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STRUCTURING TECHLAW

*Rebecca Crootof & BJ Ard**

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* Assistant Professor of Law, University of Richmond School of Law and Affiliate Fellow, Yale Law School Information Society Project; Assistant Professor of Law, University of Wisconsin Law School and Affiliate Fellow, Yale Law School Information Society Project. This piece is the product of countless hours of collaborative work; accordingly, we vary the order of our names with each publication, as it would be impossible to evaluate who contributed more.

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I. INTRODUCTION

The legal community constantly grapples with technologies that enable new conduct or facilitate previously rare actions, blur established legal categories, diffuse or centralize capabilities, and expose the limits of existing regulatory institutions. A host of techlaw questions follow as these tech-fostered changes upend doctrinal rules, shift power relationships, and inflame deeper social tensions.¹

The conventional approach is to tackle these quandaries by identifying something about a technology or its use that is “exceptional” and

1. “Techlaw” — a portmanteau of “technology law” and intended as shorthand for the study of how law and technology interact — is not to be confused with “lawtech,” the new legal technology intended to expand the capabilities of practicing lawyers. *See* Agnieszka McPeak, *Disruptive Technology and the Ethical Lawyer*, 50 U. TOL. L. REV. 457, 458 (2019). As an emerging field, there is no one definition for techlaw, but we describe it as the study of how law and technology foster, restrict, and otherwise shape each other’s evolution. *See* Rebecca Crotoof & BJ Ard, *Distinguishing Techlaw* (Mar. 1, 2021) (unpublished manuscript) (on file with authors) (discussing what makes this field distinctive); BJ Ard & Rebecca Crotoof, *The Case for Technology Law*, THE RECORD (Dec. 16, 2020), <https://ngtc.unl.edu/blog/case-for-technology-law> [<https://perma.cc/4LE2-3TF9>]. We use the term “technology” to include any combination of tools, machines, products, processes, and techniques by which human capability is extended, *see* DONALD SCHON, TECHNOLOGY AND CHANGE 1 (1967), but not legal, normative, social, economic, or other regulatory systems, *see* Lyria Bennett Moses, *Why Have a Theory of Law and Technological Change?*, 8 MINN. J.L. SCI. & TECH. 589, 591–92 (2007) (discussing the range of definitions for “technology”).

argue that this distinction necessitates new law or even a new legal regime;² or, alternatively, that a lack of exceptional characteristics implies that the technology can be adequately governed by extant rules.³ But while these focused studies are individually useful, the exceptionalist approach fosters siloed and potentially incomplete analyses, masks the repetitive nature of the underlying questions, and thereby results in the regular reinvention of the regulatory wheel.⁴ At best, a compartmentalized assessment is a missed opportunity. At worst, it leads to ineffective, counterproductive, or even harmful rules and policy prescriptions. An overarching methodology — one which can be employed across time, technologies, and legal subjects — is needed.⁵

The fundamental challenge of techlaw is not how to best regulate novel technologies, but rather how to best address familiar forms of legal uncertainty in new sociolegal contexts.⁶ Shifting our focus from the particular details of any given technology to the legal uncertainties

2. See, e.g., Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 CALIF. L. REV. 513, 513 (2015) (arguing that robotics is an exceptional technology); Ryan Calo, *The Case for a Federal Robotics Commission*, BROOKINGS, Sept. 2014, at 2, 3 (arguing for a new agency, given “the unique aspects of robotics and artificial intelligence and the novel human experiences these technologies generate”); Paul Ohm & Blake Reid, *Regulating Software When Everything Has Software*, 84 GEO. WASH. L. REV. 1672, 1700 (2016) (calling for a new agency to help regulate IoT devices); Andrew Tutt, *An FDA for Algorithms*, 69 ADMIN. L. REV. 83, 83 (2017) (arguing that a new agency is needed to address the problems raised by algorithms).

3. See, e.g., *Maryland v. King*, 569 U.S. 435, 459 (2013) (dismissing concerns with mouth-swab DNA testing because it is the “21st-century equivalent” of fingerprinting).

4. Meg Leta Jones, *Does Technology Drive Law? The Dilemma of Technological Exceptionalism in Cyberlaw*, 2018 J.L. TECH. & POL’Y 249, 251 (critiquing the exceptionalist approach for overemphasizing a technology’s architecture and not sufficiently considering its social use); Hin-Yan Liu, Matthijs Maas, John Danaher, Luisa Scarcella, Michaela Lexer & Leonard Van Rompaey, *Artificial Intelligence and Legal Disruption: A New Model for Analysis*, 12 L. INNOVATION & TECH. 205, 214 (2020) (arguing that “the current domain-specific approach is undermined by being technologically-focused, fragmented in its approach, and isolated in its responses and impact” and proposing a “Legal Disruption” model). See generally Andrea Matwyshyn, *Technology, Commerce, Development, Identity*, 8 MINN. J.L. SCI. & TECH. 515 (2007) (noting that a compartmentalized approach, focusing on a specific technology or legal issue, does not resolve the critical questions of whether that technology is special or if a current regulatory regime could adequately govern it).

5. In *Robotics and the Lessons of Cyberlaw*, Ryan Calo took the innovative step of extending insights from cyberlaw scholarship to robotics law questions. Calo, *Lessons of Cyberlaw*, *supra* note 2, at 516. While we disagree with his position that only exceptional technologies warrant this treatment, *id.*, we were inspired by his instinct to bridge siloed discussions. We abstract out from his cross-technology approach one additional step to argue that core techlaw insights, developed in any context, might be usefully applied to thinking through regulatory strategies in others.

6. As others have noted, the amount of legal confusion a technology engenders will depend as much on the legal regime and the society within which it is used as its particular design characteristics. See Jack M. Balkin, *The Path of Robotics Law*, 6 CALIF. L. REV. CIR. 45, 46–47 (2015); Jones, *supra* note 4, at 251; see also Margot Kaminski, *Legal Disruption: How Technology Disrupts the Law* (Mar. 14, 2017) (unpublished manuscript) (on file with authors).

technological development generates allows us to begin framing out a methodological structure for resolving them.

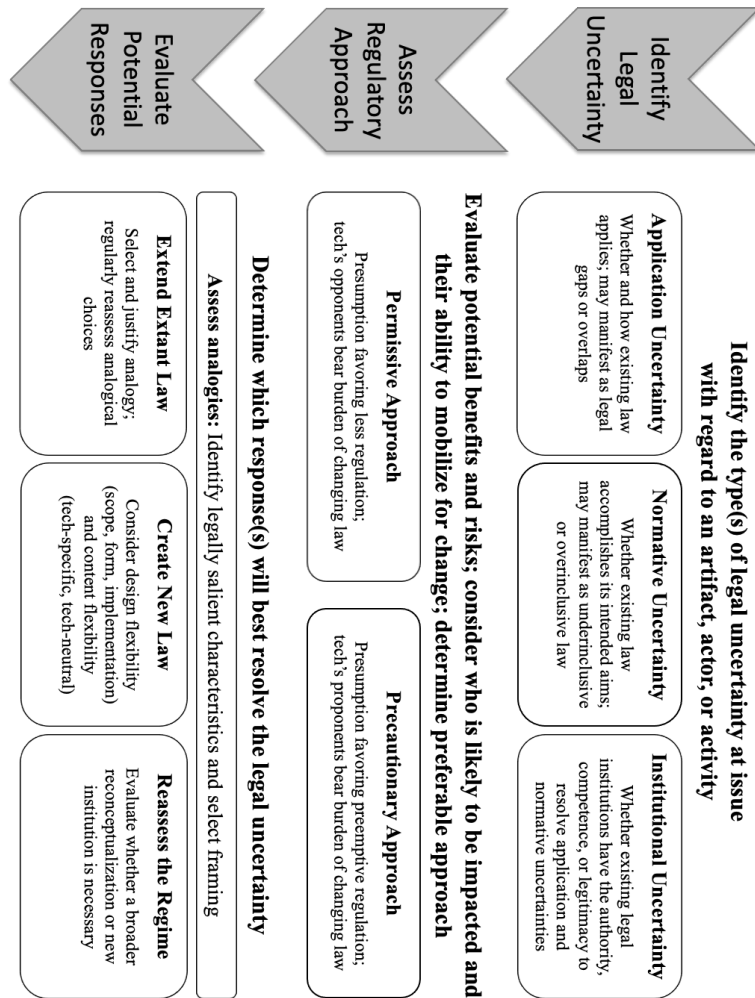


Figure 1: Structuring Techlaw: A Methodological Framework

Based on this reorientation, we construct a three-part framework (depicted in Figure 1), designed to encourage a more thoughtful resolution of structural techlaw questions. It (1) delineates the three types of tech-fostered legal uncertainty, which facilitates recognizing common issues; (2) emphasizes the import of a considered selection between adopting a permissive or precautionary approach in responding to an uncertainty, given their differing distributive and regulatory consequences; and (3) highlights techlaw-specific considerations when

employing analogies and extending extant law, creating new law, or reassessing a legal regime.⁷ In this endeavor, we are deeply indebted to the innumerable scholars who are wrestling with particular manifestations of techlaw problems,⁸ who have developed generalizable techlaw principles within specific legal fields,⁹ and who are also explicitly working to better articulate the broader, ongoing relationship between law and technology.¹⁰ Many of their insights appear as scaffolding in our structure.

