

AGENTS OF CHANGE: How the Law ‘Copes’ with Technological Change

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The difficulty of adapting legal frameworks to changing circumstances is often represented by images of ‘law’ losing a race. Such visions are commonly raised in scholarship concerned with particular problems that arise in applying existing legal rules to new situations, particularly situations involving new technologies. The dilemmas encountered in adapting legal frameworks to technological change rarely persist indefinitely, however. While no institution or methodology is exclusively concerned with changing the law in response to technological change, parliamentary committees, government departments, royal commissions, law reform organisations, technology assessment agencies, ethics bodies, courts, the Productivity Commission and an array of individuals and ad hoc bodies have all been sources of adjustment at various points in history. The diverse array of organisations represents a multiplicity of disciplinary perspectives and evolving methodologies. Each one focuses on part of the story of the mutual adjustment between technology, society and law. This article represents an initial attempt to survey the landscape in order to understand better how Australia has dealt with both technological ‘crises’ and the more mundane process of ensuring that legal rules operate sensibly and predictably in an evolving technological environment. From this, the article will explore briefly the gaps in Australia’s current mechanisms for ensuring law ‘keeps up’ with technology.

There are many stories that can be told about technology¹ and law.² This article focuses on one commonly told tale: that of the hare and the tortoise. In this fable, ‘law’ features as the loser in the endless race against ‘technology’. As technology gives rise to new possibilities, and people engage in new forms of conduct, the law continues to be directed to solving old problems and is unable to ‘keep up’ with the modern world.

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¹ In this article, I will adopt the same definition of technology as in Bennett Moses (2007b).

² Tranter (2002).

This story is so well known that reference to it in speeches, publications and judgments can be made in passing. Law journals are replete with articles bemoaning the law's inability to keep pace with technological change, with Windeyer J in *Mount Isa Mines Ltd v Pusey* a popular reference.³ The problem is given different names: a recent collection of essays is devoted to the 'pacing problem',⁴ while Brownsword refers to it as the challenge of regulatory connection.⁵ The particular technologies said to outpace law are constantly varying. Currently, the focus is on nanotechnology, biotechnology, robotics, information and communications technologies, and applied cognitive science,⁶ some of which have spawned new legal specialties. Cyclically, the law's inability to keep pace might in future be identified with other categories (such as energy technologies).⁷ While law has mounted many hurdles, and railroad law is no longer considered to be on the cutting edge of technologically generated confusion, there is always a new frontier to which law is summoned.

While legal literature at the frontier often reflects lawyers' anxieties about the future,⁸ the law is not alone in being cast as tortoise opposite the hare of technology. Rather, it is only one example of a broader perception that *everything* is lagging behind technology. Commentators commonly speak of 'cultural lag', or comment on the inability of ethics to 'keep up' with new technologies, in line with the general perception that technological change is both rapid and accelerating.⁹ In information technology, Moore's law – which predicts a doubling of the number of transistors that can be placed inexpensively on an integrated circuit every two years¹⁰ – is a common reference point. For health technologies, reference to increases in life expectancy over time or advances in the number of genes that can be mapped inexpensively are often used to represent the trend of rapid acceleration. However it is measured, technological change is generally perceived as positive, as representing economic opportunities and advances in standards of living. Where it poses challenges for law, ethics or society, it is *those* fields that are blamed for their inability to keep pace.

Despite the prevalence of the metaphor, it is not obvious what it means for one field to compete with another. While few observers would doubt the fact that technology advances rapidly, it is not clear in what sense it competes with other endeavours. Those studying ethics and culture have

³ *Mount Isa Mines Ltd v Pusey* (1970) 125 CLR 383 ('Law, marching with medicine but in the rear and limping a little'). See also Marchant (2011); Bennett Moses (2007b).

⁴ For example, Marchant et al (2011).

⁵ Brownsword (2008).

⁶ Allenby (2011).

⁷ Slating and Kesan (2012).

⁸ Beebe (1999).

⁹ Popper (2003).

¹⁰ Wikipedia, *Moore's law*, available at http://en.wikipedia.org/wiki/Moore's_law.

criticised the race metaphor and all it implies.¹¹ They rightly argue that it is simplistic to assume that technology is necessarily ‘progressive’, or that other aspects of human endeavour are either ‘intransigent sources of obstruction’ or else failures.¹² Although law has been cast in the same part in the race against technology as these other fields, law’s defenders are harder to find. Legal scholarship – especially in the many journals dedicated directly or indirectly to the study of law and technology – continues to refer to law’s failure to ‘keep up’ with technology, either generally or with respect to a specific technology.

If the story of law’s loss in the race against technology were simply a convenient means to assure the reader of an article’s relevance and importance, it might be considered harmless. While it might generate excessive legal scholarship,¹³ adding to legal literature at the technological frontier through critique of the metaphor would hardly solve the problem. But the metaphor *does* have real impact on legal decision-making. It suggests a need for urgent new legislation, despite the advantages in some cases of delay.¹⁴ It pits the rush for technology-specific responses against the need to ‘future proof’ legislation through technology-neutral drafting, without careful consideration of the advantages and disadvantages of either approach.¹⁵ It suggests a need for radical responses, such as Calabresi’s suggestion that judges be given power to revise obsolete statutes.¹⁶ To the extent that law’s portrayal as unduly slow suggests a need for a solution, it is important to understand what the race metaphor means and whether it implies a failure on the part of law. It is also necessary to take stock of what is already being done on law’s behalf before considering what improvements might be made.

This article begins by delving beneath simplistic one-liners to understand what it means for law to fail to ‘keep up’ with technology. It suggests that we can think of law as being ‘behind’ technology when law is designed around a socio-technical context of the relatively distant past. In that context, the real question becomes whether sufficient mechanisms are in place to ensure that legal issues resulting from technological change are identified and resolved soon after they arise. Thus the next section sketches a picture of current and historical mechanisms that have been used to help law ‘keep up’ with technological change. Although the focus is on Australia, important institutions in other parts of the common law world are described both as examples of alternative practice and an indication of trends. I then consider the weaknesses of these mechanisms and suggest improvements.

¹¹ Shapiro (1999); Volti (2009).

¹² Volti (2009).

¹³ Bennett Moses (2010); Beebe (1999).

¹⁴ Bennett Moses (2005).

¹⁵ Ohm (2009); Bennett Moses (2007b); Koops (2006); Reed (2007).

¹⁶ Calabresi (1982).

While the metaphor of the hare and the tortoise suggests consistent sluggishness on law's part, the reality is more complex. Most technological change fits comfortably within existing legal frameworks. Where technological change creates a basis for legal change, the issue will often be considered by a permanent or *ad hoc* body with recommendations fed back to government for consideration. This is not to say that improvements cannot be made (and some suggestions are offered below), or that solving the pacing problem will solve *all* problems associated with the relationship between law and technology. However, a sense of the institutional landscape through which Australia manages the interface between law and technological change is a better starting point for reform proposals than a simplistic and over-used metaphor of failure.

What It Means to Lose the Race

Although it may seem trite to say it, everything changes. Technology, boosted by government research and development funding as well as commercial investment, changes at what is commonly observed to be a rapid pace. Economic growth and change have become constant sources of comparison and rivalry across the globe. The law changes whenever a statute is enacted or a regulation is promulgated, and often changes when judicial and tribunal decisions are handed down. While there is no 'Moore's law' for the legal system suggesting exponential improvement, there are frequent comments about growth, usually tied to despair about volume. More broadly, society changes over time, as is evident from even a cursory study of history.

Not only does everything change, but change in one area often suggests the need for consequential changes elsewhere. Society morphs along multiple interacting dimensions, including changes in what its members do, changes in technology, economic change and changes in the legal regime. Legal change affects behaviour, as people change their behaviour (at least to some extent) to assure compliance. The law affects what technologies are developed – general duties in tort law affect product design; requirements for government approval of specific technologies (such as drugs) affect particular industries; patent law, procurement policies and funding or tax deductions for research encourage technological development (either generally or in specific areas); and specific requirements in regulations precisely prescribe design criteria for some technologies. Law can be used to channel social resistance to technology, as in the example of labelling laws. Legal change thus has the capacity to influence technological change. In turn, technological change affects what activities people engage in as well as social and political relationships, including power relations between different social groups.¹⁷ Of course, technological change does not occur 'by itself', but hinges not only on the conduct of its designers, but also on broader social preferences and behaviours.¹⁸ In particular, technological

¹⁷ Winner (1985); Koops (2010).

¹⁸ MacKenzie and Wajcman (1985); Pinch and Bijker (1987).

development in particular areas is promoted or hindered on the basis of public and private funding decisions, which are in turn based on economic and social preferences.

It is therefore not surprising that socio-technical change has an impact on law. As technologies make new things, activities and relationships possible, and people engage in new forms of conduct, laws already in existence may not operate as effectively as they did in the past to achieve particular purposes.¹⁹ It may be unclear how a legal rule applies to a new thing, activity or relationship, or there may be uncertainty as to how it will be classified. It may be that the scope of a legal rule includes or excludes the new thing, activity or relationship despite the underlying goals of that rule suggesting preference for the opposite result. Further, rules may become obsolete where conduct regulated by an existing rule is no longer important, where the justification underlying a rule no longer makes sense or where a rule is no longer cost-effective (compared with a new alternative). Finally, the technology concerned may be seen to have a positive or negative impact on what are seen as important social values, so that law may be called on to encourage, facilitate, regulate or prohibit new things, activities and relationships. In other words, the law might be asked to assist in shaping technology.

