS Research Methods: Towards a Pluralist Methodology' (2001) 12(3) Information Systems Research 240.

Misuraca G, 'Futuring E-Government: Governance and Policy Implications for Designing an ICT-Enabled Knowledge Society' in Janowski T (ed), *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance (ICEGOV '09)* (Association for Computing Machinery 2009).

Mochty F and others, 'Electronic Data Management in Austrian Waste Management Act 2002' in Pillmann W and Tochtermann K (eds), *Environmental Communication in the Information Society: Proceedings of the 16th Conference* (International Society for Environmental Protection 2002).

Moere AV and others, 'Comparative Feedback in the Street: Exposing Residential Energy Consumption on House Façades' in *Human-Computer Interaction–interact 2011* (Springer 2011).

Mol APJ, 'Environmental Governance in the Information Age: The Emergence of Informational Governance' (2006) 24(4) Environment and Planning C: Government and Policy 497.

— *Environmental Reform in the Information Age: The Contours of Informational Governance* (Cambridge University Press 2008).

— 'Environmental Governance Through Information: China and Vietnam' (2009) 30(1) Singapore Journal of Tropical Geography 114.

— 'The Future of Transparency: Power, Pitfalls and Promises' (2010) 10(3) Global Environmental Politics 132.

Möllers C, 'European Governance: Meaning and Value of a Concept' (2006) 43 Common Market Law Review 313.

Moloney S and Strengers Y, '"Going Green"?: The Limitations of Behaviour Change Programmes as a Policy Response to Escalating Resource Consumption' (2014) 24(2) Environmental Policy and Governance 94.

Monteiro E, 'Actor Network Theory and Cultural Aspects of Interpretative Studies' in Avgerou C, Ciborra C, and Land F (eds), *The Social Study of Information and Communication Technology: Innovation, Actors, and Contexts* (Oxford University Press 2004).

Monteiro E and Hanseth O, 'Social Shaping of Information Infrastructure: On Being Specific About the Technology' in Orlikowski WJ and others (eds), *Infor-*

mation Technology and Changes in Organizational Work (Chapman and Hall, London 1996).

Monteiro S, Vázquez X, and Long R, 'Improving Fishery Law Enforcement in Marine Protected Areas' (2010) 1(1) Aegean Review of the Law of the Sea and Maritime Law 95.

Moran M, *The British Regulatory State: High Modernism and Hyper-Innovation* (Oxford University Press 2003).

Morgan B, *The Intersection of Rights and Regulation: New Directions in Sociolegal Scholarship* (Ashgate Publishing 2007).

Morgan B and Yeung K, *An Introduction to Law and Regulation: Text and Materials* (Cambridge University Press 2007).

Morgera E, 'The Future of Law and the Environment: The Emergence of Global Environmental Law' in Muller S and others (eds), *The Law of the Future and the Future of Law: Volume II* (Torkel Opsahl Academic EPublisher 2012).

Morison J, 'Modernising Government and the E-Government Revolution: Technologies of Government and Technologies of Democracy' in Bamforth N and Leyland P (eds), *Public Law in a Multi-Layered Constitution* (Hart Publishing 2003).

— 'Gov 2.0: Towards a User Generated State?' (2010) 73(4) Modern Law Review 551.

Morriss AP, 'The Next Generation of Mobile Source Regulation' (2008) 17 New York University Environmental Law Journal 325.

Moses LB, 'Recurring Dilemmas: The Law's Race to Keep Up With Technological Change' (2007) 7 University of Illinois Journal of Law, Technology and Policy 239.

— 'Agents of Change: How the Law Copes With Technological Change' (2011) 20 Griffith Law Review 763.

Mowshowitz A, *The Conquest of Will: Information Processing in Human Affairs* (Addison-Wesley 1976).

Munro L, 'Non-Disciplinary Power and the Network Society' (2000) 7(4) Organization 679.

Murdoch J, 'Actor-Networks and the Evolution of Economic Forms: Combining Description and Explanation in Theories of Regulation, Flexible Specialization, and Networks' (1995) 27(5) Environment and Planning A 731.

Murray A, 'Looking Back At the Law of the Horse: Why Cyberlaw and the Rule of Law Are Important' (2013) 10(3) SCRIPTed.

Murray AD, *The Regulation of Cyberspace: Control in the Online Environment* (Routledge-Cavendish 2006).

Mutch A, 'Critical Realism and Information Systems: An Exploration' in *Seventh Annual BIT Conference* (1997).

Mutch A, 'Actors and Networks or Agents and Structures: Towards a Realist View of Information Systems' (2002) 9(3) Organization 477.

Naeser RB and Smith MG, 'Enforcing Property Rights in Western Water: Is it Better to be Upstream With a Shovel or Downstream With a Model?' in Anderson TL and Hill PJ (eds), *The Technology of Property Rights* (Rowman and Littlefield 2001).

Nandhakumar J and Avison DE, 'The Fiction of Methodological Development: A Field Study of Information Systems Development' (1999) 12(2) Information Technology and People 176.

Napoli PM, 'The Algorithm as Institution: Toward a Theoretical Framework for Automated Media Production and Consumption' (*Fordham University Schools of Business Research Paper*, 2013) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2260923⟩ accessed 27 August 2014.

Nardi BA and O'Day VL, *Information Ecologies: Using Technology With Heart* (MIT Press 2000).

Natan TE and Miller CG, 'Are Toxics Release Inventory Reductions Real?' (1998) 32(15) Environmental Science and Technology 368A.

Neuman L and Calland R, 'Making the Law Work: The Challenges of Implementation' in Florini A (ed), *The Right to Know: Transparency for an Open World* (Columbia University Press 2007).

