

**How to Think about Law, Regulation and Technology: Problems with ‘Technology’ as a
Regulatory Target
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I. INTRODUCTION

Lawyers have long been fascinated by new technologies. As quickly as new inventions and new industries are developed, lawyers and scholars have rushed to examine their legal implications. New specialties are born, while others wither. One can track the trends in legal publishing- a lot of interest while it is a hot topic, dropping off once it is perceived as more boring (with a few more established academics hanging on).¹ There are still space lawyers, but they no longer write about whether aliens have constitutional rights or whether transfer of a space platform requires a deed or bill of sale.² The hot topics of one era cease to be fascinating. Questions of law and regulation remain, of course, but the technology that is ‘regulated’ fades into the background. Those writing about traffic laws, rail franchises and workplace safety rarely self-identify as technology lawyers.

Despite this, there is a strong sense among legal scholars, practitioners and students that there is something important to say about the intersection between law or regulation on the one side and technology on the other. The large number of journals purporting to publish articles at the law/technology interface is testament to this. Indeed, many legal and regulatory problems arise on the technological frontier. Whether it be the safety of nanomaterials, the privacy implications of social media, ethical and legal issues associated with new biomedical technologies or the implications of developments in neuroscience for criminal law, new technologies are frequently the source of legal questions. Mostly, these questions are asked (and answered) in a single technological or doctrinal context. Expertise in either allows scholars to answer particular questions: What rights do users have to control images shared on Facebook?³ What are the ethical assumptions underlying the Human Fertilisation and Embryology Act 2008 s 14(4)(9)?⁴ Pieces on such questions are on occasion published together, either in edited collections or in specialist journals. However, although they make important points and offer policy guidance in their fields, they do not really speak to each other.

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¹ Sara K Stadler, ‘Essay: The Bulls and the Bears of Law Teaching’ (2006) 63 *Washington and Lee Law Review* 25.

² For a fascinating insight into ‘golden age’ space law scholarship, see Barton Beebe, ‘Law’s Empire and the Final Frontier: Legalizing the Future in the Earlyopus Juris Spatialis’ (1999) 108 *Yale Law Journal* 34.

³ Jennifer Hendry and Kay Goodall, ‘Facebook and the Commercialisation of Personal Information: Some Questions of Provider-to-User Privacy’ in Morag Goodwin, Bert-Jaap Koops and Ronald Leenes (eds), *Dimensions of Technology Regulation* (Wolf, 2010) 39.

⁴ Colin Gavaghan, ‘Regulating after Parfit: Welfare, Identity and the UK Embryology Law’ in Goodwin, Koops and Leenes, *ibid*, 147.

This paper is an attempt to understand the connections that exist in scholarship addressing questions of law, regulation and technology. It begins with a discussion of 'technology regulation', which is the framing within which much research in the area is presented. It will also present an alternative vision revolving around Brownsword's concept of the challenge of regulatory connection. The paper then seeks to explore which of these frames is the most likely to yield useful conversations among those considering different legal and regulatory problems at the technological frontier. It concludes that focus on 'technology' as a regulatory target is less likely to yield useful connections between ideas than a framing that recognises the complex relationship between law, regulation, technology and society. At the same time, it recognises the importance of adopting a more limited perspective in order to open a space for meaningful conversations, allowing those interested in legal and regulatory issues at the technological frontier to speak to each other. It concludes that the second frame provides a useful starting point.

II. WHAT IS 'TECHNOLOGY REGULATION'?

Technology, as an object of study, has a longer history in philosophy and sociology than it has in law. Studies of the relationship between technology and society have revealed a complex relationship. Simplistic technological determinism, the sense that technological development along a particular trajectory is virtually inevitable, and that this in turn impacts on society, has been rebutted by those scholars who through careful empirical work have demonstrated the contingency of technological pathways.⁵ Given the power of technological design,⁶ the consciousness of choice has led to efforts to enhance democratic involvement in technological decision making.⁷ Part of this is the recognition of the importance of mechanisms to facilitate such public involvement, for example constructive, participatory and real-time technology assessment. However, despite brief interest in the 1970s,⁸ lawyers were largely silent during these developments.

That has changed. Legal scholars are now showing more interest in the relationship between law or regulation on the one side and technology on the other. It has been suggested that this recent interest stemmed from cyberlaw scholarship, particularly the issues it raised as to the possibility, desirability and nature of internet regulation.⁹ It has taken some time, however, for the topic of internet regulation to expand into the field of technology regulation. An important moment was a 2007 forum hosted by the centre for the study of Technology, Ethics and Law in Society (TELOS) based in the School of

⁵ eg Wiebe E Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Inside Technology, MIT Press, 1995).

⁶ This is the 'code' in Lawrence Lessig, *Code and Other Laws of Cyberspace* (Basic Books, 1999) as well as the bridges in Langdon Winner, 'Do Artifacts have Politics?' in Donald MacKenzie and Judy Wajcman (eds), *The Social Shaping of Technology: How the Refrigerator Got its Hum* (Open University Press, 1985).

⁷ eg Andrew Feenberg, *Questioning Technology* (Routledge, 1999).

⁸ Laurence H Tribe, *Channeling Technology through Law* (Bracton Press, 1973).

⁹ Mathias Klang, 'Disruptive Technology: Effects of Technology Regulation on Democracy' (Göteborg University, doctoral thesis, 2006).

Law at Kings' College London on this theme. The papers from the forum were published, the contributions being split into two groups: in the first part of the collection were those papers that dealt with technologies that are used as a means of regulating (such as CCTV) and in the second part were those that dealt with regulation of technologies (to manage risks and perceived harms).¹⁰ The book did significantly better in the first part than in the second at explaining the coherence and links between ideas, and in understanding in a broad sense the relationship of technology and regulation. Work on technology as a regulatory tool, including recognition of the extent to which law has always relied on technology, has continued to thrive.¹¹ However, as I read work on the regulation of technology, the disconnectedness of the second part of the TELOS conference remains, despite valiant efforts to provide a framework for discussion.¹²

Technology regulation, as the term has been used in the literature, has diverse meanings. Generally, it has been broader than the study of how technical standards are created, interpreted and applied.¹³ Most of the differences between writers are related to the different meanings of 'technology' and 'regulation' and it is useful to start by considering the two terms separately.