7. This paper presents a methodology for resolving recurring structural techlaw questions; as such, it does not address many current substantive techlaw questions. We identify the latter in Crootof & Ard, *supra* note 1 (noting how technology alters relationships among regulatory modalities, raises difference-in-degree-versus-difference-in-kind and technological/regulatory convergence questions, and shifts power dynamics by creating new relationships and centralizing or decentralizing capabilities).

8. The sheer number of exemplary articles would render even a “*see generally*” citation folly, as “[a]ny attempt to identify an overarching purpose or common identity in the multiple lines of inquiry in this field may well fail to recognize the richness and variety of the individual contributions and the depth of their insights.” Roger Brownsword, Eloise Scotford & Karen Yeung, *Law, Regulation, and Technology: The Field, Frame, and Focal Questions*, in *THE OXFORD HANDBOOK OF LAW, REGULATION AND TECHNOLOGY* 3, 7 (Roger Brownsword, Eloise Scotford & Karen Yeung eds., 2017).

9. Telecommunications, cyberlaw, intellectual property, privacy, and robotics law scholars, along with experts in other fields, have identified and explored many of these overarching concepts. *See, e.g.*, LAWRENCE LESSIG, *CODE VERSION 2.0* (2016); JONATHAN ZITTRAIN, *THE FUTURE OF THE INTERNET — AND HOW TO STOP IT* (2009); Jack M. Balkin, *Digital Speech and Democratic Culture: A Theory of Freedom of Expression for the Information Society*, 79 N.Y.U. L. REV. 1 (2004); Gaia Bernstein, *When New Technologies Are Still New: Windows of Opportunity for Privacy Protection*, 51 VILL. L. REV. 921 (2006); Kristen E. Eichensehr, *Cyberwar and International Law Step Zero*, 50 TEX. INT’L L.J. 355 (2015); Margot Kaminski, *Binary Governance: Lessons from the GDPR’s Approach to Algorithmic Accountability*, 92 S. CALIF. L. REV. 1529 (2019); Orin Kerr, *An Equilibrium-Adjustment Theory of the Fourth Amendment*, 125 HARV. L. REV. 476 (2011); Lawrence Lessig, *The Law of the Horse: What Cyberlaw Might Teach*, 113 HARV. L. REV. 501 (1999); Paul Ohm, *The Argument Against Technology-Neutral Surveillance Laws*, 88 TEX. L. REV. 1685 (2010); Colin B. Picker, *A View from 40,000 Feet: International Law and the Invisible Hand of Technology*, 23 CARDOZO L. REV. 149 (2001); Joel R. Reidenberg, *Lex Informatica: The Formulation of Information Policy Rules through Technology*, 76 TEX. L. REV. 553 (1997); Harry Surden, *Structural Rights in Privacy*, 60 SMU L. REV. 1605 (2007).

We have also previously written on these topics. BJ Ard, *An Institutional Account of Legal Disruption* (Dec. 3, 2020) (unpublished manuscript) (on file with authors) (arguing that legal disruption is a function of whether existing institutions can address uncertainties posed by new technology); Rebecca Crootof, *Regulating New Weapons Technologies*, in *THE IMPACT OF EMERGING TECHNOLOGIES ON THE LAW OF ARMED CONFLICT* 3 (Eric Talbot Jensen & Ronald T.P. Alcala eds., 2019) (outlining categories of tech-fostered legal disruption and relevant considerations when evaluating responses).

10. *See, e.g.*, LAWRENCE TRIBE, *CHANNELING TECHNOLOGY THROUGH LAW* (1973); Balkin, *supra* note 6; Michael Birnhack, *Reverse Engineering Informational Privacy Law*, 15 YALE J.L. & TECH. 24 (2012); Bennett Moses, *Why Have a Theory of Law and Technological Change?*, *supra* note 1; Lyria Bennett Moses, *Regulating in the Face of Sociotechnical Change*, in *THE OXFORD HANDBOOK OF LAW, REGULATION AND TECHNOLOGY* 1 (Roger Brownsword, Eloise Scotford & Karen Yeung eds., 2017); Brownsword, Scotford & Yeung, *supra* note 8; Gaia Bernstein, *The Role of Diffusion Characteristics in Formulating a General Theory of Law and Technology*, 8 MINN. J.L. SCI. & TECH. 623 (2007); Calo, *Lessons of Cyberlaw*, *supra* note 2; Anupam Chander, *Future-Proofing Law*, 51 U.C. DAVIS L. REV. 1

To resolve a legal uncertainty, a legal actor must first identify which kind it is.¹¹ Part II delineates the three main kinds of tech-fostered legal uncertainties: (1) application uncertainties, which raise the question of whether and how extant law applies; (2) normative uncertainties, which arise when the law is arguably unable to accomplish its aims; and (3) institutional uncertainties, which exist when there are questions about different regulatory entities' relative authority, competence, and legitimacy to apply and update the law.¹² Our focus on legal uncertainty emphasizes that there is nothing particularly special about new technologies and no need to distinguish certain technologies as

(2017); Arthur Cockfield & Jason Pridmore, *A Synthetic Theory of Law and Technology*, 8 MINN. J.L. SCI. & TECH. 474 (2007); David Friedman, *Does Technology Require New Law?*, 25 HARV. J.L. & PUB. POL'Y 71 (2001); Justin Hurwitz, *The Technological Problem of Social Cost*, TPRC Draft (Mar. 31, 2016), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2757358 [<https://perma.cc/7JE5-UGLW>]; Jones, *supra* note 4; Kaminski, *supra* note 6; Liu, Maas, Danaher, Scarcella, Lexer & Van Rompaey, *supra* note 4; Gregory Mandel, *Legal Evolution in Response to Technological Change*, in THE OXFORD HANDBOOK OF LAW, REGULATION AND TECHNOLOGY 225 (Roger Brownsword, Eloise Scotford & Karen Yeung eds., 2017); Gary Marchant, *The Growing Gap Between Emerging Technologies and the Law*, in THE GROWING GAP BETWEEN EMERGING TECHNOLOGIES AND LEGAL-ETHICAL OVERSIGHT: THE PACING PROBLEM 19 (Gary E. Marchant, Braden R. Allenby & Joseph R. Herkert eds., 2011); Gary E. Marchant, *Governance of Emerging Technologies as a Wicked Problem*, 73 VANDERBILT L. REV. 1861 (2020); Matwyshyn, *supra* note 4; Frank Pasquale, *Technology, Competition and Values*, 8 MINN. J.L. SCI. & TECH. 607 (2007).

Our project also intersects with those analyzing how technological developments affect the cultural zeitgeist. See, e.g., YOCHAI BENKLER, THE PENGUIN AND THE LEVIATHAN: HOW COOPERATION TRIUMPHS OVER SELF-INTEREST (2011) (arguing that the greater ease of collaboration fostered by digital communications technologies has improved social and economic life); JULIE E. COHEN, BETWEEN TRUTH AND POWER: THE LEGAL CONSTRUCTIONS OF INFORMATIONAL CAPITALISM (2019) (connecting profound transformations in social ordering to the changing of our political economy from one of industrial capitalism to one of informational capitalism). To the extent possible when discussing how technologies enable new social conduct that affects extant rules, however, we are concerned with the relationship between technology and regulation, not between technology and society more broadly.

11. We use the term “legal actors” to encompass all entities charged with making, interpreting, or enforcing rules — essentially all entities who influence how law evolves. In addition to some of the more obvious players — judges, legislators, and agency rulemakers — we include legal practitioners, compliance monitors, treaty negotiators, legal advisors, policy advocates, academics, and sovereign states in this category. “Legal actors” are analogous to Lessig’s “regulators,” but our term excludes purely social actors (like the person who raises an eyebrow at another for wearing the wrong thing) or purely market actors. See generally LESSIG, *supra* note 9.

We also use the more specific terms “lawmakers” when discussing legal actors who make or amend rules and “interpreters” when discussing legal actors engaged in interpreting, constructing, or applying a rule.

12. In addition to blurring subject matter and jurisdictional lines in ways that create uncertainty regarding who has the authority to regulate the conduct at issue, tech-fostered changes often raise difficult technical and normative questions, and it may be unclear which entities possess the competence or institutional legitimacy to provide answers. We consider these institutional uncertainties in greater detail in a separate paper. See BJ Ard & Rebecca Crotoft, *Institutional Uncertainties* (Mar. 1, 2021) (unpublished manuscript) (on file with authors).