Nissenbaum H, 'Accountability in a Computerized Society' (1996) 2 Science and Engineering Ethics 25.

— 'How Computer Systems Embody Values' (2001) 34(3) Computer 120.

Norris DF, 'Building the Virtual State. Or Not? A Critical Appraisal' (2003) 21(4) Social Science Computer Review 417.

Noveck BS, *Wiki Government: How Technology Can Make Government Better, Democracy Stronger, and Citizens More Powerful* (Brookings Institution Press 2009).

NPA Group, 'Applications of Earth observation to the legal sector' (*BNSC Sector Studies Programme*, 2001) ⟨http://www.ucl.ac.uk/laws/environment/satellites/docs/EOdataLegalSector.pdf⟩ accessed 19 May 2014.

Ogus A, 'Regulation Revisited' [2009] Public Law 332.

Ogus AI, *Regulation: Legal Form and Economic Theory* (Hart Publishing 2004).

Oja M.-K, 'Electronic Government in the Age of Ubiquitous Computing' (Master of Science in Digital Media thesis, University of Lübeck 2008).

Oliver D, *Common Values and the Public-Private Divide* (Cambridge University Press 1999).

Oreskes N, 'Why Believe a Computer? Models, Measures, and Meaning in the Natural World' in Schneiderman JS (ed), *The Earth Around Us: Maintaining a Livable Planet* (WH Freeman and Co, San Francisco 2000).

— 'The Role of Quantitative Models in Science', in Draper C and others (eds), *Models in Ecoystem Science* (Princeton University Press 2003).

Oreskes N, Shrader-Frechette K, and Belitz K, 'Verification, Validation, and Confirmation of Numerical Models in the Earth Sciences' (1994) 263 Science 641.

Orlikowski WJ, 'The Duality of Technology: Rethinking the Concept of Technology in Organizations' (1992) 3(3) Organization Science 398.

Orts EW, 'A Reflexive Model of Environmental Regulation' (1995) 5(4) Business Ethics Quarterly 779.

— 'Reflexive Environmental Law' (1995) 89 Northwestern University Law Review 1227.

Outhwaite O, Black R, and Laycock A, 'The Pursuit of Grounded Theory in Agricultural and Environmental Regulation: A Suggested Approach to Empirical Legal Study in Biosecurity' (2007) 29(4) Law and Policy 493.

Overdevest C and Mayer B, 'Harnessing the Power of Information Through Community Monitoring: Insights From Social Science' (2008) 86 Texas Law Review 1493.

Owen D, 'Mapping, Modeling, and the Fragmentation of Environmental Law' [2013] Utah Law Review 219.

Packard V, *The Naked Society* (Penguin Books 1966).

Palmer CL, 'DUIs and Apple Pie: A Survey of American Jurisprudence in DUI Prosecutions' (2010) 13 University of the District of Columbia David A. Clarke School of Law Law Review 407.

Pang AS.-K, 'Actants Attack! Using STS to Think About Pervasive Computing and the Future' (2004) ⟨http://askpang.typepad.com/relevant_history/files/actants_attack.pdf⟩ accessed 19 May 2014.

Paquet G, 'Governance in the Face of Sabotage and Bricolage' (2001) 24(3) Canadian Parliamentary Review 11.

— 'Smart Communities and the Geo-Governance of Social Learning' (2001) 31(2) Optimum Online 33.

Pardo TA, Gil-Garcia JR, and Burke GB, 'Building Response Capacity Through Cross-Boundary Information Sharing: The Critical Role of Trust' in Cunningham P and Cunningham M (eds), *Exploiting the Knowledge Economy: Issues, Applications, Case Studies* (IOS Press, Amsterdam 2006).

Parkin J, 'Adaptable Due Process' (2012) 160 University of Pennsylvania Law Review 1309.

Parnas DL, 'Foreword' in Wiener LR (ed), *Digital Woes* (Addison-Wesley 1993).

Pavlichev A and Garson GD, *Digital Government: Principles and Best Practices* (IGI Global 2004).

Pech L, '"A Union Founded on the Rule Of Law": Meaning and Reality of the Rule Of Law as a Constitutional Principle of EU Law' (2010) 6 European Constitutional Law Review 359.

— 'The Rule of Law as a Guiding Principle of the European Union's External Action' (2011) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1944865⟩ accessed 19 May 2014.

Pedersen BF, 'Use of Very High Resolution Imagery in the Control of Area Based Subsidies With Remote Sensing' in *EARSeL eProceedings 4(1)* (2005).

Pedersen OW, 'Modest Pragmatic Lessons for a Diverse and Incoherent Environmental Law' (2013) 33(1) Oxford Journal of Legal Studies 103.

Pedersen WF, 'Regulation and Information Disclosure: Parallel Universes and Beyond' (2001) 25 Harvard Environmental Law Review 151.

Peltonen T and Tikkanen H, 'Productive Power, Organised Markets and Actor-Network Theory' in Czarniawska B and Hernes T (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005).

Penders M and Ronald D, 'The Hanging Chads of International Environmental Law' (2000) 15(11) National Association of Attorneys General: National Environmental Enforcement Journal 4.

Peter N, 'The Use of Remote Sensing to Support the Application of Multilateral Environmental Agreements' (2004) 20 Space Policy 189.

Petkov P and others, 'Motivating Domestic Energy Conservation Through Comparative, Community-Based Feedback in Mobile and Social Media' in Foth M, Kjeldskov J, and Paay J (eds), *Proceedings of the 5th International Conference on Communities and Technologies* (Association for Computing Machinery 2011).

Picci L, 'Reputation-Based Governance and Making States "Legible" to Their Citizens' in Masum H and Tovey M (eds), *The Reputation Society: How Online Opinions Are Reshaping the Offline World* (MIT Press 2011).