The different potential meanings of the term 'regulation' have been well explored in the literature. Regulation can mean simply the promulgation of a binding set of rules, it can refer to any deliberate state influence, or it can include all forms of social or economic influence.¹⁴ While some writers focus on regulation by government and its agencies, others adopt a 'decentred' approach that looks more broadly at (intentional, and sometimes unintentional) influences on action.¹⁵ Within the technology regulation literature, Koops defines regulation as 'the intentional influencing of someone's or something's behaviour,'¹⁶ while Brownsword and Goodwin adopt Julia Black's definition of regulation as 'the sustained and focussed attempt to alter the behaviour of others according to standards or goals with the intention of producing a broadly identified outcome or outcomes, which may involve mechanisms of standard-setting, information-gathering and behaviour modification.'¹⁷ In

¹⁰ Roger Brownsword and Karen Yeung (eds), *Regulating Technologies: Legal Futures, Regulatory Frames and Technological Fixes* (Hart Publishing, 2008).

¹¹ See especially M Hildebrandt, 'Law at a Crossroads: Losing the Thread or Regaining Control? The Collapse of Distance in Real Time Computing' in Goodwin, Koops and Leenes (n 3) 165; Mireille Hildebrandt and Bert-Jaap Koops, 'The Challenges of Ambient Law and Legal Protection in the Profiling Era' (2010) 73 *Modern Law Review* 428.

¹² Goodwin, Koops and Leenes (n 3); Roger Brownsword, *Rights, Regulation and the Technological Revolution* (Oxford University Press, 2008); Roger Brownsword and Morag Goodwin, *Law in Context: Law and the Technologies of the Twenty-First Century. Text and Materials* (Cambridge University Press, 2012).

¹³ Cf EH Hitchcock, 'Technological Law: Societal Control of Technology and the Potential of the World Standards Movement' (PhD thesis, University of Auckland School of Engineering, 1979).

¹⁴ Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy and Practice* (Oxford University Press, 2nd edn 2012) 2–3.

¹⁵ Julia Black, 'Decentering Regulation: Understanding the Role of Regulation and Self-Regulation in a "Post-Regulatory" World' (2001) 54 *Current Legal Problems* 103.

¹⁶ Bert-Jaap Koops, 'Ten Dimensions of Technology Regulation: Finding your Bearings in the Research Space of Emerging Technologies' in Goodwin, Koops and Leenes (n 3) 309, 310.

¹⁷ Julia Black, 'Critical Reflections on Regulation' (2002) 27 *Australian Journal of Legal Philosophy* 1; Brownsword and Goodwin (n 12).

some contexts, the study is limited to regulation by government or a government agent.¹⁸ Although definitions are diverse, the differences are generally articulated and justified, so confusion is rare.

‘Regulation’, which is potentially both broader and narrower than ‘law’, has some advantages over the latter when considering how technological activities are controlled and influenced. It is capable of capturing ‘soft law’ that may be ignored by traditional definitions of ‘law’ as well as more distributed means of control.¹⁹ With some definitions, it also includes unintentional influence such as market forces. A focus on regulation rather than law thus highlights means of influence (or intentional influence) other than traditional top-down rules. In the context of technology, where funding priorities and professional standards can play an important role, this broader focus is better able to explain the influences on technology (and even government influences on technology) than the concept of ‘law’ in its traditional sense. It also enables discussions about some of the advantages of decentred, less formal rulemaking in controlling and influencing rapidly evolving technological practices.²⁰ This creates a more complex picture of influences on conduct than simply asking ‘what formal legal rules apply?’

Although the reference to ‘regulation’ tends to broaden the discussion, the choice of ‘technology’ as a regulatory target worthy of study is rarely justified. Authors are less likely to be explicit about their definition of technology than about their definition of regulation. Typically, reference is made to the technologies which are currently at the forefront of development, such as biotechnology, information and communication technologies (or ICTs), neurotechnology and nanotechnology.²¹ Any such list must be constantly updated as what was once a new field may cease to be perceived as new (and yet may become ‘new’ again if it becomes a platform for a still newer technology).²² Discussions about the regulation of nanomedicine or the privacy implications of social media are thus seen, unproblematically, as being about ‘technology’. Generally speaking, discussions of older industries, even ones that are undergoing rapid innovation or are highly technological, are sidelined.²³ In particular, road rules and product liability are rarely discussed in the context of technology regulation.

¹⁸ Brownsword (n 12) 7.

¹⁹ eg A Rip, ‘De Facto Governance of Nanotechnologies’ in Goodwin, Koops and Leenes (n 3) 285.

²⁰ See also Bärbel Dorbeck-Jung, ‘How Can Hybrid Nanomedical Products Regulation Cope with Wicked Governability Problems?’ in Goodwin, Koops and Leenes (n 3) 63, 67; Carolyn Abbot, ‘Bridging the Gap—Non-State Actors and the Challenges of Regulating New Technology’ (2012) 39(3) *Journal of Law and Society* 329.

²¹ Sometimes others are included, such as energy technologies (Brownsword and Yeung (n 10)) or robotics (Braden R Allenby, ‘Governance and Technology Systems: The Challenge of Emerging Technologies’ in Gary E Marchant, Braden R Allenby and Joseph R Herkert (eds), *The Growing Gap between Emerging Technologies and Legal-Ethical Oversight*, vol 7 (International Library of Ethics, Law and Technology, Springer, 2011)).

²² Laurence Boisson de Chazournes, ‘New Technologies, the Precautionary Principle and Public Participation’ and Thérèse Murphy, ‘Repetition, Revolution, and Resonance: An Introduction to New Technologies and Human Rights’, both in Thérèse Murphy (ed), *New Technologies and Human Rights* (Oxford University Press, 2009).

²³ See generally David Edgerton, *The Shock of the Old: Technology and Global History since 1900* (Profile, 2006).

Discussion of 'technology regulation' is most concerned with how regulators ought to deal with *new* technological fields.