Consider the example of nanotechnology.²⁰ Many regulatory regimes (in Australia as well as internationally) sensibly treat existing chemicals differently from new chemicals so that manufacturers do not need to re-evaluate the toxicity of a chemical each time the same chemical is manufactured. Nanomaterials presented a problem because they have the same molecular structure as previously evaluated macro-versions of the same substance, while demonstrating vastly different properties. It was often unclear whether nano-versions of existing substances were to be treated as 'the same' as macro-versions of those same substances. This created regulatory uncertainty. Further, some chemical regulations did not apply to nanomaterials because of particular mass or volume triggers. The assumption behind such triggers was that it was not cost-effective to regulate the production of small volumes since the level of risk is correspondingly small. Nanomaterials, which can be more reactive in small quantities than their macro-version counterparts, challenge this assumption. To the extent that nanomaterials were improperly under-regulated as a result, the regulations could be said to need amending to keep pace with technological change. Finally, calls for a moratorium or strong restrictions on nanotechnology (for example, by Friends of the Earth) seek to have government play a direct role in managing the technological landscape of the future. In the case of nanotechnology, regulations have been altered, both in Australia and elsewhere, so as to close the gap generated by technological change. This has been done by modifying existing regulatory frameworks.

¹⁹ Koops (2010); Bennett Moses (2007b).

²⁰ See generally Bennett Moses (2011); Ludlow et al (2007).

Sometimes, what is required is not interstitial change but rather newly crafted legal frameworks. These might be *sui generis* rules applicable only to a particular new technology (for example, intellectual property protection for semi-conductor chips) or they may be formulated so as to apply broadly beyond the immediate technological context (as is the case with much digital signatures legislation). Often, where major legal changes are made in response to technological change, the concern is not with law's response being 'too slow' but with the resulting legislation being poorly conceived or poorly designed. If anything, the argument is often made (usually in retrospect) that the reforms were too rushed.

Nothing in this section should be read in a way that would overstate the 'pacing problem'. Most technological changes – especially those of a minor nature – raise few concerns for law. While law journals are replete with issues around cyberlaw, the law of virtual worlds and the regulation of nanotechnology, few have wondered at the legal implications of self-cleaning ovens. Most technologies sit quite comfortably with existing legal frameworks that regulate the liability of manufacturers, the conduct of retailers, the rights of inventors and the rules of competition, among other things. At the same time, there are no complaints about the inability of the law to keep pace with self-cleaning ovens, electric can openers and digital pianos, as useful as these technologies may be. My point is that *in some circumstances* technological change does raise new legal dilemmas and hence gives rise to the impression that the law is falling behind. In other words, the observation that law has failed to 'keep pace' with technology can be seen as an expression of frustration with the speed with which law changes in response to particular types of dilemmas. Technological change, as well as changes in what people do and create, matters for lawyers because ultimately all legal rules assume a particular socio-technical state. The urge to 'keep pace' with technology is thus not a call for law to grow exponentially, but a call for laws that better reflect our current technological capacity.

Although not all legal dilemmas are ultimately related to a change in technology, there is value in considering the law's response to changes in social and cultural attitudes and changes in knowledge and understanding separately.²¹ Changes in beliefs are timed and perceived differently from changes in technology and conduct. Those proposing reform of law in response to changes in belief tend to argue that a particular law was *always* bad. Laws permitting slavery are not considered *today* to have been justified *because of* the social beliefs operating at the time. Their repeal is not merely a case of law keeping up with changing opinions, but the realisation that such laws were *always* morally wrong. The urge for legal change in response to technological change has a greater sense of *timing*: laws regulating railroads are only needed after track is laid; uncertainties relating to the split of genetic and gestational motherhood need only be resolved *in response to* the availability of *in vitro* fertilisation. There is no doubt that legal change

²¹ See generally Bennett Moses (2007a).

may be demanded as a result of changes in our collective knowledge and beliefs, or social change more broadly, but differences in how such changes are timed and perceived (as well as limitations of space) explain why this article focuses only on part of the story (which is not to say that it might not, in some places, have a broader resonance).

None of the above discussion is intended to suggest that the process of identifying circumstances in which the law is 'behind' technology could ever be purely mechanical or uncontroversial. The statement that law needs reform to take account of a particular technological change is often a political one. Industry and environmental groups may disagree about the extent to which existing laws deal adequately with developments in nanotechnology. However, change in the socio-technical landscape can be seen as a basis for *reconsidering* the existing rules, whether or not that ultimately leads to any particular change. Where *anyone* can point to a potential uncertainty, a statute whose applicability (or not) to new forms of conduct is arguably contrary to the underlying goal, a law that applies to conduct that is no longer practised, a new technology that might conflict with what some consider to be important values, and so forth, then legal change ought at least to be considered. Some may advocate retaining the existing rule, arguing that it continues to work better than proposed alternatives. If such advocates are convincing, then those desiring legal change need to respond to the arguments raised rather than relying solely on rhetoric around law's failure to adapt. Criticism of the pace of legal change for failing to keep up with technology ought to be reserved for situations in which there are no opportunities to consider revising and, if decision-makers deem it appropriate, to revise law in order to align it to the new socio-technical landscape. If change is considered but deemed undesirable, then while such decisions might be criticised by those with a different view, the problem is not one of *pacing* but one of *disagreement*.

Similarly, it is important to recognise that laws are often criticised as being ineffective, illegitimate, poorly designed, and so forth *from the moment of their creation*. This problem is not limited to laws dealing with technology – it is open to anyone to argue that a particular legal rule is poorly conceived, will not work, is outweighed by negative side-effects, will be too expensive to implement, is contrary to international obligations, is poorly drafted and so on. While such criticisms can be (and often have been) made about laws regulating particular technologies or laws enacted in response to particular technological changes, this does not necessarily imply anything special about the relationship between law and technology. It is possible that laws enacted in response to technological change are drafted in greater haste (on average) than other laws, leading to more problems, but this would require separate empirical investigation, and is not the subject of this article. The focus here is specifically on institutional mechanisms for managing the fact that laws *become out of date over time* not mechanisms for ensuring that laws in general are well designed *on their creation*.

It is also important that society's criticism of law be reasonable. It is fair to criticise laws that are based on technological assumptions of the

relatively distant past. It is not always appropriate or necessarily efficient for law to 'race ahead' of technology. Law's 'victory' in the space race – a legacy that includes scholarship on the appropriate legal mechanism to transfer a space platform and the legal classification of alien life – should not be the standard for which law should strive.²² Rather, it should be enough if there are mechanisms for decision-makers to consider legal dilemmas resulting from technological change within a reasonable timeframe and make such reforms as are thought necessary or desirable.

Law's Capacity – Past and Present

To get a sense of law's performance in the never-ending race to keep up with technology, it is worth considering the institutional mechanisms that have a role to play in identifying legal dilemmas that have arisen as a result of technological change. In fact, there are many institutional mechanisms with a role that includes or has included considering whether the law ought to be changed in order to bring it 'up to date'. These include institutional law reform, technology assessment, general policy bodies such as the Productivity Commission, political bodies such as joint ministerial councils and parliamentary committees, government departments, judges, academics, professional bodies (in law, science and engineering), *ad hoc* bodies such as Royal Commissions and advisory committees, specialist bodies on particular areas of law (such as the Copyright Law Review Committee), international bodies (including the OECD) and miscellaneous others such as think-tanks, lobby groups and private actors.

The length of this list, of course, does not mean that a lot is happening to facilitate law being brought into line with technological change. No member of the list has the pacing problem as its sole, or even dominant, purpose. However, given the almost universal view that law fails to keep pace with technological change, the role played by each of these organisations and what they, as a collective, are able to achieve are worth considering. The goal of this section is thus to sketch out a map of the organisational landscape through which the law is or has been modified as a result of technological change. It will explore the role played by different types of institutions in identifying legal issues that result from technological change as well as their limits in performing this function. It provides an overview of the most significant forces in this field, rather than a detailed description of the histories, accomplishments or institutional weaknesses of any particular organisation.

Institutional Law Reform

The law *changes* with new legislation and regulations, and often new court decisions. However, according to most that use the term, it is only *reformed* when the change is for the better.²³ Improving law involves far more than

²² Picker (2001); Beebe (1999).

²³ Kirby (1983).

ensuring that legal rules are modified, as necessary, to deal with socio-technical change. Some poorly conceived laws may be in need of urgent reform from the moment of their creation. However, those writing about law reform, from the early days of the modern law reform movement to the present, have often referred to the goal of keeping the law up to date as an important aspect of law reform.²⁴

Law reform institutions play an important role in Australia, in the form of the Australian Law Reform Commission (ALRC) as well as its state counterparts that take a variety of forms. Similar bodies exist elsewhere, although their popularity in particular jurisdictions tends to move in cycles, as recent budget cuts to the ALRC and the decommissioning of two former Canadian federal law reform commissions can attest.²⁵ As is the case for law reform more generally, institutional law reform is broader than, but includes, the goal of keeping the law up to date with social and technological change. The enabling statutes of the various law reform agencies thus include adaptation (or similar language) among the delegated functions.²⁶ The Law Commission in the United Kingdom has even had a team dedicated to the task of finding obsolete and unnecessary statutes, with a view to repeal.²⁷

It is therefore not surprising to find, among law reform commission reports, those that address legal dilemmas arising out of technological change.²⁸ The inaugural chairman of the Australian Law Reform Commission, Michael Kirby, once expressed the view that: ‘Almost every task of the Commission evidenced the impact of science and technology on the law.’²⁹ This is almost certainly an overstatement, with few other commentators giving the same emphasis to this particular role.