Pickles J, 'Representations in an Electronic Age: Geography, GIS and Democracy' in Pickles J (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995).

Pinch TJ and Bijker WE, 'The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other' (1984) 14(3) Social Studies of Science 399.

Pinch T and Bijker W, 'Science, Relativism and the New Sociology of Technology: Reply to Russell' (1986) 16(2) 347.

Pitt LF and others, 'Integrating the Smartphone Into a Sound Environmental Information Systems Strategy: Principles, Practices and a Research Agenda' (2011) 20(1) Journal of Strategic Information Systems 27.

Plater ZJB, 'Environmental Law in the Political Ecosystem—Coping with the Reality of Politics' (2001) 19(2) Pace Environmental Law Review 423.

Pollitt C, 'Justification By Works or By Faith?: Evaluating the New Public Management' (1995) 1(2) Evaluation 133.

Poplin A, 'Playful Public Participation in Urban Planning: A Case Study for Online Serious Games' (2012) 36(3) Computers, Environment and Urban Systems 195.

Porsander L, '"My Name is Lifebuoy": An Actor-Network Emerging from an Action-Net' in Czarniawska B and Hernes T (eds), *Actor-Network Theory and Organizing* (Liber and Copenhagen Business School Press 2005).

Porter JH and others, 'New Eyes on the World: Advanced Sensors for Ecology' (2009) 59(5) BioScience 385.

Porter TM, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton University Press 1995).

Pottage A, 'The Materiality of What?' (2012) 39(1) Journal of Law and Society 167.

Price ME, 'The Newness of New Technology' (2000) 22 Cardozo Law Review 1885.

Prins JEJ, Broeders D, and Griffioen HM, 'iGovernment: A New Perspective on the Future of Government Digitisation' (2012) 28(3) Computer Law and Security Review 273.

Purdy R, 'Satellites: A New Era for Environmental Compliance?' (2006) 3(5) Journal for European Environmental and Planning Law 406.

— 'Using Earth Observation Technologies for Better Regulatory Compliance and Enforcement of Environmental Laws' (2010) 22(1) Journal of Environmental Law 59.

Raman B, 'The Rhetoric of Transparency and Its Reality: Transparent Territories, Opaque Power and Empowerment' (2012) 8(2) *Journal of Community Informatics*.

Ramkumar V and Petkova E, 'Transparency and Environmental Governance' in Florini A (ed), *The Right to Know: Transparency for an Open World* (Columbia University Press 2007).

Ramsey K, 'GIS, Modeling, and Politics: On the Tensions of Collaborative Decision Support' (2009) 90(6) Journal of Environmental Management 1972.

Rattle R, *Computing Our Way to Paradise: The Role of Internet and Communication Technologies in Sustainable Consumption and Globalization* (Altamira Press 2011).

Raz J, 'The Rule of Law and Its Virtue' in *The Authority of Law: Essays on Law and Morality* (Clarendon 1979).

Reed C, 'How to Make Bad Law: Lessons From Cyberspace' (2010) 73(6) Modern Law Review 903.

Reitberger F, 'Energy Awareness Through Ubiquitous Computing in Modern Households' in Hausen D and others (eds), *Ubiquitous Computing* (University of Munich Department of Computer Science Media Informatics Group 2011).

Renshaw K, 'Sounding Alarms: Does Informational Regulation Help or Hinder Environmentalism?' (2005) 14 New York University Environmental Law Journal 654.

Revell A, 'Ecological Modernization in the UK: Rhetoric or Reality?' (2005) 15(6) European Environment 344.

Richards DJ, Allenby BR, and Compton WD, 'Information Systems and the Environment: Overview and Perspectives' in Richards DJ, Allenby BR, and Compton WD (eds), *Information Systems and the Environment* (National Academies Press 2001).

Richardson BJ and Chanwai KL, 'The UK's Climate Change Levy: Is it Working?' (2003) 15(1) Journal of Environmental Law 39.

Richardson F, 'The E-Justice Revolution' (2010) 64(5) International Bar News 37.

Richardson G, Ogus A, and Burrows P, *Policing Pollution: A Study of Regulation and Enforcement* (Clarendon Press 1982).

Rist T and others, 'Creating Awareness for Efficient Energy Use in Smart Homes' in Feuerstein G and Ritter W (eds), *Intelligent Wohnen. Zusammenfassung der Beiträge zum Usability Day IX* (Pabst 2011).

Robertson SP and Vatrapu RK, 'Digital Government' (2010) 44(1) Annual Review of Information Science and Technology 317.

Robey D, 'Research Commentary: Diversity in Information Systems Research: Threat, Promise, and Responsibility' (1996) 7(4) Information Systems Research 400.

Robins K and Webster F, *Times of the Technoculture: From the Information Society to the Virtual Life* (Routledge 2004).

Rocheleau B, 'Politics, Accountability, and Governmental Information Systems' in Garson GD (ed), *Public Information Technology: Policy and Management Issues* (Idea Group Publishing 2003).

Rodgers Jr WH, 'The Most Creative Moments in the History of Environmental Law: "The Whats"' (2000) 2000 University of Illinois Law Review 1.

Romanosky S, Telang R, and Acquisti A, 'Do Data Breach Disclosure Laws Reduce Identity Theft?' (2011) 30(2) Journal of Policy Analysis and Management 256.

Rooke C, Cloatre E, and Dingwall R, 'The Regulation of Nicotine in the United Kingdom: How Nicotine Gum Came to be a Medicine, But Not a Drug' (2012) 39(1) Journal of Law and Society 39.

Rose CM, 'Environmental Law Grows Up (More or Less), and What Science Can Do to Help' (2005) 9 Lewis and Clark Law Review 273.