Some writers do engage with broader definitions of technology that implicitly embraces *all* technological fields, not simply those that are new. For example, Koops defines 'technologies' as 'the broad range of tools and crafts that people use to change or adapt to their environment'.²⁴ Klang defines technology as 'both the purposeful activity and results of the transformation or manipulation of natural resources and environments in order to satisfy human needs or goals,' although he focuses his discussion on 'disruptive' technologies which incorporates an element of newness.²⁵

Whether or not discussion is formally limited to technologies that are 'new', a further question arises as to the relationship between the regulatory target and the technology. In most contexts in which technology regulation is discussed, the problem is associated with technology, and in particular with real or potential environmental, health or social harms that result from technological artefacts and processes. 'Technology regulation' could thus be the means employed (sometimes by government, sometimes more broadly) to reduce or eliminate such harms. This may be done by treating 'technology' as the regulatory target, and prohibiting the creation of particular artefacts or the use of particular processes. But, in line with the broad concept of 'regulation' and the fact that regulation is more likely to target social conduct than technology itself,²⁶ it may be done through more subtle influences on designers and users, for instance by mandating particular courses in university engineering degrees or providing professional rewards for safety innovation. In such cases, the aim is to influence people in ways that will (hopefully) influence the shape of technological artefacts and processes.

The target of technology regulation is thus complex. Much depends on how one defines 'technology' and whether one restricts the definition to 'tools and crafts' or incorporates all 'means'. One approach is to visualise a network comprising actors (including politicians and engineers) and objects (such as technological artefacts), with each node influencing other nodes.²⁷ In this picture, the regulation of technology is simply the forces of influence within the network or, if regulation is limited to government, influence by certain actors on the overall shape of the network. The difficulty of such rendering is that it makes it difficult to distinguish questions of 'technology regulation' from regulation more broadly. After all, most regulation aims to influence a combination of people, things and relationships.²⁸

²⁴ Koops (n 16) 309, 310.

²⁵ Klang (n 9) citing P Kroes, 'Philosophy of Technology' in Edward Graig (ed), *Routledge Encyclopedia of Philosophy* 9 (Routledge, 1998) 284–8.

²⁶ See also Joseph H Sommer, 'Against Cyberlaw' (2000) 15 *Berkeley Technology Law Journal* 1145, 1161.

²⁷ Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Clarendon Press, 2005).

²⁸ See also Roger Brownsword, 'Code, Control, and Choice: Why East is East and West is West' (2005) 25 *Legal Studies* 1 (regulation may focus on places, persons or things).

Defining 'technology regulation' is not simple, and is even more difficult than defining its components separately (which is difficult enough). Overall, however, it would seem to concern regulation (defined broadly or narrowly) in a technological space, a socio-technical space, or possibly a 'new' technological space. Ultimately, technology regulation operates in practice as legal scholarship's answer to the call of sociologists and philosophers to think about how 'we' can influence the form that socio-technical complexes take.

III. LAW OR REGULATION IN AN EVOLVING SOCIO-TECHNICAL LANDSCAPE

Within technology regulation scholarship, newness plays an important role, although its role is only sometimes made explicit. The reason why technology regulation scholarship does not in fact embrace *all* regulation is that it tends to focus on the new. It is therefore worth considering the extent to which the types of problems it considers arise from newness itself.²⁹ If newness presents unique challenges, then those looking at the regulation of nanotechnologies can gain some insights from challenges described by cyberlawyers, so a unified banner for scholarship would make sense. It would also explain why the waves of scholarship in particular fields eventually decline as newness fades.

A study of newness would not be a study of the regulation of technology, as described above, but rather a study of law or regulation in the context of a new or changing technology. Between the concept of new technology and technological change, I prefer the latter as it includes situations where there is technological evolution in established fields. But either way, there is a clear link to scholarship that examines the 'challenge of regulatory connection',³⁰ the 'pacing problem',³¹ and the 'Collingridge dilemma'.³²

Brownsword's description of the 'challenge of regulatory connection' is one account of the dilemma of newness. He describes the mismatch between current laws and regulatory approaches which are designed for the technological landscape of the past, requiring constant 'reconnection'.³³ This can be seen both when 'new' technologies (such as nanotechnology) enter into a 'regulatory void' and when older technologies, such as *in vitro* fertilisation and computers, morph beyond the forms contemplated in earlier regulatory regimes. Brownsword's concept of regulatory disconnection is useful in that it allows one to observe disconnection even where there is no 'legal' disconnection. Copying digital music is still a breach of copyright – the language of the statute still applies and there is thus no *legal* disconnection – but ease of copying has affected social norms so that rates of copying have increased despite copyright laws and thus there is *regulatory* disconnection.

²⁹ See also Monroe E Price, 'The Newness of New Technology' (2001) 22 *Cardozo Law Review* 1885.

³⁰ Brownsword (n 12).

³¹ Marchant, Allenby and Herkert (n 21).

³² David Collingridge, *The Social Control of Technology* (Pinter, 1980).

³³ Brownsword (n 12) ch 6.

Like the ‘challenge of regulatory connection’, the ‘pacing problem’ is an attempt to understand the struggle to ‘keep up’ with technology.³⁴ There is more than one way to describe the ‘pacing problem’. One can look at the types of legal and regulatory problems that arise as a result of technological change including the need to manage new negative impacts and risks, the need to manage uncertainty in the application of existing laws, the need to adapt regulatory regimes that may be over-inclusive or under-inclusive when applied in the new context and the need to manage obsolescence.³⁵ Alternatively, Brownsword distinguishes between descriptive and normative disconnection, and between productive and unproductive disconnection.³⁶ These line up to some extent, although there are differences in emphasis. On a simplistic level, numerous scholars point to hare and tortoise metaphors to explain the difficulties faced by ‘law’ when interacting with ‘technology.’³⁷ On a deeper level, new technologies can force us to question our commitment to and interpretation of important concepts and values, such as democracy.³⁸

One aspect of newness that is important from a regulatory perspective is the so-called Collingridge dilemma. Collingridge was concerned that regulators responding to a new technology faced twin hurdles.³⁹ At an early stage in a technology’s development, regulation was problematic due to the lack of information about the technology’s likely impact. At a later stage, regulation was problematic as the technology would become more entrenched, making any changes demanded by regulators expensive to implement. The dilemma follows from sociological studies of technology that suggest that ‘interpretive flexibility’ is high in the early stages of a technology’s development, but ultimately stabilises in a (more or less) final form (‘closure’) following stabilisation.⁴⁰ Another way of understanding the same phenomenon is to recognise that technological systems acquire ‘momentum’ as they grow larger and more complex, making them more resistant to regulatory prodding.⁴¹ This suggests that regulators wishing to influence technological design (to avoid or minimise risks of health, environmental and social harm, for instance) need to act at an early stage when the situation is more malleable. At an early stage, however, little is known about the prospects for the new technology, the harms it might cause or the forms it might take. Thus regulators face an ‘uncertainty

³⁴ Marchant, Allenby and Herkert (n 31).