There are some who question the importance to the law reform effort of proposing change to adapt to new socio-technical landscapes. This comes out of scholarship, largely based in Canada, around the relationship between law reform and social reform. According to advocates of ‘social law reform’, law reform commissions should not focus on ‘keeping the law up to date with gradual changes in social practices’, but instead focus on achieving

²⁴ Williams (1951); Vanderbilt (1955); Gardiner and Martin (1964); Sutton (1970); Kirby (1983); Hurlburt (1986, 1997); Weisbrot (2005); Chalmers (2005); Hughes (2008).

²⁵ The Law Reform Commission of Canada operated from 1971 until 1992 and the Law Commission of Canada operated from 1997 until 2006.

²⁶ For example, *Australian Law Reform Commission Act 1996* (Cth), ss 21(1)(a), (1)(c); *Law Reform Commission Act 1967* (NSW), ss 10(1)(a)(i), (ii), (iv), (vi); *Law Commissions Act 1965*, s 3(1) (UK); *NY CLS Legis* § 72 (2011) (New York). See also Sterett (1990).

²⁷ Burrows (2003).

²⁸ The ALRC has issued reports that include discussion of legal issues arising as a result of new technology such as on human tissue transplants (1977), human genetic information (2003), privacy (1982) and evidence (1987). At a state level, there have been reports on *in vitro* fertilisation, contraceptives, genetic experimentation, medical technology and tranquiliser guns, among other topics.

²⁹ Kirby (1988).

beneficial social outcomes.³⁰ Rather than piecemeal legal change, social law reformers stress the importance of social context, legal paradigm shifts and moving beyond the traditional bounds of ‘law’ as a cure for social problems.³¹

While ‘social law reform’ is important, and a significant aspect of what law commissions in Australia have done, the argument for social law reform does not counter the need to keep the law up to date. In an ideal world, the law would undergo paradigm shifts that make fundamental changes to better reflect social needs *as well as* being altered, as necessary, to adapt to change in other spheres. In other words, both the stock and flow of legislation require attention.³² This dual function was explicitly recognised in the Manifesto for Law Reform of the (first) Law Reform Commission of Canada, which referred to both the ‘removal of anachronisms and anomalies in the law and the elimination of obsolete laws’, and also the ‘developing new approaches to and new concepts in Canadian law’.³³ If an already existing law has become unclear, poorly targeted or obsolete as a result of socio-technical change, then amending it to better fit the new socio-technical landscape might be called ‘patchwork’, and broader changes might still be required, but it is still important work. Law needs both ‘social law reform’ and ‘adaptive law reform’ – paradigm shifts and regular updates. For both, it is important that reformers remain mindful of the social context. There is little doubt that, at least in Australia, law reformers have done this.³⁴

The weighting between the different missions of law reform commissions is largely a matter of opinion. Professor McDonald, the first president of the second Canadian Law Reform Commission, described the last of its delegating missions, ‘the elimination of obsolete laws and anomalies in the law’, as being the ‘least important task’.³⁵ But this view has its critics.³⁶ Ultimately, for my purposes, what matters is that, in practice, law reform commissions at the federal and state level in Australia do devote time to considering changes in the law to bring it up to date with socio-technical change. Contrary to the statement by Michael Kirby referred to above, this is not and never has been the sole mission of law reform commissions, but it remains an important one.

Law reform commissions, however, generally do not deal with this problem comprehensively or systematically. While many projects do involve ‘adaptive law reform’, not all worthwhile potential projects come onto the working agenda of law reform commissions. Officially, most law reform

³⁰ Samek (1977); Macdonald (2000).

³¹ Lyon (1974); Samek (1977); Mason (1990); Macklin (1993); Macdonald (2000); Armstrong (2004).

³² Donelan (2008).

³³ Law Reform Commission of Canada (1979).

³⁴ Hurlburt (1986); Tilbury (2005).

³⁵ Graycar and Morgan (2005).

³⁶ Burrows (2003).

commissions do not have the power to initiate an inquiry, relying instead on an Attorney-General to set their agenda. Even where, as in England and Queensland, there is power to initiate an inquiry, this is subject to political oversight, at least for law reform commissions as opposed to university-based institutes.³⁷ Less formally, all law reform commissions can suggest projects.³⁸ But a mission such as keeping the entire law under review, while occasionally referred to, is not done in practice.

There have been attempts by some law reform commissions to engage in the task of project selection. After a report of the Senate Standing Committee on Constitutional and Legal Affairs mentioned the issue in 1979, the Australian Law Reform Commission kept track until 1993, through Appendices in its Annual Reports, of law reform suggestions received from the profession and the community. In New South Wales, the Community Law Reform Program continues to solicit proposals for law reform.³⁹ There have been some activities in other jurisdictions as well.⁴⁰ Even commissions without a formal program for community suggestions for law reform often receive them (particularly from the legal profession, courts and academic lawyers) and may make a request for a reference where deemed suitable.⁴¹

However, even where commissions solicit and review suggestions for future projects, this is neither systematic nor comprehensive. Some types of projects will be excluded for reasons other than the merits of the reform proposal. Law reform projects are generally large scale projects of sufficient scope and importance to justify the use of the commissions' resources and capacities.⁴² While one finds reports on organ transplantation, assisted reproduction, human cloning and genetic engineering, a law reform commission is unlikely to address regulatory adjustments to take advantage of developments in particular technologies. Narrower proposals for reform do not result in law reform projects and, unless managed by government departments, are ignored.

Another feature of law reform commissions that affect its contributions in this area is composition. Law reform commissions are made up almost entirely of lawyers.⁴³ While there are often suggestions for greater inclusion of non-lawyer members in order to enhance diversity,⁴⁴ or to provide sociological, criminological or economic expertise,⁴⁵ there is no call for inclusion of scientists or engineers. Law reform commissions requiring such expertise are able to rely on other means such as targeted casual hires, broad

³⁷ Warner (2005).

³⁸ Kirby (1983).

³⁹ See www.lawlink.nsw.gov.au/lawlink/lrc/ll_lrc.nsf/pages/LRC_clrp.

⁴⁰ For example, Scarman (1967); Macklin (1993).

⁴¹ Atkinson (2005); Sayers (2005).

⁴² Robertson (2005); Scarman (1967).

⁴³ Burrows (2003); Hurlburt (1986).

⁴⁴ Murphy (2004); Macklin (1993).

⁴⁵ Hurlburt (1986).

consultation (including with other bodies), consultants, part-time members and advisory committees. However, while these sources may be able to provide technical *information* to guide a law reform commission,⁴⁶ they do not prevent law reform commission reports from ‘black boxing’ technology. In other words, law reform commission reports dealing with new technologies tend to consider how law should change in response to a *predefined* technological change; the state of technology is taken as a ‘given’. Other than in circumstances where a law reform commission collaborates with other bodies,⁴⁷ few reports expressly consider the role of law in technology’s design or how law might influence the development of technology to protect important values. If ‘law reform’ as a methodology risks black boxing technology, it is worth considering the field of ‘technology assessment’ that claims to open that particular box.

Public Technology Assessment

‘Technology assessment’ is a term dating back to the late 1960s, which came to prominence in the 1970s and 1980s, and continues to play a role – albeit to varying extents in different countries. Early definitions of technology assessment articulated its purpose as being to systematically study and inform policy-makers about technological developments and trajectories, and their likely impacts (including indirect, unintended or delayed impacts) in order to facilitate long-range planning.⁴⁸ There was particular emphasis on the need to take better account of potential negative ‘side-effects’ than might otherwise be the case. Technology assessment is practised not only by government, but also by private corporations, consulting firms and policy think-tanks, although the focus here is on public technology assessment.⁴⁹ The methodologies of technology assessment initially were largely technocratic, using S-curves and other techniques to forecast technological futures and impacts. Methodologies are now more diverse.⁵⁰ As in the case of law reform, there has been growing recognition of the importance of broad consultation and engagement.

The best-known technology assessment institution is the now defunct Office of Technology Assessment (‘OTA’) in the United States. The OTA was created in 1972⁵¹ to ensure decisions influencing technological change reflected a wide range of concerns, adopted a long-term horizon and were made in light of a solid understanding of the ‘facts’.⁵² The OTA’s work went

⁴⁶ Cf Kirby (2008).

⁴⁷ An example is Australian Law Reform Commission and National Health and Medical Research Council Australian Health Ethics Committee (2003).

⁴⁸ Hetman (1973); Coates (1976); Armstrong and Harman (1980); Vig and Paschen (2000).

⁴⁹ Vig and Paschen (2000).

⁵⁰ Van den Ende et al (1998); Tran and Daim (2008).

⁵¹ Championed by Emilio Q Daddario (D Conn), the OTA was established in 1972 by the *Technology Assessment Act* (PL 92-484) (US).

⁵² National Academy of Sciences (1969); Bimber (1996).

well beyond forecasting and encompassed exploration of technical components of legal and political issues (from energy policy to copyright).⁵³ The OTA did play a useful role in identifying and framing issues around new technology, even if it did not ultimately have great influence on the eventual political debates around those issues (with politicians using the reports strategically rather than as a basis for changing their preconceived view).⁵⁴ Even long after its demise – with funding cut in 1994 – there are calls for the reinstatement of the OTA.⁵⁵

The OTA carried out a broad range of projects, with much of its work relating to questions of choice around government-funded infrastructure, research and development funding and industry support. This directly involved government in shaping future technological development. Some reports consider regulations around minimising undesirable effects of particular technologies.⁵⁶ Other reports are almost analogous to law reform commission reports, and consider similar issues to those that were considered, in an Australian context, by a law reform commission.⁵⁷ These reports sometimes refer to the same the hare and tortoise metaphor seen in much legal commentary.⁵⁸ However, while engaging explicitly with technological options, OTA reports tend to ‘black box’ law. Suggestions for law reform are presented as policy options with no attempt to be specific about issues such as statutory wording.