Rose J, 'The Rule of Law in the Western World: An Overview' (2004) 35(4) Journal of Social Philosophy 457.

Rose N, 'Governing By Numbers: Figuring Out Democracy' (1991) 16(7) Accounting, Organizations and Society 673.

— *Powers of Freedom: Reframing Political Thought* (Cambridge University Press 1999).

Rose N and Miller P, 'Political Power Beyond the State: Problematics of Government' (2010) 43(2) British Journal of Sociology 173.

Rosenqvist A and others, 'The Potential of Long-Wavelength Satellite-Borne Radar to Support Implementation of the Ramsar Wetlands Convention' (2007) 17(3) Aquatic Conservation: Marine and Freshwater Ecosystem 229.

Rosenqvist A and others, 'Remote Sensing and the Kyoto Protocol: A Review of Available and Future Technology for Monitoring Treaty Compliance' (1999) ⟨http://sedac.ciesin.columbia.edu/rs-treaties/Remote_Sensing_Kyoto.pdf⟩ accessed 19 May 2014.

Rossel P and Finger M, 'Conceptualizing E-Governance' in Janowski T and Pardo TA (eds), *Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance (icegov '07)* (Association for Computing Machinery 2007).

Rouvroy A, 'Technology, Virtuality and Utopia: Governmentality in an Age of Autonomnic Computing' in Hildebrandt M and Rouvroy A (eds), *The Philosophy of Law Meets the Philosophy of Technology* (Routledge 2011).

Rubin EL, 'On Beyond Truth: A Theory for Evaluating Legal Scholarship' (1992) 80 California Law Review 889.

Ruhl JB, 'Regulation by Adaptive Management—Is It Possible?' (2005) 7 Minnesota Journal of Law, Science and Technology 21.

Russell S, 'The Social Construction of Artefacts: A Response to Pinch and Bijker' (1986) 16(2) Social Studies of Science 331.

Ryan J, *A History of the Internet and the Digital Future* (Reaktion Books 2010).

Sahay S and Lewis J, 'Strengthening Metis Around Routine Health Information Systems in Developing Countries' (2010) 6(3) Information Technologies and International Development 67.

Sainsbury R, 'Administrative Justice: Discretion and Procedure in Social Security Decision-Making' in Hawkins K (ed), *The Uses of Discretion* (Clarendon Press 1992).

Salembier JP, 'Designing Regulatory Systems: A Template for Regulatory Rule-making—Part I' (2002) 23(3) Statute Law Review 165.

Sand PH, 'Information Disclosure as an Instrument of Environmental Governance' (2003) 63 Heidelberg Journal of International Law 487.

— 'The Right to Know: Freedom of Environmental Information in Comparative and International Law' (2011) 20 Tulane Journal of International and Comparative Law 203.

Sandberg KW and Yan P, 'Human Factors in Public Information Systems' in Anttiroiko A.-V and Mälkiä M (eds), *Encyclopedia of Digital Government* (Idea Group 2007).

Sassen S, 'Digital Networks and the State: Some Governance Questions' (2000) 17(4) Theory, Culture and Society 19.

— 'Towards a Sociology of Information Technology' (2002) 50(3) Current Sociology 365.

— *Territory, Authority, Rights: From Medieval to Global Assemblages* (Cambridge University Press 2006).

— 'Interactions of the Technical and the Social' (2012) 15(4) Information, Communication and Society 455.

Saxena K, 'Towards Excellence in E-Governance' (*CEXIM Working Paper Series*, 2005) ⟨http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan045361.pdf⟩ accessed 27 August 2014.

Sayes E, 'Actor-Network Theory and Methodology: Just What Does it Mean to Say That Nonhumans Have Agency?' (2014) 44(1) Social Studies of Science 134.

Scarrott G, 'The Nature of Information' (1989) 32(3) The Computer Journal 262.

Schafer B, 'E-Governance in the United Kingdom' in Prins JEJ (ed), *Designing e-Government* (2nd edn, Kluwer Law 2007).

Schartum DW, 'Dirt in the Machinery of Government—Legal Challenges Connected to Computerized Case Processing in Public Administration' (1994) 2 International Journal of Law and Information Technology 327.

— 'Developing eGovernment Systems—Legal, Technological and Organizational Aspects' (2010) 56 Scandinavian Studies in Law 125.

Schatz A, 'Regulating Greenhouse Gases By Mandatory Information Disclosure' (2008) 26 Virginia Environmental Law Journal 335.

Schmidt E and Cohen J, 'The Digital Disruption: Connectivity and the Diffusion of Power' (2010) 89 Foreign Affairs 75.

Schmidt P and Halliday S, 'Beyond Methods—Law and Society in Action' in Schmidt P and Halliday S (eds), *Conducting Law and Society Research: Reflections on Methods and Practices* (2009).

Scholl HJ, 'Electronic Government: A Study Domain Past Its Infancy' in Scholl HJ (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010).

— 'Electronic Government: Introduction to the Domain', in Scholl HJ (ed), *E-Government: Information, Technology, and Transformation* (ME Sharpe 2010).

Schroeder CH, 'Third Way Environmentalism' (1999) 48 Kansas Law Review 1.

Schwartz PM and Janger EJ, 'Notification of Data Security Breaches' (2007) 105 Michigan Law Review 913.

Sclove RE, *Democracy and Technology* (Guildford Press 1995).

— 'Making Technology Democratic', in Brook J and Brook IA (eds), *Resisting the Virtual Life: The Culture and Politics of Information* (City Lights Books 1995).

Scott C, 'Regulation in the Age of Governance: The Rise of the Post-Regulatory State' in Jordana J and Levi-Faur D (eds), *The Politics of Regulation* (Edward Elgar 2004).