“exceptional”¹³ or their usage as “legally disruptive.”¹⁴ Instead, all technologies can raise all three types of legal uncertainties as social circumstances and uses change.¹⁵

The second step — consciously evaluating the legal regime’s and legal actor’s underlying assumptions about how to best regulate technological development before going forward — is often ignored, but it has critical distributive and path-setting consequences. Part III presents the spectrum of approaches to tech-fostered legal uncertainties, ranging from more permissive to more precautionary stances. In addition to the usual regulatory concerns associated with balancing innovation and risk in the face of the unknown,¹⁶ we emphasize these approaches’ often under-considered implications. We employ public choice theory and a political-economy analysis to demonstrate how a more permissive or precautionary stance shifts the burden of rulemaking between those who profit from a technology and those harmed by it. The size, concentration, and political power of these respective groups will impact their ability to mobilize for change, which in turn shapes the likelihood that initial regulatory missteps will be corrected. By differentiating this often-unconscious step, we hope to encourage legal actors to engage in a more thoughtful evaluation of the associated tradeoffs and consequences.

The third step requires weighing the strengths and limitations of traditional regulatory responses — stretching extant law, creating new law, and reassessing the regulatory regime — with an awareness of their attendant techlaw issues. Part IV begins with a discussion of the varied roles of techlaw analogies and how rhetorical framings of analogical choices may promote different regulatory responses. When analogies are employed to extend old rules, legal actors must understand, articulate, and regularly reexamine those choices to avoid inappropriate entrenchment. When new law is warranted, lawmakers will need to balance stability and flexibility both in how a rule is designed

13. *But see* Calo, *Lessons of Cyberlaw*, *supra* note 2, at 549 (employing a methodology that evaluates a technology’s “essential qualities” to determine whether it is “exceptional”).

14. *But see* Liu, Maas, Danaher, Scarcella, Lexer & Van Rompaey, *supra* note 4, at 16–17 (suggesting that only technological developments that are “capable of fundamentally displacing certain core legal presumptions, subvert legal principles, or systematically distort the functioning of a legal system” surmount the high threshold for being “legally disruptive”).

15. *Cf.* Gaia Bernstein, *In the Shadow of Innovation*, 31 CARDOZO L. REV. 2257 (2010) (arguing that “innovation discourse” overemphasizes the beginning of the technological life cycle at the expense of thinking through social changes associated with its diffusion and social adoption).

16. While innovation and regulation are often framed as fundamentally in tension, a growing body of privacy scholarship questions this premise. *See, e.g.,* Julie E. Cohen, *What Privacy Is For*, 126 HARV. L. REV. 1904, 1919–20 (2013); Yafit Lev-Aretz & Katherine J. Strandburg, *Privacy Regulation and Innovation Policy*, 22 YALE J.L. & TECH. 256, 307–10 (2020).

and in what it governs, particularly in the selection between relatively tech-neutral or tech-specific formulations. And when tech-fostered changes introduce complexities, blur categories, and pose questions that expose the limits of existing modes of regulation, we may need to reassess the entire regulatory regime.

By outlining a taxonomy of tech-fostered legal uncertainties, regulatory approaches, and responsive legal strategies,¹⁷ we provide a shared language and common structure for intra- and cross-subject discussion. Too often, people working on techlaw issues talk past each other; we have all seen the failure of communication that occurs when one conversant is focused on an application uncertainty (“Are Uber drivers ‘employees’?”) and the other is focused on a normative uncertainty (“Does classifying Uber drivers as ‘employees’ lead to fair and efficient outcomes?”).¹⁸ Recognizing that these questions operate at different levels helps avoid miscommunications that might derail otherwise productive conversations and alliances.¹⁹

Additionally, being able to situate a particular techlaw question within a broader framework helps us better understand the fundamental issues, better evaluate the likely effectiveness of different legal responses, and better conduct tech-specific and subject-specific analyses. For example, there are obviously different concerns associated with having human beings in the loop in content moderation, medical, and military decision-making processes. But there is also much to be gained by considering the shared application, normative, and institutional uncertainties that arise in all three contexts.²⁰ Stepping back makes it easier to learn from the rich history of prior dilemmas and anticipate future

17. For the purpose of this Article, we often zoom in on the moment where law responds to tech-created legal uncertainty. However, prior to that moment, law will have played an instrumental role in shaping the economic incentives, regulatory environment, and social norms that contributed to the development or use of the technology. *See generally* THE SOCIAL SHAPING OF TECHNOLOGY (Donald MacKenzie & Judy Wajcman eds., 1985); Brishen Rogers, *The Law and Political Economy of Workplace Technological Change*, 55 HARV. C.R.-C.L. L. REV. 531 (2020) (discussing how labor and employment laws shape workplace technological change). Accordingly, this project coexists alongside theories of how to best incentivize or guide the development of future technologies, either to foster innovation or minimize risk, which are foundational to fields like administrative law, intellectual property, and tort law.

18. *See, e.g.*, COHEN, *supra* note 10, at 33 (distinguishing the normative question as one “that protracted litigation over who is ‘really’ an employer does not address”).

19. *Cf.* Frank Pasquale, *The Second Wave of Algorithmic Accountability*, L. & POL. ECON. PROJECT (Nov. 25, 2019), <https://lpeblog.org/2019/11/25/the-second-wave-of-algorithmic-accountability/> [<https://perma.cc/W6KH-E4JK>] (distinguishing “first wave” accountability advocates, who aim to improve existing systems, from “second wave” accountability advocates, who question whether these systems should be used at all and who should govern them).

20. Rebecca Crotoft, Margot Kaminski & Nicholson Price, *Humans in the Loop* (Mar. 15, 2021) (unpublished manuscript) (on file with author).

issues, allowing us to learn from the past and each other and to make more just and effective decisions going forward.²¹

This framework also emphasizes the possibility of purposeful intervention in the iterative and co-constructive relationship between law and technology. Each legal uncertainty is an opportunity for a legal actor to shape the further development of the law, and every resolution of that uncertainty — regardless of how apparently simple or excruciatingly difficult — impacts how the law evolves. While a legal actor's influence is most apparent when a new law is created or an older one invalidated, a decision to maintain the status quo can have equally influential implications and broader ripple effects for the distribution of power.

Admittedly, every opportunity to consciously and intentionally shift the path of legal evolution is bounded. On the front end, the known unknowns of a technology's possible beneficial or negative social effects may chill regulatory action; meanwhile the technology's architecture, the established legal structures, and the procedural and institutional constraints on different legal actors limit the range of possible action.²² On the back end, due in part to the speed of technological development and its impact on social norms, legal actors may only have a short period to make determinative regulatory moves before path dependence, lock-in, and stabilization make shifting the course of both law and future technological development more difficult.²³

But despite these constraints, law is not doomed to constantly scramble to keep up with technological change, and techlaw practitioners and scholars are not confined to a reactive posture.²⁴ Law shapes

21. Identifying common challenges allows disparate groups to recognize shared interests and mobilize for legal change. For example, farmers who want to retain their ability to fix their tractors, hospitals concerned about their equipment's safety and FDA compliance, and consumer rights advocates angered by Apple's pushed updates that slowed older phones have joined forces with hackers in arguing for "right to repair" laws, which would combat the increasingly stringent restrictions on modifying purchased devices. *See, e.g.,* Richard Jensen, *Hackers, Farmers, and Doctors Unite! Support for Right to Repair Laws Slowly Grows*, ARS TECHNICA (June 30, 2019), <https://arstechnica.com/gadgets/2019/06/hackers-farmers-and-doctors-unite-support-for-right-to-repair-laws-slowly-grows/> [https://perma.cc/V2G4-KQQG].

22. Liu, Maas, Danaher, Scarcella, Lexer & Van Rompaey, *supra* note 4, at 37.

23. Gaia Bernstein terms this period a "window of opportunity." Bernstein, *supra* note 10; *see also* DAVID COLLINGRIDGE, *THE SOCIAL CONTROL OF TECHNOLOGY* 11 (1981) ("[T]he social consequences of a technology cannot be predicted early in the life of a technology. By the time undesirable consequences are discovered, however, the technology is often so much part of the whole economic and social fabric that its control is extremely difficult.").

24. *Cf.* Jones, *supra* note 4, at 256 ("If technology is the driving force of law, law will always follow technology This approach lends itself to what is sometimes called 'the pacing problem' — the tenet that law cannot keep up with technology. By accepting the pacing problem and chasing new technologies with legal solutions, law and technology scholars, as well as policymakers, unnecessarily accept a degree of irrelevance."); JOSEPH WEIZENBAUM, *COMPUTER POWER AND HUMAN REASON: FROM JUDGEMENT TO*

and is shaped by technology, and this framework clarifies that we have the opportunity and ability to purposely engage in this process.²⁵

II. TYPES OF LEGAL UNCERTAINTIES

There are three types of tech-related legal uncertainty that may arise in the context of regulating technology, the actors who use it, or the conduct it enables. Application uncertainties ask whether and how extant law applies and may manifest as legal gaps or legal overlaps; normative uncertainties ask whether the law can accomplish its aims when it is arguably overinclusive or underinclusive; and institutional uncertainties ask whether a regulatory entity is equipped to resolve application and normative uncertainties. In short, application uncertainties encourage a focus on what the law is, normative uncertainties invite the question of what the law should be, and institutional uncertainties highlight concerns about who should decide these questions.