While Australia never created a technology assessment body such as the OTA, the history of technology assessment in Australia makes for interesting reading. Some technology assessment was done in the Department of Science as far back as 1973.⁵⁹ However, it was not until the late 1970s that Australian interest in technology assessment temporarily expanded following the report of the Committee of Inquiry into Technological Change in Australia, also known as the Myers Committee. The Myers Committee was appointed in December 1978 to ‘examine, report and make recommendations on the process of technological change in Australia’. It followed a workshop earlier that year, set up to explore what role technology assessment might play in Australia.⁶⁰ At the time, there were significant anxieties that technologies such as computers would lead to massive unemployment, and the technological impact of primary concern was therefore the impact on employment – although other issues, such as privacy, were also raised.

⁵³ Boroush et al (1980); Sarewitz (2005).

⁵⁴ Bimber (1996); Whiteman (1985); Burns (1976).

⁵⁵ There was a political move to re-establish the OTA in 2001 (Bill HR 2148). See also Epstein (31/03/2009); Kahn (20/05/2007); Rodemeyer (2005).

⁵⁶ For example, OTA (1987).

⁵⁷ For example OTA (1986, 1987, 1988); Australian Law Reform Commission (1983, 2004); New South Wales Law Reform Commission (1988).

⁵⁸ OTA (1986, 1989).

⁵⁹ Department of Science and the Environment (1979).

⁶⁰ Department of Science (1978).

A significant result of the Myers Committee report was the establishment of the Technological Change Committee of the Australian Science and Technology Council (later the Australian Science Technology and Engineering Council, also known as ASTEC), with a mission to 'review on a continuing basis the processes and trends in technological change in Australia and elsewhere; and to evaluate and report on the direct and indirect effects of technological change at the national level'.⁶¹ Members of the committee were drawn from science, industry and the trade union movement, the latter reflecting the Myers committee's focus on issues around de-skilling and unemployment.⁶² After consideration by a Senate Committee and by government across 1987–88, the Technology Change Committee was amalgamated with ASTEC.⁶³ While technology assessment remained on the agenda,⁶⁴ it received less prominence. In 1998, ASTEC's functions were transferred to the Prime Minister's Science, Engineering and Innovation Council. This body currently operates as the government's 'principal source of independent advice on issues in science, engineering and innovation and relevant aspects of education and training', but its role is focused primarily on promoting science and technology, with 'technology assessment' and regulation getting only occasional attention. Participatory technology assessment, when carried out in Australia, was conducted independently rather than through a technology assessment organisation.⁶⁵

A different approach to managing the technological future was the establishment of the Commission for the Future by Barry Jones in 1985. The role of the Commission was to examine the social implications of technological change, and stimulate debate and policy-making around longer time horizons.⁶⁶ The demise of the Commission in 1998 was followed by expressions of concern among futurists, but has otherwise generated little comment.⁶⁷

Today, concerns about negative impacts of technology and the law's role in shaping technology tend to receive less attention than the drive to innovate. There are, however, areas where Australia continues to engage in 'technology assessment'. The CSIRO plays a role in this area.⁶⁸ The Australian Research Council (ARC) funds research projects that involve technology assessment.⁶⁹ The latest attempt at broadly addressing the negative impacts of new technologies in Australia is a consultation exercise being managed by the Public and Community Engagement section of the

⁶¹ Australian Science and Technology Council (1988).

⁶² Australian Science and Technology Council (1988).

⁶³ Australian Science and Technology Council Review Committee (1992).

⁶⁴ For example, Australian Science and Technology Council (1993).

⁶⁵ Einsiedel et al (2001).

⁶⁶ Reinecke (1985).

⁶⁷ Slaughter (1998).

⁶⁸ For example, Franks et al (2010).

⁶⁹ For example, Technology Assessment in Social Context (ARC Discovery 2006–09).

National Enabling Technologies Strategy in the Department of Innovation, Industry, Science and Research. Its goal is to increase public and community engagement and input into decision-making around ‘enabling’ technologies such as nanotechnology and biotechnology. To date, this has involved discussion about public engagement activities among various stakeholder groups (researchers, social scientists, communications practitioners and members of the public) and in a multi-stakeholder workshop. Information about the precise form that the ultimate consultation will take (and how it will feed into the policy process) has yet to be released, but broad consultation is likely to commence in 2012.

The relative absence of institutional technology assessment in Australia runs contrary to trends internationally and in other jurisdictions. The OECD has urged technology policy to take account of a broader range of concerns beyond traditional research and development.⁷⁰ In Europe, parliamentary technology assessment bodies exist in the United Kingdom, France, Germany, Denmark, the Netherlands, Finland, Greece and Italy, and are coordinated through the European Parliamentary Technology Assessment Network.⁷¹ Agencies concerned with specific industries or technologies, such as biotechnology, have conducted some technology assessment activities.⁷² Technology assessment is also carried out at the European level – for example, through Science and Technology Options Assessment (STOA) within the European Parliament. Like other technology-assessment bodies, parliamentary technology assessment in Europe aims to operate as an ‘early warning system’ and to improve the scientific and technological ‘facts’ on which policy is based.⁷³ In the United Kingdom, the Parliamentary Office of Science and Technology engages in horizon-scanning on developments in science and technology with policy impacts, although it tends to avoid proposing specific suggestions for law reform.⁷⁴ It produces mostly short, factual briefing notes to keep members of parliament informed and, less frequently, longer studies on specific issues. In the United States, the Government Accountability Office conducts technology assessments, albeit at a lower volume than the former OTA.⁷⁵ There are a smattering of other public, private, professional and international bodies performing technology assessment.

Even without a formal ‘technology assessment’ body in Australia, many government departments effectively engage in technology assessment within a limited sphere, whether focusing on particular technologies (such as

⁷⁰ Hetman (1973, 1975); OECD (1983, 1988, 1998). Australia’s involvement with the OECD on the issue of technology assessment dates back to the late 1970s – see Department of Science and the Environment (1979).

⁷¹ Vig and Paschen (2000).

⁷² Russell et al (2011).

⁷³ Vig and Paschen (2000).

⁷⁴ See www.parliament.uk/parliamentary_offices/post.cfm; Norton (1997).

⁷⁵ Sclove (2010).

drugs), particular impacts (for instance, environmental impacts)⁷⁶ or particular objectives (such as health). Much of what once would have been called technology assessment is now performed *ad hoc*, often under different labels such as ‘impact assessment’, ‘risk assessment’ and ‘technology policy’, scattered across government departments and other institutions.

Technology assessment itself has changed since the 1970s. With a better understanding of the nature of technological development and the limits of forecasting, new ‘models’ of technology assessment have been devised.⁷⁷ While these differ, they generally place greater emphasis on the importance of broad public engagement rather than expert modelling. Rather than focusing on information for government, technology assessment has begun to focus on influencing the design of the technology itself (‘constructive technology assessment’).⁷⁸ In particular, ‘real-time technology assessment’ seeks to embed social science insights and reflexivity into the research and development process in order to inform research strategies and goals, thus influencing innovation trajectories.⁷⁹ Both constructive and real-time technology assessment recognise that information about technology’s effects can be usefully fed not only to policy-makers, but to those responsible for innovation and design in a way that enables social values to be embedded into technological design at an early stage.

As is the case with institutional law reform, there is variation in how technology assessment projects are selected. Even where centralised technology assessment bodies exist, such bodies are not always given the power to select their own projects or engage in horizon monitoring. The OECD has suggested that ‘[g]overnments, professional bodies and courts are the most appropriate mechanisms for identifying technologies in need of assessment’,⁸⁰ but it seems that in practice government is responsible primarily for nominating projects.

Even when it has consumed government resources, technology assessment has received little attention from lawyers. With few exceptions,⁸¹ legal scholarship and technology assessment literature do not intersect. Although the goals of technology assessment – like the goals of law reform – extend beyond dilemmas at the intersection of technological and legal change, it is nevertheless a component of what technology assessment bodies do. In much of the literature on technology assessment, there is reference to legal impacts, legal change or the need to include lawyers as part of a multidisciplinary team.⁸² For instance, it has been recognised among

⁷⁶ An environmental impact assessment is a type of technology assessment focusing on one category of impacts.

⁷⁷ For example, Williams (2006).

⁷⁸ Rip et al (1995); Schot and Rip (1997). Constructive technology assessment was developed in Denmark in the late 1980s.

⁷⁹ Guston and Sarewitz (2002).

⁸⁰ OECD (1983).

⁸¹ For example, Green (1967, 1983); Portnoy (1969); Tribe (1971, 1973); Burns (1976).

⁸² For example, see Arnstein in Boroush et al (1980).

European technology-assessment bodies that ‘improving the legal and other framework conditions for technological, social and organizational innovation is now generally held to be the predominant task of [technology assessment]’.⁸³ However, technology assessment reports generally operate at the level of policy rather than specific proposals for law reform.