— 'Regulatory Governance and the Challenge of Constitutionalism', in Oliver D, Prosser T, and Rawlings R (eds), *The Regulatory State: Constiutional Implications* (EUI RSCAS 2010).

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

Scott J and Holder J, 'Law and New Environmental Governance in the European Union' in de Búrca G and Scott J (eds), *Law and New Governance in the EU and US* (Hart Publishing 2006).

Scott J and Trubek DM, 'Mind the Gap: Law and New Approaches to Governance in the European Union' (2002) 8(1) European Law Journal 1.

Seale C, 'Quality in Qualitative Research' in Seale C and others (eds), *Qualitative Research Practice* (Sage 2007).

Seldén L, 'On Grounded Theory—with Some Malice' (2005) 61(1) Journal of Documentation 114.

Select Committee on the Constitution, *Relations Between the Executive, the Judiciary and Parliament: Report With Evidence, 6th Report of Session 2006-07* (HL 2006, 151-I).

Selznick P, 'Focusing Organizational Research on Regulation' in Noll RG (ed), *Regulatory Policy and the Social Sciences* (University of California Press Berkeley and Los Angeles 1985).

Sewchurran K and Brown I, 'Toward an Approach to Generate Forward-Looking Theories Using Systems Concepts' in Chiasson M and others (eds), *Researching the Future in Information Systems* (Springer 2011).

Shahin J and Finger M, 'The Operationalisation of e-Governance' in Janowski T and Pardo TA (eds), *Proceedings of the 2nd International Conference on Theory and Practice of Electronic Governance (ICEGOV '08)* (Association for Computing Machinery 2008).

Shane PM, 'The Rule of Law and the Inevitability of Discretion' (2013) 36 Harvard Journal of Law and Public Policy 21.

Shannon C, 'A Mathematical Theory of Communication' (1948) 27(3) Bell System Technical Journal 379.

Shapiro SA and McGarity TO, 'Not So Paradoxical: The Rationale for Technology-Based Regulation' [1991] Duke Law Journal 729.

Sharpe M, 'The 21st Century Analyst: Developments in Data Analysis and Visualisation' (2002) 4(3) Journal of Environmental Monitoring 33N.

Shein E, 'Should Everybody Learn to Code?' (2014) 57(2) Communications of the ACM 16.

Sheppard C and Raine J, 'Parking Adjudications: The Impact of New Technology' in Harris M and Partington M (eds), *Administrative Justice in the 21st Century* (Hart Publishing 1999).

Shkabatur J, 'A Global Panopticon—the Changing Role of International Organizations in the Information Age' (2011) 33 Michigan Journal of International Law 159.

Shklar JN, 'Political Theory and the Rule of Law' in Hutchinson A and Monahan P (eds), *The Rule of Law: Ideal or Ideology* (Carswell 1987).

Short C, 'Guilt By Machine: The Problem of Source Code Discovery in Florida DUI Prosecutions' (2009) 61 Florida Law Review 177.

Silva L, 'Epistemological and Theoretical Challenges for Studying Power and Politics in Information Systems' (2007) 17(2) Information Systems Journal 165.

Singh JP, 'Introduction: Information Technologies and the Changing Scope of Global Power and Governance' in Rosenau JN and Singh J (eds), *Information Technologies and Global Politics: The Changing Scope of Power and Governance* (2002).

Slee T, 'Seeing Like a Geek' (2012) ⟨http://crookedtimber.org/2012/06/25/seeing-like-a-geek/⟩ accessed 19 May 2014.

Smith A and Stirling A, 'Moving Outside or Inside? Objectification and Reflexivity in the Governance of Socio-Technical Systems' (2007) 9(3-4) Journal of Environmental Policy and Planning 351.

Sokal AD and Bricmont J, *Intellectual Impostures: Postmodern Philosophers' Abuse of Science* (Profile Books 1998).

Space Studies Board, *Landsat and Beyond: Sustaining and Enhancing the Nation's Land Imaging Program* (National Academies Press 2013).

Spagnolli A and others, 'Eco-Feedback on the Go: Motivating Energy Awareness' (2011) 44(5) Computer 38.

Sparrow MK, *The Regulatory Craft: Controlling Risks, Solving Problems, and Managing Compliance* (Brookings Institute Press 2000).

Stahl BC, 'When Does a Computer Speak The Truth? The Problem of IT and Validity Claims' in Wynn EH and others (eds), *Global and Organizational Discourse About Information Technology* (Springer 2003).

— 'The Ethical Problem of Framing E-Government in Terms of E-Commerce' (2005) 3(2) The Electronic Journal of e-Government 77.

— *Information Systems: Critical Perspectives* (Routledge 2008).

— 'IT for a Better Future: How to Integrate Ethics, Politics and Innovation' (2011) 9(3) Journal of Information, Communication and Ethics in Society 140.

— 'What Does the Future Hold? A Critical View of Emerging Information and Communication Technologies and Their Social Consequences', in Chiasson M and others (eds), *Researching the Future in Information Systems* (Springer 2011).

— 'What Future? Which Technology? On the Problem of Describing Relevant Futures', in Chiasson M and others (eds), *Researching the Future in Information Systems* (Springer 2011).

Stamper R, 'Information: Mystical Fluid or a Subject for Scientific Inquiry' (1985) 28(3) The Computer Journal 195.

Star SL, 'Power, Technologies, and the Phenomenology of Standards: On Being Allergic to Onions' in Law J (ed), *A Sociology of Monsters: Power, Technology, and the Modern World* (Routledge 1991).

Star SL and Griesemer JR, 'Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39' (1989) 19(3) Social Studies of Science 387.

Stavins RN, 'Policy Instruments for Climate Change: How Can National Governments Address a Global Problem' [1997] University of Chicago Legal Forum.