Consider an autonomous vehicle on the highway. First, there is the application-level question of whether rules like speed limits, which were written for human-driven cars, apply to this new type of vehicle.²⁶ Second, one might consider the normative questions of what the extant rules are meant to accomplish and whether the new technology renders them superfluous or overly constraining. If the speed limit is intended to minimize harm from human drivers' inability to react sufficiently quickly at high speeds, perhaps the rule should not be applied to autonomous vehicles. However, if the speed limit's purpose is to reduce pollution or increase fuel efficiency, it is still relevant. Conducting this

CALCULATION 241 (1976) ("The myth of technological and political and social inevitability is a powerful tranquilizer of the conscience. Its service is to remove responsibility from the shoulders of everyone who truly believes in it. But, in fact, there *are* actors!").

25. Our emphasis on the relevance of the sociolegal context may raise the question of why we present this as a techlaw framework, rather than one relevant to legal evolution more generally. While there are certainly parallels with other analyses of legal evolution, the nature of the uncertainties, the choice among regulatory approaches, and the analysis of potential responses raise distinct issues in the techlaw context. While other drivers of social change also raise some of these issues, few do so as often or in tandem. See Crootof & Ard, *supra* note 2.

Even should our reader remain unconvinced of our reasons for distinguishing techlaw, all is not lost; our framework can still be usefully applied to other sources of legal uncertainty. We would count it a success if our work fosters the development of rules and institutions with the stability to withstand repeated challenges and the flexibility to adapt to changed circumstances caused by *all* drivers of legal evolution.

26. While this is largely a linguistic exercise in interpreting rules, the substantive impact of the rule may also matter; courts and other interpreters may reject plausible readings that lead to absurd or self-defeating outcomes. See Frederick Schauer, *A Critical Guide to Vehicles in the Park*, 83 N.Y.U. L. REV. 1109, 1128 (2008). The extent to which a decision maker can consider substantive issues in addition to (or in conflict with) legal texts is determined in part by their institutional role and the greater legal culture. See *id.* at 1128–29 (contrasting the common law and civil law approaches). U.S. courts, for example, have greater leeway to consider substantive outcomes when applying the common law than when applying a statute.

analysis requires a rich understanding of the history and substantive impact of the rule. In practice, however, there are constraints on any given entity's ability to collect the relevant information or act on it. This implicates the third level of legal uncertainty: given different institutional strengths and weaknesses, which entity should have the power to definitively answer these questions? Courts are positioned to extend the speed-limit rules to autonomous vehicles, but they lack the general law-making authority of legislatures. Legislatures lack the subject-matter expertise of agencies to fully weigh the policy considerations. And even agency expertise may be attenuated: The National Highway Traffic and Safety Authority's familiarity with road safety does not make it an expert on distinctive robotics issues.²⁷

These are not mutually exclusive categories with impermeable edges; rather, they are rough groupings of common kinds of legal uncertainty, each addressing a distinct set of concerns. Technological developments may raise several uncertainties simultaneously, and the resolution of uncertainty at one level may create uncertainties at another. For example, ensuring gapless coverage in the application of a law may lead to problematic overinclusion. Likewise, a legal actor's decisions at one level are often made with an awareness of other levels and may be grounded in a desire to avoid or resolve concerns at another. A court might decide to apply a statute expansively with the aim of maintaining its effectiveness, or an agency might decline to eliminate a legal gap after reasoning that it is the wrong institution to address the issue. Ideally, the process of examining a techlaw question in light of the three levels of uncertainty will expose alternative ways of posing questions, highlight relevant considerations, and foster a more comprehensive understanding of the related challenges.

A. Artifacts, Actors, and Activities

Technologies give rise to legal uncertainties by foregrounding unanticipated artifacts, actors, and activities. While this Article is peppered with examples, it is worth briefly disaggregating these sources of legal uncertainty.

New items, devices, objects, platforms, and other technological artifacts are commonly (if not always accurately) charged with raising difficult questions. Consider personalized health and wellness apps. Who owns the data they produce? Who is or should be permitted to access it?²⁸ Do the full range of HIPAA privacy protections apply?

27. See Calo, *Lessons of Cyberlaw*, *supra* note 2, at 3.

28. See, e.g., Marshall Allen, *You Snooze, You Lose: Insurers Make the Old Adage Literally True*, PROPUBLICA (Nov. 21, 2018, 5:00 AM), <https://www.propublica.org/article/you-snooze-you-lose-insurers-make-the-old-adage-literally-true> [https://perma.cc/E7RH-YJ9R];

The emergence of newly relevant actors may also create uncertainty. For example, most international law was originally developed by and for sovereign states, and many established obligations presume state-level capabilities and interests. But thanks to modern communications and weapon technologies, non-state actors — including multinational corporations and organized armed groups — are now able to organize, fundraise, and wield state-like power and force.²⁹ Are these entities bound by extant international law? Should they be? Are foundational principles like state sovereignty still relevant? Are new regulatory institutions needed?

Legal uncertainties also arise when technological development enables previously impossible conduct, actions, or activities. Take civilian drones: Trespass usually includes causing a thing to enter land in the possession of another,³⁰ so it prohibits landing a drone on a neighbor's lawn, but what about persistently flying a drone over a neighbor's property?³¹ Relatedly, new surveillance tools regularly grant "government agents a power to see or know something from a location in a space not covered by the Fourth Amendment about a space that is protected by the Fourth Amendment."³² Employing thermal imaging devices to measure the temperature inside a home,³³ using a beeper to follow a car,³⁴ and installing a GPS tracking device on a vehicle³⁵ have required law enforcement, civil society, and courts to re-evaluate the scope of the Fourth Amendment in light of newly possible conduct.

Likewise, uncertainty may stem from activities that were once rare but have become newly prevalent due to technological changes that

Hugo Campos, *The Heart of the Matter: I Can't Access the Data Generated by My Implanted Defibrillator. That's Absurd*, SLATE (Mar. 24, 2015, 10:00 AM), http://www.slate.com/articles/technology/future_tense/2015/03/patients_should_be_allowed_to_access_data_generated_by_implanted_devices.html [<https://perma.cc/F2HG-F8XK>].

29. See, e.g., Kristen Eichensehr, *Digital Switzerlands*, 167 U. PA. L. REV. 665, 672 (2019) (arguing that U.S. technology companies are becoming "competing sovereigns"); T.X. Hammes, *Technology Converges; Non-State Actors Benefit*, in HOOVER INSTITUTION: GOVERNANCE IN AN EMERGING WORLD (2019), <https://www.hoover.org/research/technology-converges-non-state-actors-benefit> [<https://perma.cc/J3M3-B55N>].

30. RESTATEMENT (SECOND) OF TORTS § 158 (AM. LAW. INST. 1965).

31. While U.S. law recognizes property owners' rights in airspace up to a certain height, see *United States v. Causby*, 328 U.S. 256, 264 (1946), courts have yet to provide a clear answer to how high these rights extend with respect to drones. Lane Page, Note, *Drone Trespass and the Line Separating the National Airspace and Private Property*, 86 GEO. WASH. L. REV. 1152, 1163 (2018) ("Because it is unclear how far airspace property rights extend, low-altitude airspace — the airspace where drones will be flying — is currently a property rights no-man's land.") (internal quotation marks omitted).

32. Kerr, *supra* note 9, at 496; see, e.g., *United States v. Jones*, 565 U.S. 400 (2012) (addressing this kind of application uncertainty in determining whether installing a GPS tracking device on a vehicle constituted an unreasonable search).

33. See *Kyllo v. United States*, 533 U.S. 27 (2001); Kerr, *supra* note 9, at 496–99.

34. See *United States v. Knotts*, 460 U.S. 276 (1983); Kerr, *supra* note 9, at 499–500.

35. See *Jones*, 565 U.S. 400.

minimize a practical or market barrier.³⁶ States have always been able to influence other states without using military force — say, with economic sanctions or psychological operations. However, cyberoperations now enable remote, non-kinetic actions that can result in widespread physical, economic, and institutional damage, raising the question of how new levels of invasive and harmful but non-violent interference should be addressed.³⁷

B. Application Uncertainties

The facile but persistent claim that “law cannot keep up with new technologies”³⁸ ignores the myriad ways in which law shapes most technological developments³⁹ and obscures the fact that all new technologies are governed by complex and overlapping tech-neutral background rules. Even if you invent the first thingamabob, you are bound by the rules of commercial law should you try to sell it, and you cannot use it to batter someone without incurring tort liability.

Most existing law can be applied to most new technologies most of the time.⁴⁰ However, there is often some element of uncertainty, as it

36. Surden, *supra* note 9, at 1618 (“Importantly, many emerging technologies possess exactly this characteristic — the tendency to lower transactional and operational costs. This in turn permits conduct which was previously costly or impossible.”); *see also* Crootof, *supra* note 9, at 5 (“A variant on this kind of legal disruption occurs when a difference in degree becomes a difference in kind, requiring clarification of a once-infrequent ambiguity.”); Hurwitz, *supra* note 10 (“[T]echnology defines the transaction costs that define what the law both can and should be.”).