The Productivity Commission

One Australian body with a sufficiently broad mission to consider both traditional ‘law reform’ and ‘technology assessment’ is the Productivity Commission. This body, created by an Act of Parliament in 1998,⁸⁴ replaced the former Industry Commission. Like a law reform commission, the Productivity Commission is an independent body with an advisory role. Rather than reporting to the Attorney-General, it reports to the Treasurer. Its mission is broader than that of its predecessor and includes promoting ‘public policy excellence’ and enhancing productivity in Australia.⁸⁵ The Productivity Commission adopts an economic cost-benefit framework for analysing government policy. The ability of such a methodology to capture ‘priceless’ values and goals has been criticised,⁸⁶ but without entering into that debate it is clear that its focus is narrower than broader visions of technology assessment.

While not targeting interactions between law and technological change, the Productivity Commission has played a role in this field. It has, for example, made a submission to the Copyright Law Reform Committee concerning reforms to copyright law, including reference to the fact that ‘rapid technological change’ was ‘putting pressure on copyright to adapt’.⁸⁷ As might be expected, the submission took an economic approach in justifying and critiquing proposed reforms. The broad mission of the Productivity Commission means that its involvement in managing technological change could be quite extensive.

One area where the Productivity Commission has had an important impact on the impact of technological change on law is regulation. While generally promoting a free-market philosophy, the Commission recognises the need for regulation to respond to market failures and inequities requiring intervention, provided the burden is measured and justified.⁸⁸ The chairman of the Productivity Commission headed up a Regulation Taskforce that has had important implications in terms of how regulation is assessed and reviewed. This is discussed in the next section.

⁸³ Vig and Paschen (2000).

⁸⁴ *Productivity Commission Act 1998* (Cth).

⁸⁵ Banks (2010).

⁸⁶ Ackerman and Heinzerling (2002).

⁸⁷ Productivity Commission (1995).

⁸⁸ Banks (2010).

Government Departments

So far, the focus has been on bodies that can, in theory, look at any part of the relationship between technology and law. Despite having a narrower jurisdiction, government departments have a significant role to play in creating and modifying regulations in response to ongoing technological change within their sphere. Where a government department has jurisdiction over a particular set of laws or a particular type of technology, it will amend or recommend changes to relevant regulations and statutes as appropriate. For example, the National Industrial Chemicals Notification and Assessment Scheme (NICNAS), which regulates industrial chemicals, has implemented a program for review of new nanomaterials.⁸⁹ Where a particular technology cuts across multiple government departments or agencies, then committees, task forces or working groups may be formed to coordinate reforms. Where a law is within the domain of one or more government departments, they are generally faster and more responsive to needed change compared with more general institutions such as law reform commissions.⁹⁰ Even supporters of law reform commissions recognise that where law is administered by a particular department, ongoing reform should be (at least in the first instance) the responsibility of that department.⁹¹

There are now additional mechanisms, with which all Commonwealth government agencies must comply, designed to ensure that regulations are properly assessed at the time they are created and are monitored on an ongoing basis. Ongoing monitoring is particularly important in order to ensure that the stock of regulation is kept up to date. As the chairman of the Productivity Commission and Regulatory Taskforce has noted, the task of 'ensuring that existing regulations remain relevant and effective over time' is 'fundamentally important'.⁹² As a result, the Office of Best Practice Regulation now requires five-yearly reviews of regulation to ensure that the regulatory stock remains fit for purpose over time and, in particular, that changes are made to account for new technological circumstances.⁹³ Australia's efforts in this regard are in line with a growing international trend towards better management of regulation. It is comparable with, for example, the European Union's 'Better Regulation' initiative.⁹⁴ Improved regulatory design (whether 'better' or 'smarter') and a requirement for regular review and, if necessary, adjustment have the potential to facilitate law's response to technological change.⁹⁵

However, there are important reasons why government departments cannot be relied on as the sole mechanism for managing the pacing problem.

⁸⁹ See www.nicnas.gov.au/Current_Issues/Nanotechnology.asp.

⁹⁰ Handford (1997).

⁹¹ Gardiner and Martin (1964).

⁹² Banks (2010).

⁹³ Regulation Taskforce (2006).

⁹⁴ See http://ec.europa.eu/governance/better_regulation/index_en.htm.

⁹⁵ Murray (2007).

A new technology may fall outside the jurisdiction of all government departments, either because the enabling statutes are drafted under-inclusively or because the new technology raises new issues that are not within the goals of any existing regulatory regime.

e-democracy

One limitation of all of the above mechanisms is that those burdened by obsolete laws have few opportunities to initiate change. While there is some opportunity to propose a law reform project, or participate through consultation in law reform projects and regulatory reviews, there is little opportunity to initiate change, and no comprehensive, systematic review of proposals. In particular, regulators generally have few means of learning from those living with regulation which aspects of it are no longer functional or effective.

The United Kingdom is currently experimenting with direct citizen input into the process of ensuring that the stock of regulation remains relevant over time. These efforts operate on the explicit assumption that there is too much regulation – much of it no longer relevant. One example used in justifying government intervention in the ‘red tape’ problem is the requirement to report the presence of a grey squirrel on one’s property to police, presumably an early form of fauna management.

The first version of this project, entitled *Your Freedom*, used a web interface to ask the public three questions in particular:

1. *Restoring civil liberties*: Which current laws would you like to remove or change because they restrict your civil liberties?
2. *Cutting business and charity regulations*: Which regulations do you think should be removed or changed to make running your business or organisation as simple as possible?
3. *Repealing unnecessary laws*: Which offences do you think we should remove or change and why?

The *Your Freedom* website resulted in many disparate and unrelated suggestions, with over 46,000 people leaving suggestions, and is unlikely to result in any follow-up.⁹⁶

The later version of the government’s initiative, the *Red Tape Challenge*, facilitates a greater sorting and threading of responses, enabling more of a conversation among those commenting on benefits and problems associated with particular provisions. In line with its name, the focus of the *Red Tape Challenge* is on repeal of unnecessary or obsolete regulations, although comments on the website often extend beyond this prescribed mission. The website operates on an explicit assumption that there is ‘too much’ regulation and that, unless a justification is put forward, the default option is repeal. It adopts a construction of ‘regulation’ as ‘red tape’, downplaying the positive purposes that regulation is usually designed to achieve and focusing on the element of hassle. This has led to a flurry of

⁹⁶ Kite (2010).

comments in relation to some laws (such as the *Equality Act*, safety regulations and environmental legislation) that the description of ‘red tape’ is not always an appropriate one.⁹⁷ Language around presumptive repeal and axing regulations is not a helpful frame for public engagement on issues such as discrimination law and climate change policy. An image of the website (Figure 1) neatly captures the philosophy of the UK approach.



Figure 1: The Red Tape Challenge website

As well as the often-unhelpful trope of ‘red tape’, there are other problems with the *Red Tape Challenge*. It tends to list regulations on a topic, including transitional and technical provisions, making it hard for a non-expert to locate the provisions that affect them. From the perspective of the pacing problem, a further difficulty is that the *Red Tape Challenge* is limited in time. What is being done is a one-off overhaul of regulation, with particular segments assigned to particular weeks, not regular ongoing monitoring and review.

Nevertheless, the United Kingdom suggests the idea of e-democracy as a kind of ‘real-time law reform’. If an e-democracy initiative could move beyond the ‘red tape’ stereotype and allow separately for both broad and specific comments, it could provide a useful means of identifying poorly functioning and obsolete laws. For example, a website could provide space for general comments as well as give an opportunity to those whose concerns are more specific to make notations on statutes and regulations. It would also be possible to allow for ratings, so as to identify comments with

⁹⁷ Stratton (2011); Kettle (2011).

a measure of community support.⁹⁸ Provided comments were monitored by relevant government agencies or a default central body where the matter was outside a specific jurisdiction, the machinery of adaptive law reform could be accelerated.

Other Actors

In some specific areas of law, there are semi-permanent bodies that exist (or have existed) in order to monitor or respond to issues arising in that particular area. Examples include the Copyright Law Review Committee and the Family Law Council. Some of these bodies have prepared reports that deal with legal issues arising out of technological change, such as the Copyright Law Review Committee's report on protection for computer software. However, like administrative agencies, these bodies have limited jurisdiction and do not, between them, capture all situations in which law may need to be updated.

While many permanent and semi-permanent bodies play a role in facilitating the law's response to technological change, other people and bodies play a more occasional role. While these are important, their *ad hoc* nature means that they cannot always be relied on as mechanisms of reform. There are many advantages of permanency (other than the obvious saving of start-up costs), not the least of which is the possibility of a systematic mechanism for selection of projects.⁹⁹

An example of *ad hoc* bodies that have played a role in managing the interface between law and technology is Royal Commissions. Before the establishment of law reform commissions, Royal Commissions were called on frequently to consider the impact of particular technological changes. Royal Commissions, for example, considered the implications of wireless (1927), television (1954) and FM broadcasting (1957). While most Royal Commissions are not concerned with policy as such (focusing instead on alleged wrongdoing or disasters), policy-focused (also known as advisory) Royal Commissions such as these can operate within a limited sphere similarly to law reform commissions.¹⁰⁰ As a mechanism, Royal Commissions can consider issues at the intersection of law and technology, and may in some cases be effective; however, they remain an *ad hoc* possible response, with no logic (other than the logic of politics) determining whether a reference is made.¹⁰¹ They thus do not provide a systematic means for managing the pacing problem.

There are other *ad hoc* committees and public inquiries formed around particular issues that are not formally Royal Commissions. For example, the Lockhart Committee was appointed in 2005 to review the *Prohibition of Human Cloning Act 2002* (Cth) and the *Research Involving Human Embryos*

⁹⁸ Ramesh (2010).

⁹⁹ Neave (2007).