Stavins RN, 'Market-based Environmental Policies: What Can We Learn from US Experience (And Related Research)?' (*Resources for the Future Discussion Paper*, 2003) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=421720⟩ accessed 27 August 2014.

Stea B and Harindranath G, 'Public Sector ICT Management Strategy and Its Impact on E-Government: A Case Study' in *ECIS 2006 Proceedings* (Association for Information Systems 2006).

Steiner C, *Automate This: How Algorithms Took Over Our Markets, Our Jobs, and the World* (Penguin 2012).

Steinzor RI, 'Reinventing Environmental Regulation: The Dangerous Journey From Command to Self-Control' (1998) 22 Harvard Environmental Law Review 103.

Stepanova E, 'The Role of Information Communication Technologies in the "Arab Spring"' [2011] (15) Ponars Eurasia 1.

Stephenson J and others, 'Energy Cultures: A Framework for Understanding Energy Behaviours' (2010) 38 Energy Policy 6120.

Steurer R, 'Disentangling Governance: A Synoptic View of Regulation By Government, Business and Civil Society' (2013) 46(4) Policy Sciences 387.

Stewart RB, 'Economic Incentives for Environmental Protection: Opportunities and Obstacles' in *Environmental Law, the Economy and Sustainable Devel-*

opment: The United States, the European Union and the International Community (Cambridge University Press 2000).

— 'A New Generation of Environmental Regulation?' (2001) 29 Capital University Law Review 21.

— 'The Importance of Law and Economics for European Environmental Law' (2002) 2 Yearbook of European Environmental Law 856.

— 'Instrument Choice', in Bodansky Daniel Brunnée J and Hey E (eds), *The Oxford Handbook of International Environmental Law* (Oxford University Press 2007).

Stone A, *Regulation and Its Alternatives* (Congressional Quarterly Press 1982).

Stratford J and Johnston T, 'The Snowden "Revelations": Is GCHQ Breaking the Law?' [2014] European Human Rights Law Review 129.

Strauss PL, 'Legislative Theory and the Rule of Law: Some Comments on Rubin' (1989) 89 Columbia Law Review 427.

Strengers Y, 'Designing Eco-Feedback Systems for Everyday Life' in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2011).

— 'Negotiating Everyday Life: The Role of Energy and Water Consumption Feedback' (2011) 11(3) Journal of Consumer Culture 319.

— 'Peak Electricity Demand and Social Practice Theories: Reframing the Role of Change Agents in the Energy Sector' (2012) 44 Energy Policy 226.

— *Smart Energy Technologies in Everyday Life: Smart Utopia?* (Palgrave Macmillan 2013).

Summers RS, 'A Formal Theory of the Rule of Law' (1993) 6(2) Ratio Juris 127.

Sundramoorthy V and others, 'DEHEMS: A User-Driven Domestic Energy Monitoring System' in *Internet of Things* (IEEE 2010).

Sunstein CR, *After the Rights Revolution: Reconceiving the Regulatory State* (Harvard University Press 1993).

Susskind R, *The Future of Law: Facing the Challenges of Information Technology* (Clarendon Press 1998).

— *Transforming the Law: Essays on Technology, Justice, and the Legal Marketplace* (Oxford University Press 2003).

— *The End of Lawyers?: Rethinking the Nature of Legal Services* (Oxford University Press 2009).

Swedin EG and Ferro DL, *Computers: The Life Story of a Technology* (Greenwood Publishing Group 2005).

Swiss JE, 'Information Technology as a Facilitator of Results-Based Management in Government' in Garson GD (ed), *Public Information Technology: Policy and Management Issues* (IGI Global 2003).

Switzer A, Bertolini L, and Grin J, 'Transitions of Mobility Systems in Urban Regions: A Heuristic Framework' (2013) 15(2) Journal of Environmental Policy and Planning 141.

Taipale KA, 'Information Technology as Agent of Change In Environmental Policy' (*Center for Advanced Studies in Science and Technology Policy Working Paper*, 2003) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=712161⟩ accessed 19 May 2014.

Tamanaha BZ, *On the Rule of Law: History, Politics, Theory* (Cambridge University Press 2004).

Tanenbaum JG, Antle AN, and Robinson J, 'Three Perspectives on Behavior Change for Serious Games' in *Proceedings of the 2013 ACM Annual Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2013).

Tate A, 'The "Helpful Environment": Geographically Dispersed Intelligent Agents That Collaborate' (2006) 21(3) IEEE Intelligent Systems 57.

Tatnall A and Gilding A, 'Actor-Network Theory and Information Systems Research' in Yoong P and Hope B (eds), *10th Australasian Conference on Information Systems* (1999).

Taylor JA, 'The Information Polity: Towards a Two Speed Future?' (2012) 17(3) Information Polity 227.

Taylor J and others, 'Innovation in Public Service Delivery' in Dutton WH (ed), *Information and Communication Technologies: Visions and Realities* (Oxford University Press Oxford 1996).

Tenner C, 'Multilateral Environmental Agreements: Trends in Verification' [2000] Verification Yearbook 133.

Teubner G, *Dilemmas of Law in the Welfare State* (Walter De Gruyter 1986).

— 'Juridification: Concepts, Aspects, Limits, Solutions', in Baldwin R, Scott C, and Hood C (eds), *A Reader on Regulation* (Oxford University Press 1988).

The Climate Group, *Smart 2020: Enabling the Low Carbon Economy in the Information Age* (Global eSustainability Initiative 2008).

Theunissen C, 'Contextual Issues Surrounding Portable and Interactive Technologies Within the Contemporary and Future Environment of E-Government and Informatisation' in Prins JEJ (ed), *Designing e-Government* (2nd edn, Kluwer 2007).