37. Rebecca Crootof, *International Cybertorts: Expanding State Accountability in Cyberspace*, 103 CORNELL L. REV. 565, 626–28 (2018) (discussing how the internet facilitates once-difficult invasive acts, ranging from “publicizing hacked private communications to disseminating misinformation to exploiting voting machine vulnerabilities to manipulating social media” and outlining a regulatory structure for addressing these activities).

38. *See, e.g.*, LARRY DOWNES, *THE LAWS OF DISRUPTION: HARNESSING THE NEW FORCES THAT GOVERN LIFE AND BUSINESS IN THE DIGITAL AGE 2* (2009) (“[T]echnology changes exponentially, but social economic, and legal systems change incrementally.”). While regulatory lags certainly exist for some technologies, they are the exception rather than the norm. The concept of regulatory lags has been articulated most definitively by Gary Marchant. *See* Marchant, *Growing Gap*, *supra* note 10.

39. *See supra* note 25 and accompanying text.

40. Louis Henkin famously observed, “almost all nations observe almost all principles of international law and almost all of their obligations almost all of the time.” LOUIS HENKIN, *HOW NATIONS BEHAVE* 47 (2d ed. 1979) (emphasis omitted). The idea that international law isn’t really law nonetheless persists largely because its apparent failures are far more dramatic than its successes. *See* Oona A. Hathaway & Scott J. Shapiro, *What Realists Don’t Understand About Law*, FOREIGN POL’Y, (Oct. 9, 2017), <https://foreignpolicy.com/2017/10/09/what-realists-dont-understand-about-law/> [<https://perma.cc/55FJ-5D4R>] (“When it is most effective, the law doesn’t induce states to act contrary to incentives; it changes those incentives.”). As with international law, it is easy to overlook how extant law quietly but powerfully shapes technological development and focus instead on the headline-grabbing cases where law appears inadequate to address a particular problem, inspiring our adaptation

may be unclear how the law should apply or which law (if any) is relevant.⁴¹ These “application uncertainties” — situations where there is some indeterminacy as to whether and how existing law applies to an artifact, actor, or activity — are the most commonly addressed kinds of tech-fostered uncertainties.⁴² They highlight both settled law and its outer limits.

As highlighted above, tech-fostered application uncertainties may take various forms. They may also manifest as “gaps” and “overlaps.” Gaps are scenarios where it is not clear whether any existing law applies; overlaps arise when multiple laws apply, but it is unclear how to resolve conflicts among them.

1. Legal Gaps

Gaps exist where artifacts, actors, or activities defy existing categories to such a degree that there may be no governing law. In the face of an apparent gap, a legal actor must determine *whether* the law applies before reaching the usual application uncertainty question of *how*. While frequently portrayed as problematic, gaps are sometimes generative: They may leave room for innovation or prompt interpreters to engage in more deliberate analysis.⁴³

Gaps often materialize where legal actors would expect a body of law to govern yet cannot find a specific rule that actually does.⁴⁴ For example, many are concerned that people can now produce 3D-printed

of the Henkin quotation. *See also* Eichensehr, *supra* note 9, at 357 (adapting the line to new weapons technologies).

41. Crotoft, *supra* note 9, at 9 (“As it will not necessarily be clear whether new, technologically-enabled conduct is permitted, prohibited, or regulated, new technology often creates uncertainty regarding the proper application or scope of existing rules.”).

To be sure, many rules are ambiguous even in the absence of technological change. Consider the classic “no vehicles in the park” statutory interpretation problem, which forces law students to wrestle with whether skateboards, ambulances, or toy cars are prohibited. H.L.A. HART, *THE CONCEPT OF LAW* 125–27 (1994). It would have been ambiguous as soon as the law passed whether the rule applied to non-motorized toy cars; technological developments that result in the introduction of remote-controlled toy cars merely highlight the same underlying ambiguity. Birnhack, *supra* note 10, at 38 (observing that technological advancement accentuates the indeterminacy of the “no-vehicle-in-the-park” rule).

42. Application uncertainty is the most frequently addressed because it is the first (and often only) question explicitly considered. While each techlaw dispute also presents an opportunity to grapple with normative or institutional uncertainties, legal actors typically acknowledge these further questions only after they have attempted to apply existing law and found it lacking in some way.

43. The question of whether legal change to address a gap is needed goes beyond application uncertainty to raise a normative uncertainty, specifically to the question of whether existing law is underinclusive. *See infra* Section II.C.

44. Alternatively, many legal actors will be incentivized to describe artifacts, actors, or activities as existing outside of a legal regime, either to evade regulations or promote the creation of new rules. *See infra* Section II.B.3.

guns at home. While it has long been possible for individuals to manufacture firearms, it has not historically happened at a level sufficient to spur regulation — given the expense and expertise required to make a functional firearm, it has been easier and cheaper for those who want guns to simply purchase them.⁴⁵ Accordingly, federal gun-control laws are premised on regulating the sale or transfer of guns, rather than their creation.⁴⁶ The proliferation of 3D printers, which enables individuals to manufacture anything at home after downloading an instructional file, makes manifest this legal gap.⁴⁷

Technology can also expose legal gaps by allowing access to or creating new realms beyond conventional jurisdictional lines, making it unclear whether and what law governs. As technology enables more activity and uses of outer space, for example, it has revealed legal gaps (the resolution of which has fostered a growing body of domestic and international space law).⁴⁸ Similarly, the internet has facilitated the creation of cyberspace and various kinds of virtual online worlds. The popular conception of cyberspace as “lawless” suggests that there are significant legal gaps.⁴⁹

2. Legal Overlaps

Overlaps exist where a technology gives rise to an artifact, actor, or activity that is plausibly governed by two or more laws or legal regimes and it is unclear how to resolve conflicts among them.⁵⁰ Sometimes laws apply in tandem for the first time, as when a device merges features regulated by separate regimes; sometimes an ambiguity or contradiction has long existed at the intersection of two legal regimes, and

45. Deven R. Desai & Gerard N. Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, 102 GEO. L.J. 1691, 1701 (2014).

46. See Lucas S. Osborn, *Regulating Three-Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 577–79 (2014). The 1968 Gun Control Act, which requires that people who make or sell firearms be licensed and employ methods that allow the government to trace the weapons, does not apply to those who make firearms for personal use. See Gun Control Act, 18 U.S.C. § 923 (regulating “manufacturers”); *id.* § 921(10) (limiting the term “manufacturers” to those who manufacture “for purposes of sale or distribution”).

47. *Id.* at 1701–02.

48. See, e.g., Picker, *supra* note 9, at 176 (“[I]t is hard[] to imagine a field of international law more beholden to technology than the Law of Outer Space.”).

49. See, e.g., SHOSHANA ZUBOFF, *THE AGE OF SURVEILLANCE CAPITALISM: THE FIGHT FOR A HUMAN FUTURE AT THE NEW FRONTIER OF POWER* 104 (2019) (arguing this “lawlessness” has been instrumental to the rise of surveillance capitalism). This characterization, however, is debated. See COHEN, *supra* note 10, at 2 (explaining that law has hardly been absent from cyberspace; rather, it has facilitated the expansion of private power).

50. This section addresses overlaps between existing rules or bodies of law; we address overlaps between legal actors who make, update, interpret, and enforce the law elsewhere. See *infra* Section II.D.

a technological development has simply made the conflict more prominent. An overlap may exist between specific laws, such as this and that statute, treaty, or constitutional provision; between areas of law, such as international human rights law and the law of armed conflict; or when a single law unexpectedly intersects with a legal regime that had previously been entirely separate, such as trade secret law preventing criminals from challenging algorithms used in sentencing determinations.⁵¹ In all these situations, a legal actor must determine not only *how* the law applies, but also *which* law applies, which might entail evaluating whether one rule displaces or should be interpreted in light of the other.⁵² As with gaps, overlaps are not necessarily problematic: any given technology is already governed by multiple legal regimes;⁵³ it is often possible to comply with all rules simultaneously, and awareness of potential conflicts may spur a more deliberate evaluation of the rules than would otherwise occur.

The most challenging overlap scenarios arise when different laws impose contradictory requirements, such as one explicitly authorizing or even compelling what the other expressly prohibits. Consider the disputes that have arisen as new communications technologies have made various products and practices more speech-like. The Digital Millennium Copyright Act (“DMCA”), for example, makes it unlawful to traffic in the tools to decrypt a copyrighted work.⁵⁴ At the time the DMCA was enacted, no one in Congress imagined that the use of such a tool might be protected by the First Amendment;⁵⁵ the rule was aimed at anticipated “black box” devices that would facilitate piracy.⁵⁶ But these devices never materialized. Instead of building decryption devices, hackers uploaded decryption codes to the internet, bringing the

51. See generally Rebecca Wexler, *Life, Liberty, and Trade Secrets: Intellectual Property in the Criminal Justice System*, 70 STAN. L. REV. 1343 (2018).

52. Disentangling these overlaps can be particularly challenging when the legal actor is not an expert in both fields, implicating the institutional questions of which entity is best able to make these types of determinations. See generally Ard & Crotoof, *supra* note 12.