¹⁰⁰ Sackville (1985); Weisbrot (2005); ALRC (2010).

¹⁰¹ Benson and Rothschild (1982); see also Prasser (2006).

Act 2002 (Cth). The committee, which included legal and scientific members, engaged in extensive consultation and is generally considered to have done a good job of reviewing legislation in light of technological change and changes in community views.¹⁰² Limited tasks may also be given to specific bodies, as was the case with the National Research Council's consideration of copyright issues arising in relation to the internet in the United States.¹⁰³ There is increasing reliance on reports prepared by professional bodies that consider the impact of technological developments, including legal issues. Legal responses to nanotechnologies were considered in a variety of *ad hoc* contexts, including a commissioned report prepared by Australian academics.¹⁰⁴

Parliamentary committees may, from time to time, deal with questions at the intersection of law and technological change. At both Commonwealth and state levels, there are parliamentary committees that focus on law reform.¹⁰⁵ Parliamentary committees have been responsible for reports on a variety of topics at the intersection of law and new technologies, including privacy and computers, regulation of biomedical technology, genetically modified organisms and the operation of the classification scheme online.¹⁰⁶ However, while important, parliamentary committees tend not to have a systematic method for determining their agenda and proceedings can be disrupted for elections and other matters of political importance.

Academics often write about legal issues that have arisen as a result of technological change. If anything, these topics tend to go through heights of popularity with the volume of literature extending beyond the attention given to more mundane topics.¹⁰⁷ The funding available to explore ethical, legal and social impacts of major technological advances such as the human genome project has further increased the volume of material produced. However, most of these ideas – which fill the pages of journals – do not find their way into the policy process or the design of technology.

Judges commonly are called on to resolve legal dilemmas arising in new contexts, and have a particularly important role in resolving uncertainties as they arise. The common law itself has a high degree of inherent adaptability, with the lack of a canonical text for common law rules rendering them more transparent to their underlying rationales and thus potentially less likely to suffer from over- or under-inclusiveness in the face of technological change.¹⁰⁸ Judges must, however, resolve disputes in the

¹⁰² Skene et al (2008).

¹⁰³ Committee on Intellectual Property Rights and the Emerging Information Infrastructure (2000).

¹⁰⁴ Ludlow et al (2007).

¹⁰⁵ See Warner (2005). In the United Kingdom, a prominent committee in this field is the House of Lords Science and Technology Committee.

¹⁰⁶ Weisbrot (2005).

¹⁰⁷ Beebe (1999); Bennett Moses (2010).

¹⁰⁸ Bennett Moses (2003); Cockfield (2004).

order in which they are brought, and cannot rewrite legislation to deal with problems of over-inclusiveness and under-inclusiveness. They can contribute to, but do not replace, law reform. Further, although judicial decisions play a role in determining technological development, judges cannot replace technology assessment.¹⁰⁹

For technologies with international or human rights implications, international law can play a role. Examples include the Cybercrime Convention and UNESCO's Universal Declaration on the Human Genome and Human Rights. There have been suggestions for greater international coordination on management of new technologies. For example, Abbott has proposed an International Framework Agreement on Scientific and Technological Innovation and Regulation with the goal of coordinating, steering and facilitating national regulation of technology.¹¹⁰ While this would assist with international coordination of national responses, it does not replace the need for national mechanisms that can focus on necessary changes to domestic law.

There are other types of *ad hoc* initiatives at the intersection of law and technology. For instance, private sector consultancies, think-tanks and public-interest groups may be involved from time to time in advocacy around particular issues. Some may even maintain an interest in issues surrounding new technologies for some time, such as the Carnegie Commission on Science, Technology and Government.¹¹¹ While these have led to useful reform and provided useful platforms for engagement with technologists and industry, they do not offer a systematic method for dealing with the pacing problem. They may be further limited depending on their nature, constitution, resources and independence.

Boosting Law's Performance

Despite the evident frustration of commentators that law fails to keep pace with technology, in many instances a variety of institutions have played an important role in proposing changes in order to bring the law into line with modern conditions. Law reform commissions, technology assessment bodies, the Productivity Commission, government agencies and various *ad hoc* bodies have been involved in the task of keeping the law up to date and using law to shape technological development. The trend across all of these institutions towards engagement with stakeholders and the broader community is a positive development with the potential to capture more information and perspectives, and facilitate better policy.

Lament at the law's inability to keep pace with technological change needs to take account of the institutional capacity we already have for addressing the problem. Given the brevity of the analysis conducted here, it

¹⁰⁹ Portnoy (1969). This is a particular problem in the United States, where constitutional decisions can have important unforeseen effects as technology evolves: Kerr (2003).

¹¹⁰ Abbott (2011).

¹¹¹ The Commission operated between 1988 and 1993.

would not be appropriate to either celebrate victory over the pacing problem or embrace the pessimism of the race metaphor. The broad mapping does, however, demonstrate that we do have tools at our disposal to manage the interface between technological and legal change. At the same time, it illustrates a few areas that could be worth further analysis to determine whether there is scope for improvement.

The most significant problem with all organisations responsible for keeping law ‘up to date’ is that each exists in a disciplinary silo. Thus law reform agencies black-box ‘technology’, bodies conducting technology assessment black-box ‘law’ and the Productivity Commission focuses primarily on that which can be quantified. Each delves into what is part of a complex problem. Better results tend to come from collaborative interdisciplinary efforts. The need for interdisciplinarity across the law–technology border is particularly important. In order to craft appropriate laws, both the technology and its uses must be well understood.¹¹²

Another difficulty is the tendency for one-off momentous reform in a particular field as opposed to ongoing monitoring and adjustment.¹¹³ Where new technologies are controversial or economically desirable, institutional responses can be relatively prompt. However, where changes are more mundane, they tend to be ignored.¹¹⁴ In 2001, for example, 42 states in the United States had laws regulating sperm donation (including requirements for testing of communicable and genetic disease, mandatory record-keeping and consent requirements) that remained inapplicable to ova donation. These smaller issues, easily corrected without the energies of a law reform commission report, are possibly responsible for the frustration felt by those wishing the law would adapt more quickly to technological change.

Another limitation of existing approaches is the lack of ‘early warning’ mechanisms. Better horizon scanning would enable legal change with an eye to influencing technological design (through regulation or otherwise) during the development phase. This is a function at which the OTA performed poorly, especially compared with its European counterparts. There are proposals for earlier management of future technological risks, including real-time technology assessment (discussed above) and a proposal for the appointment of special government officers to keep tabs on technological developments and potential policy implications.¹¹⁵ The lack of any Australian equivalent to the technology assessment bodies found in Europe makes this particular task more difficult.

Another limitation of the institutions considered here is that each engages in distinct projects, each with a limited focus. This creates a tendency for solutions to be framed around the problems within a project’s scope. While not necessarily problematic, such a focus makes it more likely that solutions to identified problems will be conceived in technology-

¹¹² Reed (2007).

¹¹³ Murray (2007).

¹¹⁴ Marchant (2011).

¹¹⁵ Rejeski (2011).

specific terms. Although in some contexts there are advantages to such specificity,¹¹⁶ in most situations it is problematic. In Europe, where technology assessment focused around ‘nanotechnology’, the result was legislation that subjected ‘nanomaterials’ to specific legislation.¹¹⁷ However, due to the problematic and evolving nature of how such materials are defined, the legislation was not well targeted to managing the risks associated with new types of chemicals.¹¹⁸ By crafting the scope of particular projects in technological terms, there is a risk that proposals for change will be designed through the same lens.

Nothing in this article deals with all the myriad issues involved in designing appropriate laws for managing technological risks or facilitating new technologies. Books can (and have) been written on the many challenges and dimensions of regulating technology.¹¹⁹ In particular, no mechanism can ensure that, when examined, the reforms proposed will be optimal, or even an improvement. From an institutional perspective, the most one can hope for is that issues will be identified within a suitable timeframe, that these issues are considered by an appropriately staffed and resourced body, and that some process exists for feeding recommendations to government. We have some components of such a framework in place, and improvements can be made. However, at most, improving the framework will assist in solving one problem – whether labelled the pacing problem or the challenge of regulatory connection; it cannot guarantee that the result will be legitimate, effective, well-designed legal rules. The improvements suggested here can assist with only one of the many dimensions of issues at the interface between law and technology.¹²⁰

Conclusion

Law and technology are both pervasive and constantly shifting spheres within the broader realm of society. Each has the ability to change in ways that influence the other. The widely held view that law lags behind technology represents a necessary, but not necessarily problematic, state of affairs. The law should not race ahead by anticipating technological trajectories that may never come to pass. Rather, a useful goal should be to have mechanisms in place to ensure that law is designed around the socio-technical landscape of the present or, more realistically, the recent past. To the extent that the law looks into the technological future, it should be with an eye to creating desirable futures, whether through mechanisms designed

¹¹⁶ Ohm 2009, arguing that in the context of surveillance laws, the under-inclusiveness generated by technology-specificity effectively sunsets laws at precisely the time-changing facts suggests re-examination would be prudent.

¹¹⁷ Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 20 November 2009 on cosmetic products.

¹¹⁸ Bennett Moses (2011).

¹¹⁹ For example, Brownsword (2008); Goodwin et al (2010).

¹²⁰ Goodwin et al (2010).

to promote innovation (either generally or in specific fields) or regulations and incentives designed to influence future technological developments in line with social goals.