³⁵ 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.

³⁶ Brownsword (n 12) 166–7.

³⁷ Lyria Bennett Moses, ‘Agents of Change: How the Law “Copes” with Technological Change’ (2011) 20(4) *Griffith Law Review* 763.

³⁸ Klang (n 9). See generally Emmanuel G Mesthene, *Technological Change: Its Impact on Man and Society* (Harvard Studies in Technology and Society, Harvard University Press, 1970).

³⁹ Collingridge (n 32).

⁴⁰ Trevor 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’ in Wiebe E Bijker, Thomas P Hughes and Trevor Pinch (eds), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (MIT Press, 1987) 17–50; Bijker (n 5).

⁴¹ Thomas Hughes, ‘Technological Momentum’ in Leo Marx and Merritt Roe Smith (eds), *Does Technology Drive History? The Dilemma of Technological Determinism* (MIT Press, 1994).

paradox',⁴² where they are forced to make decisions in the absence of reliable risk information or foreknowledge of technological developments. The extent to which these twin obstacles prove to be a dilemma depends on the rapidity and unpredictability of technological change, as well as the diffusion pattern associated with the technology in question.⁴³ There may be partial solutions to this problem, such as involving experts, improving understandings of how regulators can manage different types of uncertainty, expressing obligations in broad terms or adopting a particular approach (such as the precautionary principle).⁴⁴ Evaluating such solutions, alone or in combination, is important as it could guide government decision-making processes in new technological contexts.

Of course, not every new technology results in a Collingridge dilemma or a challenge of regulatory connection. New technologies are governed at the outset by general (or more general) regulatory regimes. The electric can opener, for instance, was governed at the outset by ordinary principles of patent law, property law, contract law and product liability. Only where there are regulatory gaps, associated with potential new harms or risks, does the Collingridge dilemma explain the difficulties of regulatory timing.

A focus on 'newness' fits well with most 'technology regulation' literature. While the definition of 'technology' used is often broad, most discussion is in fact confined to technologies that are relatively 'new' or evolving. The literature deals with questions such as how to regulate nanotechnology, the internet or biotechnology not how to regulate cars, boilers or building construction. This is not because the latter are unregulated, far from it, but because, as Koops puts it, 'well known, "more of the same" technology applications will usually fall within the scope of existing legislation or other regulatory instruments in contrast to radically new technologies'.⁴⁵ He highlights this point when discussing the 'dimension of innovation', pointing out that innovative technologies raise more questions than non-innovative ones. Others make similar points, For instance, Goodwin writes that '[r]egulatory efforts thus face an enormous challenge in keeping pace with technological developments'.⁴⁶ Another advantage to a focus on newness is that it recognises that technological change is an important problem for regulation generally, even when the target of regulation is not technology as such.⁴⁷

⁴² Marjolein van Asselt, Ellen Voss and Tessa Fox, 'Regulating Technologies and the Uncertainty Paradox' in Goodwin, Koops and Leenes (n 3) 259.

⁴³ Gaia Bernstein, 'The Paradoxes of Technological Diffusion' (2006) 39 *Connecticut Law Review* 59.

⁴⁴ *Ibid*; David Rejeski, 'Public Policy on the Technological Frontier' in Marchant, Allenby and Herkert (n 21); Chris Reed, 'How to Make Bad Law: Lessons from Cyberspace' (2010) 73 *Modern Law Review* 903; Esther Versluis *et al*, 'Calculable Risks? An Analysis of the European Seveso Regime' in Goodwin, Koops and Leenes (n 3) 21.

⁴⁵ Koops (n 16) 313.

⁴⁶ Morag Goodwin, 'Introduction: A Dimensions Approach to Technology Regulation' in Goodwin, Koops and Leenes (n 3) 1.

⁴⁷ In the context of securities regulation, see Joseph A Grundfest, 'Future of United States Securities Regulation: An Essay on Regulation in an Age of Technological Uncertainty' (2001) 75 *St John's Law Review* 83.

A focus on technological change is, of course, simply one side of the equation. It looks at how technology has changed and what the implications are for law or regulation. It fits nicely with a hare and tortoise framing of the relationship between law and technology.

One can move to broader approaches. Perhaps the most broad is that suggested by Dizon, who takes a pluralist approach and recommends developing a field of socio-techno-legal studies which would explore the interactions among these related normative orders, in particular in the context of ICT.⁴⁸ This approach has much to recommend it as it declines to make assumptions in advance about the dominance of any particular normative ordering in shaping behaviour. At the same time, it fails to give any sense of where connections might be found, leaving those questions open. While it is a useful avenue for scholarship generally, it is in a sense the beginning of the story. It leaves to later the substantive questions of what kinds of mutual learning might be possible, what patterns there might be in the interactions between society, law and technology.

One can, however, begin with a broader framing yet adopt a particular perspective, while recognising that other perspectives are also important. In particular, one can take the perspective of the lawyer or regulator concerned with issues at the technological frontier. Such a person usually has particular concerns, such as minimising the risk of harm to health or the environment, preserving social values such as privacy or enhancing democracy. They see socio-technical changes (either recent, potential or prospective) through the lens of such a concern. They then explore how law or regulation might be of assistance. This is the origin of most literature on 'technology regulation', as well as much legal literature in fields such as cyberlaw. It is not the only important question, it does not purport to be a comprehensive study of socio-techno-legal spaces, but it is an attempt to understand where mutual learning among legal scholars might take place.

The reference to socio-technical change, rather than simply technological change, recognises the difficulties of defining 'technology' alluded to above. In particular, it acknowledges that what changes over time will not always be tools or processes themselves. Further, it avoids a narrow focus on invention, instead implicitly incorporating innovation and diffusion, in other words the potential new forms of conduct becoming part of social practice.

Summing up, this second approach to the study of law, regulation and technology would look at how law and regulation make explicit and implicit assumptions about the socio-technical environment in which they will operate. New technological options, when taken up in a significant way, require lawmakers and regulators to rethink their approach. At the same time, regulators are reminded of their own ability to influence the path of socio-technical development as it evolves.

IV. CHOOSING A LENS

⁴⁸ Michael Anthony C Dizon, 'From Regulating Technologies to Governing Society: Towards a Plural, Social and Interactive Conception of Law' in Heather Morgan and Ruth Morris (eds), *Moving Forward: Tradition and Transformation* (Cambridge Scholars Publishing, 2012).