53. In practice, any given artifact, actor, or activity is already governed by multiple wider regimes. It is often possible to comply with all these rules simultaneously, even when technologies blur the lines between existing legal categories and create new overlaps: Our internet-connected cars are governed by both laws that apply to vehicles, like parking requirements, and laws that apply to computer software, like prohibitions on circumventing protections on the car’s copyrighted code. See 17 U.S.C. § 1201(a); Ohm & Reid, *supra* note 2, at 1682–84.

54. 17 U.S.C. § 1201(a)(2) (prohibiting trafficking in “any technology, product, service, device, component, or part thereof” designed for this purpose).

55. While the supporters and opponents of the Act debated the *impact* of the ban on free speech, no congressperson argued that the decryption tool *itself* should be protected as speech. See WIPO Copyright Treaties Implementation Act and Online Copyright Liability Limitation Act: Hearing on H.R. 2281 and H.R. 2280 Before the Subcomm. on Courts and Intellectual Property of the House Comm. on the Judiciary, 105th Cong. (1997).

56. See Section-by-Section Analysis of H.R. 2281 as Passed by the United States House of Representatives on August 4, 1998, 105th Cong., at 8–9 (1998).

DMCA into conflict with the nascent legal determination that computer code was entitled to First Amendment protection.⁵⁷ In the first case decided under the Act, the accused hacker attempted to extend the scope of this protection by arguing that his distribution of the decryption code for DVDs was protected speech.⁵⁸ While the court ultimately upheld the trafficking ban, it did so only after acknowledging that computer code raises new legal questions because it combines the elements of a functional tool with expressive content.⁵⁹

Less dramatically, overlaps sometimes manifest as confusion regarding which of multiple potentially relevant legal regimes apply, as exemplified by the difficulties of categorizing Bitcoin and other cryptocurrencies. Cryptocurrencies blur the lines between several categories of more traditional assets, causing different federal and state regulators to classify it variously as a currency,⁶⁰ a security,⁶¹ or a commodity.⁶² Each classification places cryptocurrency into a distinct regulatory regime with differing obligations. Consequently, many cryptocurrency legal disputes hinge on deciding what classification is most appropriate in contexts like taxation, bankruptcy, or initial public offerings.⁶³ More broadly, regulating cyberspace is challenging because it implicates the laws of several competing jurisdictions, creating a range of potential legal overlaps.⁶⁴

57. See, e.g., *Bernstein v. United States*, 176 F.3d 1132, 1141 (9th Cir. 1999), *withdrawn* 192 F.3d 1308 (9th Cir. 1999). The *Bernstein* district court had reached this conclusion prior to the passage of the DMCA, 922 F. Supp. 1426 (C.D. Ca. 1996), but this was irrelevant to Congress at the time because they had not contemplated the tools they were regulating would take the form of freestanding code rather than a piece of hardware. See *supra* notes 55–56 and accompanying text.

58. See *Universal City Studios, Inc. v. Corley*, 273 F.3d 429, 445 (2d Cir. 2001).

59. *Id.* at 445–53.

60. See, e.g., N.Y. COMP. CODES R. & REGS. Tit. 23 § 200.1 et seq. (regulating cryptocurrency exchange businesses); WASH. REV. CODE § 19.230.010 (same); see also *Wisconsin Cent. Ltd. v. United States*, 138 S. Ct. 2067, 2076 (2018) (Breyer, J., dissenting) (describing how Bitcoin might serve as employee compensation).

61. See, e.g., IRS Notice 2014-21 (2014); Sec. Rep. No. 81207, (2017), Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO.

62. See A CFTC PRIMER ON VIRTUAL CURRENCIES 11 (2017), https://www.cftc.gov/sites/default/files/idc/groups/public/documents/file/labcftr_primercurrencies100417.pdf [<https://perma.cc/X6KL-UK7N>].

63. See, e.g., Ryan W. Beall, *Cryptocurrency in the Law: An Analysis of the Treatment of Cryptocurrency in Bankruptcy*, 35 CALIF. BANKR. J. 43, 51–57 (2019); Carol Goforth, *Securities Treatment of Tokenized Offerings Under U.S. Law*, 46 PEPP. L. REV. 405, 407–10 (2019); Roland Weekley, *The Problematic Tax Treatment of Cryptocurrencies*, 17 FLA. ST. U. BUS. REV. 109, 127–30 (2018). See generally Sarah Jane Hughes, *Property, Agency, and the Blockchain: New Technology and Longstanding Legal Paradigms*, 65 WAYNE L. REV. 57, 62 (2019) (“Choosing characterizations is hard because we trigger different legal or regulatory regimes, at least in the United States and Canada. The consequence of not getting the taxonomy of this property right could cause vastly different tax treatments, criminal sanctions, or civil remedies to apply.”) (internal citation omitted).

64. See, e.g., JACK GOLDSMITH & TIM WU, *WHO CONTROLS THE INTERNET? ILLUSIONS OF A BORDERLESS WORLD* (2006).

3. Framing Gaps and Overlaps

Depending on how it is framed, the same technological development might be described as creating either a gap or an overlap. In his Law and Technology class, for example, Kiel Brennan-Marquez asks his students to imagine a world with one legal regime for houses and another for boats. One day, someone invents the houseboat. This could be understood as producing a legal overlap, which could be resolved by determining whether a houseboat is most like a house or a boat. Should it be subject to regulations for houses, because people can live in it? Or to those governing boats, because it moves on water and is subject to associated risks? Or both? The answer might vary depending on the rule at issue, the incentives the rule is intended to promote, or the risks it attempts to minimize. Simultaneously, if houseboats raise distinct issues unique to floating homes, they might reveal a legal gap.⁶⁵

Internet-connected devices are today's houseboats. Once, if you purchased a home audio speaker and it abruptly stopped working, you could bring a claim grounded on the U.C.C. implied warranty of merchantability for goods.⁶⁶ Today, when you purchase a "smart" speaker, you purchase both the physical device and some kind of service, such as the Alexa Voice service, which can play requested songs, set timers, or answer questions. Should the company decide to remotely deactivate the device's "smart" capabilities, it is unclear if the U.C.C. implied warranty applies — is the device a good, a service, or some new hybrid?⁶⁷ The resulting application uncertainty might be fairly characterized as (1) an overlap between the legal regimes governing goods and those governing services or (2) a gap, as there is an entirely new kind of item.

65. Brennan-Marquez developed this example from *Amads v. New Jersey Steamboat Co.*, 45 N.E. 369 (N.Y. 1986), where the court wrestled with the question of whether steamboat operators are more akin to innkeepers or railroad conductors.

66. U.C.C. § 2-314.

67. See, e.g., Karl Bode, *Sonos Makes It Clear: You No Longer Own the Things You Buy*, VICE (Jan. 22, 2020), <https://www.vice.com/en/article/3a8dpn/sonos-makes-it-clear-you-no-longer-own-the-things-you-buy> [<https://perma.cc/8B59-3HEW>] (discussing the burgeoning corporate practice of remotely "bricking" purchased devices). For academic analyses of related issues, see, for example, Rebecca Crootof, *The Internet of Torts: Expanding Civil Liability Standards to Address Corporate Remote Interference*, 69 DUKE L.J. 583 (2019); and Stacy-Ann Elvy, *The Hybrid Transactions and the Internet of Things: Goods, Services, or Software?*, 74 WASH. & LEE L. REV. 77 (2017).

Nor is this purely a domestic law issue; international legal regimes are wrestling with how to characterize these and other "houseboats." For example, given that goods and services are regulated under different trade agreements (GATT and GATS) with different attendant obligations, trade lawyers contest what governs products that might be described as either. See, e.g., Appellate Body Report, *China – Measures Affecting Trading Rights and Distribution Services for Certain Publications and Audiovisual Entertainment Products*, WT/DS363/AB/R (Dec. 21, 2009) (debating whether streaming movies are goods or services). Thanks to Harlan G. Cohen for this example.

Framing the application uncertainties raised by houseboats, internet-connected devices, and other technologies as overlaps will bolster arguments for clarifying extant law (either to leave the contested subject “unregulated” or to define how the law does apply), while framing the application uncertainties as gaps will strengthen arguments for creating new law. As we discuss below, these rhetorical strategies raise normative uncertainties about what the law should be;⁶⁸ here, it is critical to recognize that the framing of an application uncertainty as a gap or overlap will have long-term effects for the future regulation of an artifact, actor, or activity.