The good news is that we already have a variety of mechanisms that, among other things, work towards this goal. These mechanisms are not perfect. While institutions sometimes work together, much work is still done in disciplinary silos. We lack a systematic means of identifying circumstances in which either adjustments to law need to be considered as a result of technological change or law has the potential to positively influence the future design of particular technologies at an early stage. Finally, the fact that inquiries and reports are often crafted around a technology-specific jurisdiction can lead to poor regulatory design.

Developments in the United Kingdom, while far from perfect, offer some interesting possibilities. An online forum could be used to enhance dialogue among those familiar with the law, those working at the technological frontier and broader publics. It could be used to identify suggestions for large-scale projects as well as more minor amendments to existing law and regulations. Provided it was well structured and monitored, with information fed back to relevant decision-makers, it could help facilitate the mutual adjustment between law and technology.

Law is not as poor a performer in the race to keep up with technology as is often assumed in the literature. Much law operates independently of a technological context. Where technological change does pose a challenge for existing legal rules and frameworks, the dilemmas frequently are solved. There are improvements that can be made to existing institutions to enhance regulatory connection with an evolving socio-technical framework. But suggestions for improvements need to be grounded in a better understanding of the (limited) scope of the pacing problem and a clearer picture of our existing institutional capacity. A metaphor that suggests that law simply needs to 'move faster' is unhelpful and, if it leads anywhere, is likely to result in rushed and poorly conceived responses.

References

Secondary sources

- Kenneth W Abbott (2011) 'An International Framework Agreement on Scientific and Technological Innovation and Regulation', in Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds), *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, Springer.
- Frank Ackerman and Lisa Heinzerling (2002) 'Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection' 15 *University of Pennsylvania Law Review* 1578.
- Braden R Allenby (2011) 'Governance and Technology Systems: The Challenge of Emerging Technologies', in Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds), *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, Springer.

- Joe E Armstrong and Willis W Harman (1980) *Strategies for Conducting Technology Assessments*, Westview Press.
- Susan Armstrong (2004) 'Evaluating Law Reform' 10 *University of Western Sydney Law Review* 13.
- Roslyn Atkinson (2005) 'Law Reform and Community Participation', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.
- Australian Law Reform Commission (1983) *Privacy*, ALRC.
- Australian Law Reform Commission (2004) *Genes and Ingenuity: Gene Patenting and Human Health*, ALRC.
- Australian Law Reform Commission (2010) *Report 111: Making Inquiries: A New Statutory Framework*, ALRC.
- Australian Law Reform Commission and National Health and Medical Research Council Australian Health Ethics Committee (2003) *Report 96: Essentially Yours: The Protection of Human Genetic Information in Australia*, ALRC, NHMRC and AHEC.
- Australian Science and Technology Council (1988) *After the Myers Report: Improving the Management of Technological Change*, Occasional Paper, ASTC.
- Australian Science and Technology Council (1993) *Gene Technology: Issues for Australia*, ASTEC.
- Australian Science and Technology Council Review Committee (1992) *Review of ASTEC*, ASTEC.
- Gary Banks (2010) *An Economy-wide View: Speeches on Structural Reform*, Productivity Commission.
- Barton Beebe (1999) 'Law's Empire and the Final Frontier: Legalizing the Future in the Earlyopos Juris Spatialis' 108 *Yale Law Journal* 34.
- Lyria Bennett Moses (2003) 'Adapting the Law to Technological Change: A Comparison of Common Law and Legislation' 26 *University of New South Wales Law Journal* 394.
- Lyria Bennett Moses (2005) 'Understanding Legal Responses to Technological Change: The Example of *In Vitro* Fertilization' 6 *Minnesota Journal of Law, Science and Technology* 505.
- Lyria Bennett Moses (2007a) 'Why Have a Theory of Law and Technological Change?' 8 *Minnesota Journal of Law, Science and Technology* 589.
- Lyria Bennett Moses (2007b) 'Recurring Dilemmas: The Law's Race to Keep Up with Technological Change' 7 *University of Illinois Journal of Law, Technology and Policy* 239.
- Lyria Bennett Moses (2010) 'Exploring Technological Frontiers: Autonomy in Legal Scholarship' 30 *Bulletin of Science, Technology and Society* 22.
- Lyria Bennett Moses (2011) 'Regulating Beyond Nanotechnology: Do Nano-Specific Problems Require Nano-Specific Solutions' 30 *IEEE Technology and Society Magazine* 42.
- H Benson and N Rothschild (1982) 'Royal Commissions: A Memorial' 60 *Public Administration Review* 9.
- Bruce Bimber (1996) *The Politics of Expertise in Congress: The Rise and Fall of the Office of Technology Assessment*, SUNY Press.
- Mark A Broush et al (eds) (1980) *Technology Assessment: Creative Futures*, North Holland.
- Roger Brownsword (2008) *Rights, Regulation and the Technological Revolution*, Oxford University Press.
- Stephen G Burns (1976) 'Congress and the Office of Technology Assessment' 45 *George Washington Law Review* 29.
- Andrew Burrows (2003) 'Some Reflections on Law Reform in England and Canada' 39 *Canadian Business Law Journal* 17.

- Guido Calabresi (1982) *A Common Law for the Age of Statutes*, Harvard University Press.
- Don Chalmers (2005) 'Science, Medicine and Health and the Work of the Australian Law Reform Commission', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.
- Joseph F Coates (1976) 'The Role of Formal Models in Technology Assessment' 9 *Technological Forecasting and Social Change* 139.
- Arthur J Cockfield (2004) 'Towards a Law and Technology Theory' 30 *Manitoba Law Journal* 32.
- Computer Sciences and Telecommunications Board Committee on Intellectual Property Rights and the Emerging Information Infrastructure, Commission on Physical Sciences, Mathematics and Applications, National Research Council (2000) 'The Digital Dilemma: Intellectual Property in the Information Age', The Board.
- Department of Science (1978) *Proceedings of Workshop on Technology Assessment*, AGPS.
- Department of Science and the Environment (1979) *Submission to the Committee of Inquiry into Technological Change in Australia*, AGPS.
- Edward Donelan (2008) 'Reviewing the Stock of Legislation: Renovation is as Important as Innovation', paper presented to Fourth Regional Meeting of the GFD Working Group IV on Public Service Delivery, Public-Private Partnerships and Regulatory Reform and Regional Capacity Building, 29-30 April 2008, Amman, Jordan.
- Edna F Einsiedel et al (2001) 'Publics at the Technology Table: The Consensus Conference in Denmark, Canada and Australia' 10 *Public Understanding of Science* 83.
- Gerald L Epstein (2009) 'Restart the Congressional Office of Technology Assessment' *Science Progress*, 31 March.
- D Franks et al (2010) *Technology Futures Discussion Paper: Technology Assessment and the CSIRO Minerals Downunder National Research Flagship*, CSIRO.
- Gerald Gardiner and Andrew Martin (1964) 'The Machinery of Law Reform', in Gerald Gardiner and Andrew Martin (eds), *Law Reform Now*, Victor Gollancz.
- Morag Goodwin et al (eds) (2010) *Dimensions of Technology Regulation*, Wolf.
- Reg Graycar and Jenny Morgan (2005) 'Law Reform: What's in It for Women?' 23 *Windsor Yearbook of Access to Justice* 30.
- Harold P Green (1967) 'Technology Assessment and the Law: Introduction and Perspective' 36 *George Washington Law Review* 12.
- Harold P Green (1983) 'Should Technology Assessment Guide Public Policy' 69 *American Bar Association Journal* 5.
- David H Guston and Daniel Sarewitz (2002) 'Real-Time Technology Assessment' 24 *Technology in Society* 16.
- Peter Handford (1997) 'The Changing Face of Law Reform' 73 *Australian Law Journal* 21.
- Francois Hetman (1973) *Society and the Assessment of Technology*, OECD.
- Francois Hetman (1975) *Methodological Guidelines for Social Assessment of Technology*, OECD.
- Patricia Hughes (2008) 'Law Commissions and Access to Justice: What Should We Be Talking About?' 46 *Osgoode Hall Law Journal* 33.
- William H Hurlburt (1997) 'Case for the Reinstatement of the Manitoba Law Reform Commission' 25 *Manitoba Law Journal* 52.
- William H Hurlburt (1986) *Law Reform Commissions in the United Kingdom, Australia and Canada*, Juriliber.