Thus far, I have articulated two lenses through which the problems of law, regulation and technology might be examined. These are (1) technology regulation and (2) the challenges for law and regulation in an evolving socio-technical landscape.

In choosing one, it is important to reflect on *what* makes a useful framework for scholarship, and here particularly legal scholarship. At the very least, a framework must offer a useful lens for considering a particular problem. The subject matter being studied must be connected (so that something can be said about it) at the same time as being of some particular importance (so that a broader focus is inadequate for studying the problem). Secondly, it must avoid framing the problem in a way that introduces arbitrary biases. For instance, in the context of the relationship between law, regulation and technology, it would be unhelpful to arbitrarily prefer technology-specific solutions to legal problems or make inaccurate assumptions about the relationship between technology and society. Thirdly, it must allow its stories to be told from an appropriate starting -point. The 'dimension of time' is particularly important in understanding the relationship between law, regulation and technology. This section will evaluate the two potential frames against each of these criteria.

What Constitutes a Useful Lens—or How to Avoid the 'Law of the Horse'

At a 1996 cyberlaw conference, Judge Frank Easterbrook compared cyberlaw to the 'law of the horse', being the attempt to understand the law of horses through the lens of cases concerning sales of horses, people kicked by horses, licensing and racing of horses and so forth.⁴⁹ In other words, Easterbrook argued that neither horses nor computers were a useful lens through which to view the law. One was much better off, in his view, studying traditional subjects such as tort law, contract law, property law and so forth. The application to horses and computers (and everything else) would then follow. His argument also pointed to the risks of dilettantism, but that aspect of his argument is contingent,⁵⁰ and of less interest here.

Easterbrook's critique of cyberlaw was rebutted by Lawrence Lessig, who explained that cyberlaw was a useful lens because it revealed that 'law' as traditionally conceived was not the only regulatory force.⁵¹ This became Lessig's wellknown thesis in *Code and Other Laws of Cyberspace*, that law, norms, market and architecture/technology/code were all regulatory forces that operated alone and in combination to restrict and influence behaviour.⁵² Cyberspace proved to be useful for the points Lessig was making about technology as a form of regulation, although one could arguably have reached similar conclusions from architecture in a traditional sense. Lessig was making a general

⁴⁹ Frank H Easterbrook, 'Cyberspace and the Law of the Horse' [1996] *University of Chicago Legal Forum* 207.

⁵⁰ Andrew Murray, *The Regulation of Cyberspace: Control in the Online Environment* (Routledge Cavendish, 2007).

⁵¹ Lawrence Lessig, 'The Law of the Horse: What Cyberlaw Might Teach' (1999) 113 *Harvard Law Review* 501.

⁵² Lessig (n 6).

point about diverse influences on behaviour, using the example of cyberspace which, by virtue of the fact that its 'code' evolved rapidly, was extremely useful as an illustration.

One can ask the same question that Easterbrook did about cyberlaw in the choice to study the regulation of technology. If the regulation of technology is to be a useful subject for scholarly examination, (1) one must be able to say something about the regulation of technology *in general* (aside from what one can say about the regulation of particular technologies) and (2) there must be something unique about questions around the regulation of 'technology' that do not apply when considering regulation more generally. The choice of field cannot be arbitrary in the way that horses are for law. Alternatively, like Lessig, one can use 'technology regulation' examples to make broader points, presumably because they provide the most useful illustrations of those broader points.

While there is much to say about the regulation of particular technologies, or particular classes of technologies (such as ICT or biomedical technologies), there is little in the notion of 'technology' that explains connections between fields or that differentiates technology regulation from regulation more broadly. Surveying the field to date, it would seem that the fact that technology (as opposed to technological change) is involved leads to little commonality in terms of questions about regulation. Brownsword's discussion of regulatory legitimacy, regulatory effectiveness and regulatory cosmopolitanism are important beyond the context of technology—legitimacy, effectiveness and cosmopolitanism should be considered in any regulatory exercise, whether or not technology is the regulatory target. Similarly, many of Koops' 'dimensions of technology regulation' operate on a narrower or broader lens. Thus the dimension of technology type is a reminder that many useful insights are found, not when considering technology as a whole but when considering particular classes of technology or even particular technologies. The dimension of place, when seen as a reference to geography and jurisdiction, is a relevant factor for all regulatory questions, whether or not technology is involved. To the extent that some technologies create new places (such as cyberspace and virtual worlds), the issues are primarily related to ICT. The dimensions of regulation type and normative outlook apply to regulation generally. To the extent technology raises unique issues in the dimensions of knowledge and time, they are largely tied to technological change rather than technology as such. Questions of discipline, problem and framing raise issues about the comparability of academic research that apply very broadly, and are not limited to the field of technology regulation. One remaining dimension, the dimension of innovation, is intriguing. To some extent, this dimension refers to technological change. But it can also refer to the link between regulation and innovativeness. Various policy settings, including the applicable regulatory framework, have the effect of encouraging or stifling innovation in particular fields. Bernstein might add that they will also have an impact on the *diffusion* of innovation.⁵³ This relates to a broader scholarship about how innovation can be

⁵³ Bernstein (n 43).

encouraged, from the design of patent law to analyses of funding models.⁵⁴ There are important questions to be asked about the role of regulation in this context, including the extent to which assumptions made in designing regulations unwittingly discriminate against as-yet-unknown technological possibilities⁵⁵ and whether a right to innovate ought to limit our willingness to embrace precautionary approaches to regulation.⁵⁶

However, these questions are not only important in the context of the regulation of technology as such. Regulation of activities with no evident technological link can stifle innovation. To take an example from land law, there used to be a rule that one owned land *usque ad coelum* (up to the heavens). This rule did not purport to regulate any particular technology as such, but rather clarified the meaning of what was essentially a twodimensional allocation of land. Yet it was reflection on the desirability for innovation (and diffusion) of air transportation technologies that led to a judicial restriction of the doctrine. In *Pickering v Rudd*,⁵⁷ the court held that no action in trespass was available on the basis of a board overhanging the plaintiff's garden lest it follow that 'an aeronaut is liable to an action of trespass *quare clausum fregit* at the suit of the occupier of every field over which his balloon passes in the course of his voyage'.⁵⁸ The *usque ad coelum* rule risked restricting innovation (and diffusion) of new technologies, despite the fact that it itself had nothing to do with 'technology regulation'. Consideration of the impact of regulation on technological innovation (and diffusion) thus needs to look beyond regulation of *technology* as such.