* * * * *

All application uncertainties — created by unanticipated items, newly relevant actors, once-rare activities, or previously impossible conduct — occur because technology has created or exposed ambiguity in existing legal categories. But this does not mean that gaps, overlaps, and other unresolved questions represent rulemaking failures. When states can only cause widespread destruction via kinetic means, that is the only kind of act that needs to be limited. If individuals cannot mass-manufacture firearms, there is no need to regulate such unlikely endeavors. In a world of only houses and boats, lawmakers will neither pass rules to address the novel challenges posed by houseboats nor resolve the dilemma of what to do when the rules for houses and for boats come into conflict. It would be unreasonable to expect lawmakers to foresee all possible contingencies.⁶⁹

Application uncertainties arise regularly, and legal actors at all levels — including regulated entities, law enforcers, judges, and other legal interpreters — are practiced at employing various strategies to resolve them.⁷⁰ Indeed, sometimes the resolution of an application uncertainty may seem so obvious that the legal actor may not be aware that the uncertainty existed at all.⁷¹

But some resolutions may be unsatisfying or obviously problematic. For example, a group of experts was charged with evaluating whether a military operation that targeted civilian data would constitute

68. See *infra* Section II.C.

69. Indeed, regulatory attempts to proactively “future-proof” the law may fail or even backfire. See *infra* Section IV.C.

70. See discussion *infra* Part IV for strategies to resolve these and other uncertainties.

71. When a new device or form of conduct is not materially different from one where the application of the rule is settled, an interpreter may simply use analogical reasoning to extend the rule without deeper analysis. See *infra* Section IV.A–B. For example, if it has already been determined that the “no vehicles in the park” rule does not apply to toy cars, it follows that it also does not apply to remote controlled toy cars.

a prohibited attack on a civilian object.⁷² Reasoning that data did not satisfy the accepted definition of “object” because it was not visible or tangible, the experts concluded that social security data, tax records, and bank account information would not qualify as protected civilian “objects.”⁷³ In other words, they decided that, while the destruction of your local brick-and-mortar bank branch is prohibited, the destruction of your banking data is not. These defensible but substantively problematic conclusions raise a different kind of uncertainty.

*C. Normative Uncertainties*⁷⁴

Seemingly reasonable resolutions of application uncertainties may still result in undesirable outcomes when the applicable rule is incapable of accomplishing a desired result, inviting legal actors to reevaluate the rule or regime’s underlying purpose.⁷⁵ These normative uncertainties may manifest as the law becoming underinclusive, in that it fails to apply to the full range of activity necessary to achieve its purposes, or overinclusive, in that it unnecessarily restricts socially valuable activity.

72. TALLINN MANUAL 2.0 ON THE INTERNATIONAL LAW APPLICABLE TO CYBER OPERATIONS r.100 cmts. 6–7 at 437 (Michael N. Schmitt ed., 2017).

73. *Id.*

74. In moral philosophy, “normative uncertainty” suggests that there is uncertainty regarding the moral principles that should be used to reach a decision, even when all of the morally relevant facts are known. *See* WILLIAM MACASKILL, NORMATIVE UNCERTAINTY 2, 5 (2014). In contrast, we use the same term to describe the situation when, even assuming it is clear how a rule applies to an artifact, actor, or activity, it is unclear whether that application serves the normative aims of the rule.

75. Many techlaw scholars have wrestled with variations on this theme. *See, e.g.*, LESSIG, *supra* note 9, at 160–62 (discussing the importance of “presuppositions” to law and how they are influenced by technological development); Kerr, *supra* note 9, at 479–80 (observing that new technologies regularly shift power relations between police and criminal suspects and arguing that Fourth Amendment doctrine can be understood as a judicial attempt to restore a status quo power equilibrium); Surden, *supra* note 9, at 1610–15, 1617–20 (arguing, in the context of privacy law, that physical and technological barriers make certain conduct more or even prohibitively costly, that lawmakers rely on these constraints when drafting law, and that technological change can shift or even eliminate these barriers in ways that result in regime-level ineffectiveness). As Adil Haque observed when discussing these issues in the law of war context, “[n]ew technology may create conflicts between existing legal norms. Importantly, attempts to avoid such conflicts by narrowly interpreting the relevant norms may do more harm than good, creating gaps in the general legal protection enjoyed by civilians and civilian objects in order to avoid a specific legal problem.” Adil Ahmad Haque, *The “Shift Cold” Military Tactic: Finding Room Under International Law*, JUST SECURITY (Feb. 20, 2018), <https://www.justsecurity.org/52713/shift-cold-military-tactic-finding-room-under-international-law/> [<https://perma.cc/N6QY-ZZ77>]. But “[r]ather than *avoid* such conflicts by defining them out of existence, we may have to *resolve* such conflicts. More precisely, we may have to specify the conditions under which one obligation *outweighs* or *takes priority over* competing obligations. In doing so, we may have to look to the purposes and values underlying those obligations — to their underlying moral justification — to determine which obligation should prevail in the specific circumstances.” *Id.*

There is a relationship between application and normative uncertainties, but they operate on different planes. While it is intuitive to associate gaps with underinclusion and overlaps with overinclusion, any application uncertainty may be benign, underinclusive, or overinclusive. For example, an autonomous vehicle may present an overlap uncertainty because it is covered by multiple consumer-protection, cybersecurity, and data-protection laws, yet these regimes may collectively prove underinclusive with respect to privacy. The key distinction is that application uncertainties implicate rule interpretation while normative uncertainties require evaluating whether a rule achieves its purpose.

Of course, whether a rule is perceived as being ineffective necessarily depends on the interpreter's assessment of the law or regime's purpose.⁷⁶ As a result, normative assessments may be inadvertently or opportunistically cloaked by seemingly objective resolutions of application uncertainties. While the questions of whether the law *does* apply and whether the law *should* law apply may seem inextricable,⁷⁷ employing this framework encourages a more honest, separate normative reassessment of the underlying aims of the legal regime in light of systemic changes.⁷⁸

1. Underinclusion

Many laws are narrowly tailored to avoid challenges, to achieve a legislative consensus, or for some other principled or practical reason. Regulators may choose to leave artifacts, actors, or activities that do not present obvious dangers unregulated, either to promote innovation or to avoid squandering limited lawmaking resources.⁷⁹ But when a technological development alters what, who, or how certain technologies are used, the law may fail to cover the full range of activity necessary to accomplish its aims.

76. When presenting different examples of normative uncertainties, we presume possible underlying aims of the related legal regime. We do not necessarily endorse these goals.

77. This concern is especially prominent in the U.S. legal system, where the common law process infuses legal analysis. See, e.g., Karl N. Llewellyn, *Remarks on the Theory of Appellate Decision and the Rules or Canons About How Statutes Are To Be Construed*, 3 VAND. L. REV. 395, 396 (1950) ("The major defect in that system is a mistaken idea which many lawyers have about it — to wit, the idea that the cases themselves and in themselves, plus the correct rules on how to handle cases, provide one single correct answer to a disputed issue of law.").

78. See Eichensehr, *supra* note 9, at 378 (describing each reconsideration of how extant law applies to new technologies as "an action forcing event: It focuses attention, drives debate, and ultimately fosters the careful consideration that can lead to consensus about law moving forward").

79. See, e.g., COHEN, *supra* note 10, at 90–93 (documenting the contemporary understanding of innovation and regulation as forces in opposition).

a. Types of Underinclusion

Relatively tech-specific laws, which regulate a technology rather than the conduct it enables, may become irrelevant with the advent of a newer technology not covered by the law. The Audio Home Recording Act is emblematic: Because the drafters did not anticipate that computers would become a medium for engaging with music, the Act excludes sound recordings saved to a computer hard drive.⁸⁰ This exclusion implicitly exempts MP3 players — devices that copy music to and from a computer's hard drive — rendering the Act a dead letter less than six years after its passage.⁸¹

Similarly, laws drafted to apply only to a specific class of actors may become underinclusive when new entities engage in the regulated activity. Many U.S. privacy laws regulate the use of personal information only when specific types of actors are engaged in that use.⁸² Rather than protect reader privacy in general, laws restrict what libraries or bookstores can do with readers' information;⁸³ rather than protect financial information, laws restrict what "financial institutions" can do with it.⁸⁴ But data aggregators, who obtain the same sorts of information via consumers' internet-browsing activities and app use, are outside the class of regulated parties. As a result, they can collect and use the same sort of information while evading the consumer-rights regulations.⁸⁵

Alternatively, law can become underinclusive when it addresses a particular set of economic or social practices that have been reshaped by technological development. The Stored Communications Act distinguished between unread emails on a server that were more or less than 180 days old; older emails could be accessed with an administrative subpoena, while younger ones required a warrant.⁸⁶ This distinction

80. See David Nimmer, *Codifying Copyright Comprehensibly*, 51 UCLA L. REV. 1233, 1333 (2004) ("[N]o one but a geeky propeller-head would do something as bizarre as to use the instrumentality of a PC to listen to music.").

81. See Recording Indus. Ass'n of Am. v. Diamond Multimedia Sys. Inc., 180 F.3d 1072, 1078–79 (9th Cir. 1999); see also All. of Artists & Recording Cos. v. DENSO Int'l Am., 947 F.3d 849, 864 (D.C. Cir. 2020) (extending this holding to the hard drives in a car's in-vehicle entertainment and navigation system).

82. See BJ Ard, *The Limits of Industry-Specific Privacy Law*, 51 IDAHO L. REV. 607, 608–13 (2015).

83. See Anne Klinefelter, *Library Standards for Privacy: A Model for the Digital World?*, 11 N.C. J.L. & TECH. 553, 562–63 (2010) (collecting laws).