Thomas G and James D, 'Reinventing Grounded Theory: Some Questions About Theory, Ground and Discovery' (2006) 32(6) British Educational Research Journal 767.

Thomas J and Harden A, 'Methods for the Thematic Synthesis of Qualitative Research in Systematic Reviews' (2008) 8 BMC Medical Research Methodology 45.

Thompson K, 'Reflections on Trusting Trust' (1984) 27(8) Communications of the ACM 761.

Thornberg R, 'Informed Grounded Theory' (2012) 56(3) Scandinavian Journal ofEducational Research 243.

Tiersma PM, *Parchment, Paper, Pixels: Law and the Technologies of Communication* (University of Chicago Press 2010).

To W.-M, Chung AW, and Lai LS, 'Creating Green Awareness Using IT: The Case of Hong Kong' [2013] IT Professional 44.

Tomlinson B, *Greening Through IT: Information Technology for Environmental Sustainability* (MIT Press 2010).

Tonn B and Turner R, 'Environmental Decision Making and Information Technology: Issues Assessment' (1999) ⟨http://www.osti.gov/bridge/servlets/purl/7911-KYxW9I/webviewable/7911.pdf⟩ accessed 19 May 2014.

Treib O, Bähr H, and Falkner G, 'Modes of Governance: Towards a Conceptual Clarification' (2007) 14(1) Journal of European Public Policy 1.

Tribe L, 'Policy Science: Analysis or Ideology?' (1972) 2(1) Philosophy and Public Affairs 66.

— 'Technology Assessment and the Fourth Discontinuity: The Limits of Instrumental Rationality' (1972) 46 Southern California Law Review 617.

Trubek DM and Trubek LG, 'New Governance and Legal Regulation: Complementarity, Rivalry, and Transformation' (2006) 13 Columbia Journal of European Law 539.

Turner F, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (University Of Chicago Press 2010).

Unger RM, *Law in Modern Society* (The Free Press 1977).

Valkanova N and others, 'Reveal-it!: The Impact of a Social Visualization Projection on Public Awareness and Discourse' in Mackay WE, Brewster S, and Bødker S (eds), *SIGCHI Conference on Human Factors in Computing Systems* (Association for Computing Machinery 2013).

Valverde M, 'Authorizing the Production of Urban Moral Order: Appellate Courts and Their Knowledge Games' (2005) 39(2) Law and Society Review 419.

van de Walle S and Hammerschmid G, 'The Impact of the New Public Management: Challenges for Coordination and Cohesion in European Public Sectors' (2011) 12(2) Administrative Culture 190.

Vandenbergh MP, 'From Smokestack to SUV: The Individual as Regulated Entity in the New Era of Environmental Law' (2004) 57 Vanderbilt Law Review 515.

— 'Order Without Social Norms: How Personal Norm Activation Can Protect the Environment' (2004) 99 Northwestern University Law Review 1101.

Vandenbergh MP and Steinemann AC, 'The Carbon-Neutral Individual' (2007) 82 New York University Law Review 1673.

Vega A and Brown D, 'Systems of Innovation, Multidisciplinarity, and Methodological Pluralism: A Realist Approach to Guide the Future of Information Systems Research and Practice' in Chiasson M and others (eds), *Researching the Future in Information Systems* (Springer 2011).

Venturelli S, 'Inventing E-Regulation in the US, EU and East Asia: Conflicting Social Visions of the Internet and the Information Society' (2001) 19(2) Telematics and Informatics 69.

Veregin H, 'Computer Innovation and Adoption in Geography: A Critique of Conventional Technological Models' in Pickles J (ed), *Ground Truth: The Social Implications of Geographic Information Systems* (Guilford Press 1995).

Vick DW, 'Interdisciplinarity and the Discipline of Law' (2004) 31(2) Journal of Law and Society 163.

Vodacek A, 'Environmental Applications of Remote Sensing' (2000) 4 Informatik/Informatique 21.

Volokh A, 'The Pitfalls of Environmental Right-to-Know' (2002) 2 Utah Law Review 805.

von der Dunk FG, 'Intellectual Property Rights as a Policy Tool for Earth Observation Data in Europe' in Harris R (ed), *Earth Observation Data Policy and Europe* (A A Balkema 2002).

— 'European Satellite Earth Observation: Law, Regulations, Policies, Projects, and Programmes' (2008) 42 Creighton Law Review 397.

Wagner RP, 'On Software Regulation' (2005) 78 Southern California Law Review 457.

Wagner WE, 'Stormy Regulation: The Problems That Result When Stormwater (and Other) Regulatory Programs Neglect to Account for Limitations in Scientific and Technical Information' (2006) 9 Chapman Law Review 191.

Wagner W, Fisher E, and Pascual P, 'Misunderstanding Models in Environmental and Public Health Regulation' (2010) 18 New York University Environmental Law Journal 293.

Wajcman J, 'Reflections on Gender and Technology Studies: In What State is the Art?' (2000) 30(3) Social Studies of Science 447.

— 'Addressing Technological Change: The Challenge to Social Theory' (2002) 50(3) Current Sociology 347.

Walker BP, 'Using Geographic Information System Mapping and Education for Watershed Protection Through Better-Defined Property Rights' in Anderson TL and Hill PJ (eds), *The Technology of Property Rights* (Rowman and Littlefield Publishers, Inc 2001).

Walsham G, 'Actor-Network Theory and IS Research: Current Status and Future Prospects' in Lee A, Liebenau J, and DeGross J (eds), *Information Systems and Qualitative Research* (Springer 1997).

Wang D and others, 'Monitoring Ambient Air Quality With Carbon Monoxide Sensor-Based Wireless Network' (2010) 53(5) Communications of the ACM 138.