The difficulty here is thus not that work on questions around 'technology regulation' does not yield insights. Many articles have made important points either within a particular technological context or more broadly. Rather the question is whether the 'technology' lens is a useful one for considering questions of regulation.⁵⁹ In other words, it is important to consider whether there is anything that links this field together other than the use of up-to-date examples. To be a useful lens, 'technology regulation' must be able to yield insights that could not be gained by looking at the problem of regulation either more broadly (as regulatory theory does) or more narrowly (in a particular technological or regulatory context). Alternatively, it must be a particularly useful field on which to test a particular idea, which is how Lessig ultimately used cyberlaw. Indeed the study of the use of technology as a regulatory tool, which is closely related to Lessig's recognition that 'code is law' has

⁵⁴ Such as the problems of patent thickets and technology-specific approaches to patent examination. Maurice Schellekens, 'Patenting Nanotechnology: Are We on the Right Track?' in Goodwin, Koops and Leenes (n 3) 107.

⁵⁵ Bert-Jaap Koops, 'Should ICT Regulation be Technology-Neutral?' in Bert-Jaap Koops *et al* (eds), *Starting Points for ICT Regulation: Deconstructing Prevalent Policy One-Liners* (Asser, 2006) 77, 77.

⁵⁶ Wolfgang van den Daele, 'Access to New Technology: In Defense of the Liberal Regime of Innovation' in Goodwin, Koops and Leenes (n 3) 85.

⁵⁷ (1815) 4 Camp 219.

⁵⁸ *Ibid.* See also *Bernstein v Skyviews & General Ltd* [1978] 1 QB 479, 487 (involving the issue of whether flight over property constituted trespass, in which the judge stated, 'the maxim, *usque ad coelum* ... is a fanciful notion leading to the absurdity of a trespass at common law being committed by a satellite every time it passes over a suburban garden').

⁵⁹ See also Sommer (n 26).

yielded important insights for regulatory theory. However, scholarship on technology regulation, as in the regulation *of* technologies, does not meet these requirements. There is nothing about technology, no hidden element in any of the usual definitions offered that explains why technology needs to be regulated more than other kinds of social activities, or why it presents unique regulatory problems. That is not to say that *some* technologies (weaponry, dangerous processes and so forth) ought not be regulated, only that such regulation would need to be justified in the particular context. Pointing to the fact that ‘technology’ is involved reveals little.

One thread that connects much of that literature, and which does provide a useful lens through which related problems can be studied, is to study legal and regulatory issues faced as a result of technological change. This is, in Brownsword’s terminology, the challenge of regulatory connection. It can be demonstrated that similar issues are found across historical, doctrinal and technological contexts.⁶⁰ One can study the kinds of problems that arise as technology changes, one can ask about the effectiveness of prevention (in the form of technology neutral drafting, for instance), and one can consider how regulators ought to approach a new, rapidly changing technology in the face of uncertainty about risk (both known unknowns and unknown unknowns). One can also consider questions of institutional design, in particular how existing institutions such as law reform agencies or proposed specialised institutions such as a ‘scanning probe agency’ might help lawmakers and regulators manage technological change generally or in particular contexts.⁶¹ All of these issues are tied to the idea of technological, or socio-technical, change. This study of the impact of a changing socio-technical context on legal and regulatory design thus presents unique, yet related, problems.

Avoiding Arbitrary Bias: the Risk of Unnecessary Technology-Specificity

Despite the fact that ‘technology’ as a category is unhelpful in deciding whether or not to regulate, the idea of ‘technology regulation’ as a topic for study tends to suggest the opposite. It is not hard to convince lawyers of the benefits of ‘colonizing’ new technological frontiers such as space and virtual worlds.⁶² The sense that technology needs control, needs regulation, is often non-specific. This can be seen in the responses to *in vitro* fertilisation, where the Foreword to the Warnock Report referred to the desire for ‘some principle or other’ to govern developments in reproductive technologies with ‘some barriers’ and ‘some limits’ set by government.⁶³ Regulation of technology seems desirable for its own sake.

Asking questions about ‘technology regulation’ does more than suggest a need to regulate technology, it causes problems and questions to be phrased in those terms. As Susan Brenner has observed, there

⁶⁰ Bennett Moses (n 35).

⁶¹ *Ibid*; Stefan Gammel, Andreas Lösch and Alfred Nordmann, ‘A “Scanning Probe Agency” as an Institution of Permanent Vigilance’ in Goodwin, Koops and Leenes (n 3) 125.

⁶² Beebe (n 2).

⁶³ Report of the Committee of Inquiry into Human Fertilisation and Embryology, July 1984, Cmnd 9314 (Warnock Report).

is a tendency to think of problems in terms of the 'misuse' of technology.⁶⁴ This can, as she notes, result in duplicative, compartmentalised rules designed around particular technological contexts – separating telephone harassment laws from computer harassment laws, for instance. If one begins with the question 'How should we protect against risks associated with X technology?', one is more likely to conclude that what is needed is regulation designed to control risks associated with *that* technology, which often leads to technology-specific thinking in formulating a solution.⁶⁵ If the regulatory problem is defined in terms of technology, it is likely the solution will be crafted in similar terms. Regulators do not need to worry *generally* about how to frame new laws in a way that will manage particular risks or protect particular values if they are asked only to think about how a particular technology should be regulated.

In the context of nanotechnology, which has generated the field of nano-law, it is thus not surprising to find technology-specific laws being proposed and enacted. A number of cities and states in the United States have adopted or considered nanotechnology as a regulatory category.⁶⁶ In Europe, cosmetics containing nanomaterials are subject to specific provisions, including safety, reporting and labelling requirements.⁶⁷ The European Parliament has also expressed its preference for a nano-specific approach more generally.⁶⁸ A private member's bill in Canada (C-494) proposed a nano-specific approach. The United States Environmental Protection Agency has also considered nano-specific regulation.⁶⁹ In Australia, industrial nanomaterials that do not correspond to an 'existing' chemical are excluded from some exemption categories by the regulator NICNAS (National Industrial Chemicals Notification and Assessment Scheme).⁷⁰ Regulators were asked to solve the regulatory problems raised by nanotechnology, and they did, but they often did so in a technology-specific way. Technology-specific laws are sometimes desirable.⁷¹ If there is a moral objection to a technology as such, then the prohibition needs to target that technology. Without getting into the debate, if human reproductive cloning is seen as wrong in itself, then it ought to be prohibited. Similarly, the Catholic Church and radical feminists who oppose artificial reproduction generally, are entitled to argue that we should 'discriminate' against artificial means of reproduction. There is nothing illogical in arguing

⁶⁴ Susan W Brenner, *Law in an Era of 'Smart' Technology* (Oxford University Press, 2007).