- Laura H Kahn (2007) 'Bring Back the Office of Technology Assessment' *Bulletin of the Atomic Scientists*, 20 May.
- Orin S Kerr (2003) 'The Fourth Amendment and New Technologies: Constitutional Myths and the Case for Caution' 102 *Michigan Law Review* 89.
- Martin Kettle (2011) 'This Attack on Red Tape will Cause a Clearout of Good Law' *The Guardian*, 13 May.
- Michael Kirby (1983) *Reform the Law: Essays on the Renewal of the Australian Legal System*, Oxford University Press.
- Michael Kirby (1988) 'Law Technology and the Future' 21 *Australian Journal of Forensic Sciences* 112.
- Michael Kirby (2008) 'Forty Years of the Alberta Law Reform Institute – Past, Present, Future' 46 *Alberta Law Review* 17.
- Melissa Kite (2010) 'Clegg Abandons Battle Against Bureaucracy' *Sunday Telegraph*, 7 November.
- Bert-Jaap Koops (2006) 'Should ICT Regulation be Technology-Neutral?' in Bert-Jaap Koops et al (eds), *Starting Points for ICT Regulation: Deconstructing Prevalent Policy One-Liners*, TMC Asser Press.
- Bert-Jaap Koops (2010) 'Law, Technology, and Shifting Power Relations' 25 *Berkeley Technology Law Journal* 65.
- Law Reform Commission of Canada (1979) 'Federal Law Reform in Canada', in *Manifesto for Law Reform*, LRCC.
- K Ludlow et al (2007) *A Review of Possible Impacts of Nanotechnology on Australia's Regulatory Framework: Final Report*, Australian Office of Nanotechnology.
- JN Lyon (1974) 'Law Reform Needs Reform' 12 *Osgoode Hall Law Journal* 16.
- Roderick A Macdonald (2000) 'Law Reform and Its Agencies' 79 *Canadian Bar Review* 20.
- Donald MacKenzie and Judy Wajeman (1985) *The Social Shaping of Technology: How the Refrigerator Got Its Hum*, Open University Press.
- Audrey Macklin (1993) 'Law Reform Error: Retry or Abort?' 16 *Dalhousie Law Journal* 21.
- Gary E Marchant (2011) 'The Growing Gap Between Emerging Technologies and the Law', in Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds), *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, Springer.
- Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds) (2011) *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, Springer.
- Keith Mason (1990) 'How Change (Reform) Occurs and How to Block It' 14 *Bulletin of Australian Society of Legal Philosophy – Constancy and Change* 31.
- Gavin Murphy (2004) *Law Reform Agencies*, Department of Justice, Canada.
- Andrew Murray (2007) *The Regulation of Cyberspace: Control in the Online Environment*, Routledge Cavendish.
- National Academy of Sciences (1969) *Technology: Processes of Assessment and Choice*, USGPO.
- Marcia Neave (2007) 'Making Law Reform Work: The Promise and Limits of Law Reform' 14 *James Cook University Law Review* 19.
- New South Wales Law Reform Commission (1988) *Artificial Conception: In Vitro Fertilization*, NSWLRC.
- Michael Norton (1997) 'The UK Parliamentary Office of Science and Technology and Its Interaction with the OTA' 54 *Technological Forecasting and Social Change* 17.

- Paul Ohm (2009) 'The Argument Against Technology-Neutral Surveillance Laws' 88 *Texas Law Review* 31.
- Organisation for Economic Co-operation and Development (OECD) (1983) *Assessing the Impacts of Technology on Society*, OECD.
- Organisation for Economic Co-operation and Development (OECD) (1988) *New Technologies in the 1990s: A Socio-economic Strategy*, OECD.
- Organisation for Economic Co-operation and Development (OECD) (1998) *21st Century Technologies: Promises and Perils of a Dynamic Future*, OECD.
- OTA (1986a) *Electronic Record Systems and Information Privacy*, OTA.
- OTA (1986b) *Intellectual Property Rights in an Age of Electronics and Information*, OTA.
- OTA (1987a) *The Electronic Supervisor: New Technology, New Tensions*, OTA.
- OTA (1987b) *New Developments in Biotechnology: Ownership of Human Tissues and Cells*, OTA.
- OTA (1988) *Infertility: Medical and Social Choices*, OTA.
- OTA (1989) *Copyright and Home Copying: Technology Challenges the Law*, OTA.
- Colin B Picker (2001) 'A View From 40,000 Feet: International Law and the Invisible Hand of Technology' 23 *Cardozo Law Review* 70.
- Trevor Pinch and Wiebe Bijker (1987) 'The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', in Wiebe Bijker, Thomas Hughes and Trevor Pinch (eds), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, MIT Press.
- Steven W Popper (2003) 'Technological Change and the Challenges for 21st Century Governance', in Albert H Teich et al (eds), *AAAS Science and Technology Policy Yearbook 2003*, AAAS.
- Barry M Portnoy (1969) 'Role of the Courts in Technology Assessment' 55 *Cornell Law Review* 18.
- Scott Prasser (2006) *Royal Commissions and Public Inquiries in Australia*, LexisNexis Butterworths.
- Productivity Commission (1995) *An Economic Analysis of Copyright Reform*, Productivity Commission.
- Randeep Ramesh (2010) 'Society: Interview: Chris Quigley: Sounding the crowd: The e-democracy champion has made a niche for himself in open government circles' *The Guardian*, 28 July.
- Chris Reed (2007) 'Taking Sides on Technology Neutrality' 4 *SCRIPT-ed* 263.
- Regulation Taskforce (2006) *Rethinking Regulation: Report of the Taskforce on Reducing Regulatory Burdens on Business*, Regulation Taskforce.
- Ian Reinecke (1985) 'Why a Commission for the Future?' 3 *Prometheus* 3.
- David Rejeski (2011) 'Public Policy on the Technological Frontier', in Gary E Marchant, Braden R Allenby and Joseph R Heckert (eds), *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem*, Springer.
- Arie Rip et al (eds) (1995) *Managing Technology in Society: The Approach of Constructive Technology Assessment*, Pinter.
- J Bruce Robertson (2005) 'Initiation and Selection of Projects', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.
- Michael Rodemeyer (2005) 'Back to the Future: Revisiting OTA Ten Years Later', in *The Future of Technology Assessment*, Woodrow Wilson International Center for Scholars.

- A Wendy Russell et al (2011) 'Technology Assessment in Australia: The Case for a Formal Agency to Improve Advice to Policy Makers' 44 *Policy Sciences* 157.
- Ronald Sackville (1985) 'The Role of Law Reform Agencies in Australia' 59 *Australian Law Journal* 12.
- Robert Samek (1977) 'A Case for Social Law Reform' 55 *Canadian Bar Review* 27.
- Daniel Sarewitz (2005) 'Back to the Future: Revisiting OTA Ten Years Later', *The Future of Technology Assessment*, Woodrow Wilson International Center for Scholars.
- Michael Sayers (2005) 'Co-operation Across Frontiers', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.
- Leslie Scarman (1967) 'Law Reform: Lessons from English Experience' 3 *Manitoba Law Journal* 14.
- Johan Schot and Arie Rip (1997) 'The Past and Future of Constructive Technology Assessment' 54 *Technological Forecasting and Social Change* 18.
- Richard Sclove (2010) *Reinventing Technology Assessment: A 21st Century Model*, Woodrow Wilson International Centre for Scholars.
- Michael H Shapiro (1999) 'Is Bioethics "Broke"? On the Idea of Ethics and Law "Catching Up" with Technology' 20 *Indiana Law Review* 17.
- Loane Skene et al (2008) 'The Lockhart Committee: Developing Policy Through Commitment to Moral Values, Community and Democratic Processes' 16 *Journal of Law and Medicine* 8.
- Timothy A Slating and Jay P Kesan (2012) 'Making Regulatory Innovation Keep Pace with Technological Innovation' *Wisconsin Law Review*, forthcoming.
- Richard Slaughter (1998) 'Lessons from the Australian Commission for the Future: 1986–1998' 6 *The ABN Report* 5.
- Susan Sterett (1990) 'Keeping the Law Up to Date: The Idiom of Legalism and the Reform of Administrative Law in England and Wales' 15 *Law and Social Inquiry* 36.
- Allegra Stratton (2011) 'Huhn Attacks Tory "Zealots" on Green Laws: Energy Secretary Threatens Coalition Rift Over Plans to Scrap Regulations' *The Guardian*, 20 June.
- KCT Sutton (1970) *The Pattern of Law Reform in Australia*, University of Queensland Press.
- Michael Tilbury (2005) 'The History of Law Reform in Australia', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.
- Thien A Tran and Tagrul Daim (2008) 'A Taxonomic Review of Methods and Tools Applied in Technology Assessment' 75 *Technological Forecasting and Social Change* 1396.
- Kieran Tranter (2002) 'Terror in the Texts: Technology – Law – Future' 13 *Law and Critique* 24.
- Laurence H Tribe (1971) 'Legal Frameworks for the Assessment and Control of Technology' 9 *Minerva* 243.
- Laurence H Tribe (1973) 'Technology Assessment and the Fourth Discontinuity: The Limits of Instrumental Rationality' 46 *Southern California Law Review* 617.
- Jan Van den Ende et al (1998) 'Traditional and Modern Technology Assessment: Toward a Toolkit' 58 *Technological Forecasting and Social Change* 5.
- Arthur T Vanderbilt (1955) *The Challenge of Law Reform*, Princeton University Press.
- Norman J Vig and Herbert Paschen (eds) (2000) *Parliaments and Technology: The Development of Technology Assessment in Europe*, State University of New York Press.
- Rudi Volti (2009) *Society and Technological Change*, 6th ed, Worth.
- Kate Warner (2005) 'Institutional Architecture', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.

- David Weisbrot (2005) 'The Future of Institutional Law Reform', in Brian Opeskin and David Weisbrot (eds), *The Promise of Law Reform*, Federation Press.
- David Whiteman (1985) 'The Fate of Policy Analysis in Congressional Decision Making: Three Types of Use in Committees' 38 *The Western Political Quarterly* 17.
- Glanville Williams (1951) *The Reform of the Law*, Stevens and Sons.
- Robin Williams (2006) 'Compressed Foresight and Narrative Basis: Pitfalls in Assessing High Technology Futures' 15 *Science as Culture* 21.
- Langdon Winner (1985) '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.

Legislation

- Australian Law Reform Commission Act 1996* (Cth)
- Law Commissions Act 1965* (UK)
- Law Reform Commission Act 1967* (NSW)
- NY CLS Legis* § 72 (2011) (New York)
- Productivity Commission Act 1998* (Cth)
- Prohibition of Human Cloning Act 2002* (Cth)
- Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 20 November 2009 on Cosmetic Products
- Research Involving Human Embryos Act 2002* (Cth)
- Technology Assessment Act* (PL 92-484) (US)