Warschauer M, *Technology and Social Inclusion: Rethinking the Digital Divide* (MIT Press 2004).

Watson RT, Boudreau M.-C, and Chen AJ, 'Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community' (2010) 34(1) MIS Quarterly 23.

Watson RT and others, 'An Information Strategy for Environmental Sustainability' (2012) 55(7) Communications of the ACM 28.

Waygood O and others, 'Developing an Online Tool for Behavioural Change in Urban Transport' (2011) ⟨http://www.carbonaware.eu/fileadmin/user_upload/Publications/ECEEE_online.pdf⟩ accessed 19 May 2014.

Webster F and Robins K, 'Plan and Control' (1989) 18(3) Theory and Society 323.

Weiner LR, *Digital Woes* (Addison-Wesley 1993).

Weiner N, *Cybernetics or Control and Communication in the Animal and the Machine* (MIT Press 1948).

Weizenbaum J, *Computer Power and Human Reason: From Judgment to Calculation* (Penguin 1984).

Whitt RS, 'Adaptive Policymaking: Evolving and Applying Emergent Solutions for US Communications Policy' (2009) 61 Federal Communications Law Journal 483.

Whittle A and Spicer A, 'Is Actor Network Theory Critique?' (2008) 29(4) Organization Studies 611.

Wikgren M, 'Critical Realism as a Philosophy and Social Theory in Information Science?' (2005) 61(1) Journal of Documentation 11.

Williams R and Edge D, 'The Social Shaping of Technology' (1996) 25(6) Research Policy 865.

Willig C, 'Beyond Appearances: A Critical Realist Approach to Social Constructionist Work' in *Social Constructionist Psychology: A Critical Analysis of Theory and Practice* (Open University Press 1999).

Wilson AJ, 'Discovery of Breathalyzer Source Code of DUI Prosecutions' (2011) 7 Washington Journal of Law Technology and the Arts 121.

Wimmer MA, 'European Development towards Online One-stop Government: The "eGOV" Project' in *International Conference on Electronic Commerce* (Vienna, Austria, 2001).

Winner L, 'Do Artifacts Have Politics?' in *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (University of Chicago Press 1986).

— 'Mythinformation', in *The Whale and the Reactor* (University of Chicago Press 1986).

— 'Technologies as Forms of Life', in *The Whale and the Reactor* (University of Chicago Press 1986).

— 'Upon Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology' (1993) 18(3) Science, Technology, and Human Values 362.

Woodruff A and Mankoff J, 'Environmental Sustainability' (2009) 8(1) IEEE Pervasive Computing 18.

Woolgar S and Neyland D, *Mundane Governance: Ontology and Accountability* (Oxford University Press 2013).

Wyeth GB, '"Standard" and "Alternative" Environmental Protection: The Changing Role of Environmental Agencies' (2006) 31 William and Mary Environmental Law and Policy Review 5.

Yang K, 'Neoinstitutionalism and E-Government: Beyond Jane Fountain' (2003) 21(4) Social Science Computer Review 432.

Yang T and Percival RV, 'The Emergence of Global Environmental Law' (2009) 36 Ecology Law Quarterly 615.

Yeung K, *Securing Compliance: A Principled Approach* (Hart Publishing 2004).

— 'Government By Publicity Management: Sunlight or Spin?' [2005] Public Law 360.

— 'Better Regulation, Administrative Sanctions and Constitutional Values' (2013) 33(2) Legal Studies 312.

Yu PK, 'The Escalating Copyright Wars' (2003) 32 Hofstra Law Review 907.

Zachariadis M, Scott S, and Barrett M, 'Exploring critical realism as the theoretical foundation of mixed-method research: evidence from the economics of IS innovations' (*Judge Business School Working Paper Series*, 2010) ⟨http://www.jbs.cam.ac.uk/fileadmin/user_upload/research/workingpapers/wp1003.pdf⟩ accessed 27 August 2014.

Zimmermann PD, Finger M, and Mueller PS, 'Moving Beyond the Technological Neutrality Myth: ICTs and Power in Public Administration' (2008) 1(2) International Journal of Electronic Governance 215.

Zimmermann P and Finger M, 'Information-and Communication Technology (ICT) and Local Power Relationships: An Impact Assessment' (2005) 3(4) The Electronic Journal of E-Government 231.

Zinnbauer D, 'False Dawn, Window Dressing or Taking Integrity to the Next Level? Governments Using ICTs for Integrity and Accountability: Some Thoughts on an Emerging Research and Advocacy Agenda' (2012) ⟨http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2166277⟩ accessed 19 May 2014.

Zito AR and others, 'Instrument Innovation in an Environmental Lead State: "New" Environmental Policy Instruments in the Netherlands' (2003) 12(1) Environmental Politics 157.

Zouridis S, 'The Rule of Law in the 21st Century: Bridging the Compliance Deficit' in Muller S and others (eds), *The Law of the Future and the Future of Law* (Torkel Opsahl Academic EPublisher 2011).

Zouridis S and Thaens M, 'E-Government: Towards a Public Administration Approach' (2003) 25(2) Asian Journal of Public Administration 159.

— 'Reflections on the Anatomy of E-Government', in Bekkers VJJM and Homburg VMF (eds), *Information Ecology of E-Government: E-Government as In-*

stitutional and Technological Innovation in Public Administration (IOS Press 2005).

Zuboff S, 'Automate/Informate: The Two Faces of Intelligent Technology' (1985) 14(2) Organizational Dynamics 5.

— *In the Age of the Smart Machine: The Future of Work and Power* (Basic Books 1988).

Zumbansen P, 'Law After the Welfare State: Formalism, Functionalism, and the Ironic Turn of Reflexive Law' (2008) 56(3) American Journal of Comparative Law 769.