⁶⁵ eg Geert van Calster, Diana Bowman and Joel D'Silva, "'Trust me, I'm a Regulator": The (In)adequacy of EU Legislative Instruments for Three Nanotechnologies Categories' in Goodwin, Koops and Leenes (n 3) 205.

⁶⁶ John DiLoreto, 'We Should Have Seen It Coming: States Regulating Nanotechnology' *Nanotechnology Now*, 7 September 2010, www.nanotech-now.com/columns/?article=484.

⁶⁷ Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products.

⁶⁸ European Parliament resolution of 24 April 2009 on regulatory aspects of nanomaterials, P6_TA(2009)0328.

⁶⁹ Environmental Protection Agency, 'Control of Nanoscale Materials under the Toxic Substances Control Act', www.epa.gov/oppt/nano.

⁷⁰ NICNAS (National Industrial Chemicals Notification and Assessment Scheme), Australian Government Gazette (Chemical), No C 10, 5 October 2010.

⁷¹ Chris Reed, 'Taking Sides on Technology Neutrality' (2007) 4(3) *SCRIPTed* 263, www.law.ed.ac.uk/ahrc/script-ed/vol4-3/reed.asp.

for technology-specific legislation, but it only makes sense to do so if the regulatory rationale is closely tied to the technology itself.

In the case of nanotechnology, the risks presented are closely related to the risks associated with other chemical substances and methods of manufacture. They are different at the level of specifics (in that nano-silver has different properties from standard silver) but they are not different in kind. Whatever risk-avoidance mechanisms are prescribed for chemicals generally can be used for nano-materials provided legislation is amended to undo the assumptions made about chemicals in the original legislation.⁷² For instance, the legislation needs to recognise that particle size (among other things) can affect properties and more thought is needed on how chemicals whose risks are still being investigated (the known unknowns) are managed. Regulation that targets 'nanotechnology', on the other hand, will almost inevitably become obsolete.

None of this is to say that nanotechnology does not raise unique problems, and that regulatory regimes designed prior to the manufacture of nanomaterials worked effectively in the new context. They did not, and many articles and reports have been written explaining the problems faced when applying older laws and regulatory regimes to nanotechnology.⁷³ But these are exactly the kinds of problems faced generally in applying rules, designed for an older socio-technical landscape, in a new context. Solving such problems need not involve technology-specific thinking (unless, of course, a technology-specific rule is considered appropriate in the specific context). Further, by thinking of *reasons why* particular rules do not work, broader solutions can be formulated. By thinking of the problematic assumptions underlying the formulation of rules, one can resolve those problems in a technologically -neutral way.

Of course, one could demand as a principle of technology regulation that the resulting regulatory regimes also be technology-neutral. One could have 'technological neutrality' as a principle for regulating technology (when that principle is appropriate).⁷⁴ However, that only raises the question of

⁷² Lyria Bennett Moses, 'Regulating beyond Nanotechnology. Do Nano-Specific Problems Require Nano-Specific Solutions?' (2011) 30 *IEEE Technology and Society Magazine* 42.

⁷³ eg Karinne Ludlow, Diana Bowman and Graeme Hodge, *A Review of Possible Impacts of Nanotechnology on Australia's Regulatory Framework: Final Report*, September 2007, www.innovation.gov.au/Industry/Nanotechnology/NationalEnablingTechnologiesStrategy/Documents/MonashReport2007.pdf; J Clarence Davies, *Managing the Effects of Nanotechnology*, Woodrow Wilson International Center for Scholars, Project on Emerging Nanotechnology, 2005, www.nanotechproject.org/process/assets/files/2708/30_pen2_mngeffects.pdf; Q Chaudhry, J Blackburn, P Floyd, C George, T Nwaogu, A Boxall and R Aitken, *A Scoping Study to Identify Gaps in Environmental Regulation for the Products and Applications of Nanotechnologies*, 2006, http://randd.defra.gov.uk/Document.aspx?Document=CB01075_3484_FRP.doc; Lori Frater, Elen Stokes, Robert Lee and Taiwo Oriola, *An Overview of the Framework of Current Regulation Affecting the Development and Marketing of Nanomaterials*, December 2006, www.berr.gov.uk/files/file36167.pdf; Commission of the European Communities, *Regulatory Aspects of Nanomaterials*, COM(2008) 366 and SEC(2008) 2036, 17 June 2008; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0366:FIN:en:PDF> and http://ec.europa.eu/nanotechnology/pdf/com_regulatory_aspect_nanomaterials_2008_en.pdf; RG Lee and S Vaughan, 'REACHING Down: Nanomaterials and Chemical Safety in the European Union' (2010) 2 *Law, Innovation and Technology* 193.

⁷⁴ Koops (n 55).

why the problem is framed in terms of regulating 'technology' in the first place. In other words, why embed technological-specificity in the framing of the problem, if one often prefers technology-neutral outcomes?

There is another sense in which technology-focussed thinking becomes problematic. We tend to be more concerned about technological dimensions of what are in fact broader problems. This is best illustrated by the concern with 'human enhancement' technologies, whether chemical or genetic in origin. Some of the concern relates to health risks, but a substantial reason for opposing these technologies is that they advantage some children (generally already privileged and wealthy children) over others. In other words, there is an element of unfair competition.⁷⁵ These same arguments are applicable to other situations, although they are generally seen as less persuasive. For instance, private schooling can entrench advantage and result in unfair competition for university places and jobs and, while it has opponents, the same arguments become less politically persuasive in this context. There is a tendency to be more concerned when the means through which unfair advantage is obtained are technological, rather than social or economic. Whether or not this is appropriate raises broader questions. But we should not build a bias against the technological into the framing of the question.

The alternative framing of the issue does not suffer from the same problem. It leaves open the question of whether socio-technical change ought to result in legal or regulatory change and how any such change ought to be expressed. Where new laws or regulatory change is thought appropriate, the question of the extent to which they ought to be designed around particular new things, activities or relationships remains an open one.

The Dimension of Time

A study that focuses on the regulation of technology suggests that analysis begins with a technological invention, extends through innovation and diffusion, with hurdles tied to ongoing evolution. The law and regulation being studied or proposed are born in response to technology, their history is hidden. In particular, it evokes statements such as that allegedly made by one of the men who devised the atom bomb: 'Edwin, now that the scientists have invented the atom bomb, it is up to you lawyers to find a way of controlling its use.'⁷⁶

As was illustrated earlier with the *usque ad coelum* example, rules that pre-date a technology can 'regulate' or even 'prohibit' it prior to its invention. The overall regulatory environment influences technological development in advance. One can see this in the context of technical standards which can unwittingly discriminate against particular avenues of innovation, even when expressed as

⁷⁵ Frank Pasquale, 'Technology, Competition, and Values' (2007) 8 *Minnesota Journal of Law Science and Technology* 607.

⁷⁶ Edwin Wilhite Patterson, *Law in a Scientific Age* (Columbia University Press, 1963).

technologically-neutral performance standards.⁷⁷ It is even more obvious in laws designed to be technology-forcing, such as tax laws that encourage particular avenues of research and development and carbon taxes that provide financial incentives for the development of renewable energy technologies. But even generally applicable forms of regulation, such as that implicit in tort law, have an impact on the design of new technologies.

Conversely, a new technology can change the regulatory effect of a particular rule. In the west of the United States, prior to the invention and diffusion of barbed wire fences, parliament wished to pass a law that would protect the free range from a common law rule that the owner of an animal was liable for damage done by that animal to a neighbour's land.⁷⁸ The law that made sense to them was to limit liability for harm done by animals to animals that crossed a physical fence on the neighbour's land. This balanced a person's right to their homestead against grazier's rights to the free range. From an interest group perspective, the graziers won the argument in the legislature. But they lost the war, not because legislators changed their minds, but because barbed wire fencing converted the exact same law into an abolition of the free range. Regulatory intent, in a law that appeared to have nothing to do with technology, was subverted by technological change.

In each of these two examples, regulatory regimes were impacted by technological change or, more accurately, a change in the socio-technical landscape. After the change, one could ask whether the rules ought to be changed, and one could come to different conclusions. But neither story really began with technology. By studying law and regulation as impacted by a changing socio-technical landscape, one can see this. Just as a new regulatory move does not work in isolation but rather impacts on a pre-existing regulatory matrix,⁷⁹ so too new and potential socio-technical practices are influenced at the outset by the pre-existing regulatory matrix, and in turn change it, either directly (in the code as law sense) or indirectly (as where rules are changed to better fit with the new practices).

However, thinking about the problem in terms of 'regulating technologies' seems to begin the story at the wrong moment in time. A new technology does not only raise the question of whether we need to regulate it. It also raises the question of how it fits into a pre-existing legal and regulatory landscape. We do not think of land law as 'regulating' the technologies of ballooning or barbed wire, although it may have this effect. The relationship is more complex, and better characterised by a recognition that law and regulation make assumptions about what is possible in the world, they are designed to operate in an assumed socio-technical landscape. Sometimes this is explicit, but often it is implicit. Changes in a socio-technical landscape are thus potentially problematic, even though they will not always cause problems. What Brownsword calls 'the challenge of regulatory connection' is crucial. However, it is crucial beyond regulatory regimes that target technology as such.

⁷⁷ Richard B Stewart, 'Regulation, Innovation, and Administrative Law: A Conceptual Framework' (1981) 69 *California Law Review* 1256.

⁷⁸ Guido Calabresi, *A Common Law for the Age of Statutes* (Harvard University Press, 1982) 244.

⁷⁹ Murray (n 50).

V. CONCLUSION

My aim in this article has been to suggest that 'technology regulation' is not the best lens for considering the kinds of issues raised by new technologies. One might still ask, however, whether this really matters. Since important and useful work is being published under that heading, who cares?

My first response to that question would be to observe that we need to ensure that the right kinds of conversations are taking place. If nanotechnology, information technology, neurotechnology and biotechnology are all being discussed in the same places, we need to know what kinds of things scholars in these different fields can learn from one another. As Easterbrook noted, little would be gained by bringing together diverse scholars to consider the law of the horse. However, there are real links between the kinds of problems that arise in all of these areas as a result of socio-technical change. For example, one can look to problems such as the Collingridge dilemma without re-inventing the intellectual wheel with each new technology in terms of how such problems are approached.

The second reason why it is important is that, while lawyers tend to be very good at rushing to the scene when something is new and exciting, we tend to disappear when problems become more mundane, but no less important. The challenge of regulatory connection is an ongoing one, and we need good mechanisms for making ongoing adaptations as circumstances change. Technology will not always be new, but it will always be changing, presenting new legal and regulatory problems.

On a related point, because change is continuous, we need to think broadly about how to minimise risks of harm and protect important values in an evolving socio-technical landscape. We cannot do this by limiting our thinking to singular one-at-a-time technological frames. Nano-law can solve today's problems, but technology specific solutions will be short-lived. We need to think more broadly about regulation of new materials with as-yet-unknown risks. If we care about values such as privacy, we need to think about how it can be supported by regulation. It is not that the technological context is irrelevant—technologies such as miniature cameras, data mining, data storage are all important as they shape the socio-technical landscape. But while the solution will sometimes be 'technology regulation' in the form of restrictions on particular products or particular processes, this is not always optimal from a design perspective. We need to think more broadly about how to regulate to protect values and minimise harm in light of an evolving socio-technical landscape rather than simply asking how technology ought to be regulated.

Of course, the approach I am advocating still takes a particular perspective, that of a person considering changes to laws or intentional regulation. It is not directly interdisciplinary, but lives within legal scholarship at the technological frontier. It also focuses on changes related to technology, rather than changes related to knowledge or moral beliefs. It is thus only one part of a broader story about the relationship between law, regulation, science, technology and society. It does not address

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larger questions such as whether law and regulation are inherently technological in their approach or whether either will continue to be effective in controlling behaviour in particular imagined technological futures. Nevertheless, it is one that will hopefully enable useful conversations about how law and regulation can operate effectively at the technological frontier.