84. See, e.g., Gramm-Leach-Bliley Act, 15 U.S.C. §§ 6801–09.

85. See Ard, *supra* note 82, at 614–16; Clark D. Asay, *Consumer Information Privacy and the Problem(s) of Third-Party Disclosures*, 11 NW. J. TECH. & INTELL. PROP. 321, 340 (2013).

86. 18 U.S.C. § 2703 (2010). This distinction was subsequently eliminated — at least in the Sixth Circuit — in *United States v. Warshak*, 631 F.3d 266, 285–87 (6th Cir. 2010) (finding this provision unconstitutional to the extent it allows the government to obtain emails without a warrant).

may have made sense when it was standard practice to download one's emails to a personal computer and delete them from the server. Now that server-side storage is so cheap, however, most people no longer download or delete most emails, rendering this distinction underinclusive and ineffective from a privacy perspective. Indeed, entire legal regimes may be characterized as underinclusive if they are unable to address a new, technologically enabled source of harm that logically falls within their ambit.⁸⁷

Finally, underinclusive law may manifest as underenforcement, which arises when the costs of detection and enforcement increase.⁸⁸ For example, the diffusion of increasingly private communication technologies — from the telephone to encrypted messaging — has shifted criminal activity to more difficult-to-monitor spaces.⁸⁹ At each transition, law enforcement has argued that these shifts justify more invasive surveillance practices.⁹⁰

b. Underinclusion Issues

Underinclusive law is problematic when it fails to encompass the full range of activity necessary to vindicate the law's purposes. This lack of coverage spurs regulated entities to game the legal system, further undermining the law's effectiveness and legitimacy.⁹¹

Because underinclusive law fails to cover the full range of artifacts, actors, or activities necessary to fulfill the law's purpose, it may motivate parties to shift from the proscribed activity towards a comparable, less-regulated activity. For example, the Fourth Amendment requires search warrants for home searches but not vehicle searches; much policing has accordingly shifted to vehicle stops.⁹² While the original rule may still command widespread compliance, its failure to reach the full range of relevant conduct may nonetheless undermine the purpose of the overarching legal regime. Similarly, Charlie Dunlap has argued that

87. Cf. Samuel Warren & Louis Brandeis, *The Right to Privacy*, 4 HARV. L. REV. 193, 195–200 (1890) (characterizing existing tort law as underinclusive because it did not include a private right of action for privacy harms).

88. See Friedman, *supra* note 10, at 72 (arguing that some “technological advances have made pre-existing [copyright] law unenforceable”).

89. See Kerr, *supra* note 9, at 487.

90. *Id.* at 526–29.

91. Cf. Jane Bambauer & Tal Zarsky, *The Algorithm Game*, 94 NOTRE DAME L. REV. 1, 28 (2018) (exploring the normative consequences of “gaming” an algorithmic decision-making system).

92. Whether this discrepancy raises normative uncertainty depends on one's understanding of the purpose of the warrant requirement. Some might argue that this distinction is sensible, given different expectations of privacy in homes and vehicles; others are concerned about the lack of equivalent due process and privacy protections for vehicles. Thanks to Hannah Bloch-Wehba for this example.

the prohibition on the use of non-lethal chemical weapons in armed conflict — which was intended to further humanitarian aims — has actually “incentivize[d] warfighters to resort to ‘legal’ but more destructive weaponry,” with disastrous humanitarian consequences.⁹³

Indeed, regulations on one kind of technology, actor, or activity can incentivize the development of a non-regulated alternative. This is productive when the alternative avoids the harm the regulation was intended to avert. But it can also take the form of “avoision,”⁹⁴ or what Dan Burk terms “perverse innovation” — technological creations that “provide a technical work-around to ingeniously dodge the intended outcome of regulation, while still formally adhering to the text of the regulation.”⁹⁵ A recent example of this practice was the technology at issue in *American Broadcasting Cos., Inc. v. Aereo, Inc.*, where the defendant devised an entirely new broadcasting system in an attempt to exploit a perceived loophole in copyright law.⁹⁶ Similarly, entities may create new business configurations to avoid regulation: Room-sharing companies like AirBnB argue that laws governing hotels should not apply to them. To the extent the evaded regulations are intended to protect consumers, these new business arrangements threaten the legal regimes’ effectiveness.

2. Overinclusion

While many laws are unproblematically or even intentionally over-inclusive, technological developments can also render a rule problematically overinclusive with respect to the artifacts, actors, or activities it governs. In the paradigmatic scenario, a law restricts socially valuable conduct even though tech-fostered changes have made such restrictions unnecessary. Alternatively, an overinclusive law may be so mismatched to a new context that legal actors may refuse to enforce it (and thereby render it obsolete) or take advantage of newly discretionary enforcement options. The end result — a rule that officially has force, but that creates unnecessary compliance costs and is enforced arbitrarily or not at all — hampers progress and undermines the rule of law.

93. Charlie Dunlap, *A Better Way to Protect Civilians and Combatants Than Weapons Bans: Strict Adherence to the Core Principles of the Law of War*, LAWFIRE (Dec. 3, 2015), <https://sites.duke.edu/lawfire/2015/12/03/a-better-way-to-protect-civilians-and-combatants-than-weapons-bans-strict-adherence-to-the-core-principles-of-the-law-of-war-2/> [<https://perma.cc/B66B-AF8T>].

94. LEO KATZ, ILL-GOTTEN GAINS: EVASION, BLACKMAIL, FRAUD, AND KINDRED PUZZLES OF THE LAW 4 (1996) (noting that regulated entities may engage in “avoision” — evasion and avoidance).

95. Dan L. Burk, *Perverse Innovation*, 58 WM. & MARY L. REV. 1, 5 (2016) (discussing why innovation that exploits legal loopholes may nonetheless be socially beneficial).

96. *Am. Broad. Cos. v. Aereo, Inc.*, 573 U.S. 431 (2014).

a. Types of Overinclusion

A law that regulates certain activities may become overinclusive if later technological developments eliminate that action's harms or change the nature of the risk. The conflict between net neutrality and zero rating is instructive. Net neutrality laws were drafted to safeguard consumer welfare, innovation, and democratic participation by prohibiting internet service providers from engaging in discriminatory practices like blocking or charging higher rates for disfavored sites or providing faster downloads and lower prices for favored sites.⁹⁷ Some jurisdictions have held that these laws also prohibit a practice called "zero rating," where mobile providers have partnered with organizations like the Wikimedia Foundation and Facebook to waive data charges for select websites; this practice has been particularly impactful in providing free internet access to poorer communities who could not otherwise afford to pay for data.⁹⁸ While there are several ways zero rating might be abused, it also has the potential to enhance users' interests and autonomy;⁹⁹ given this, a net neutrality law that interfered with user autonomy would be overinclusive because it would undercut net neutrality's goals.

Law may also become overinclusive when a technological development enables a wider range of actors to engage in the regulated activity. Take the expansion of copyright law to cover an increasing array of consumer activities. When the current regime was crafted in 1976, it was designed to regulate established industry actors as well as bootleggers who intentionally engaged in wide-scale piracy; its technical complexity and steep penalties were roughly calibrated to the sophistication, means, and culpability of the parties.¹⁰⁰ With the subsequent introduction of technologies like the personal computer, the VCR, and more recent digital distribution platforms, individual consumers suddenly found themselves within the law's ambit.¹⁰¹ Many

97. See BJ Ard, *Beyond Neutrality: How Zero Rating Can (Sometimes) Advance User Choice, Innovation, and Democratic Participation*, 75 MD. L. REV. 984, 987–88, 1002 (2016); Arturo J. Carrillo, *Having Your Cake and Eating It Too? Zero-Rating, Net Neutrality, and International Law*, 19 STAN. TECH. L. REV. 364, 399, 401–02 (2016).

98. Ard, *supra* note 97, at 990–91 (documenting the launch of "Facebook Zero" in 2010 and "Wikipedia Zero" in 2012); Carrillo, *supra* note 97, at 399–400 (documenting enforcement in Chile).

99. Ard, *supra* note 97, at 985–88.

100. See JESSICA LITMAN, *DIGITAL COPYRIGHT* 19, 73–74 (2006).

101. *Id.* at 111 ("The threat and promise of networked digital technology is that every individual with access to a computer will be able to perform the twenty-first-century equivalent of printing, reprinting, publishing, and vending.").

question whether holding consumers to the standards originally written for other actors goes too far.¹⁰²

Perhaps counterintuitively, tech-specific laws — those that regulate particular technologies rather than activities or their consequences¹⁰³ — can also become overinclusive. A law that focuses on regulating a device, rather than the harms associated with it, may prove unnecessarily burdensome if later iterations of the regulated technology no longer present the same harms. Many automobile-safety laws, for example, aim to counteract the risk or consequences of human failings by imposing universal obligations in the design or operation of automobiles. Brakes and other control mechanisms must be located within reach of the driver;¹⁰⁴ commercial trucks must stop for at least ten hours per day so the driver can rest.¹⁰⁵ These requirements may be ill-suited for autonomous vehicles, which purport to minimize the risk of human error by minimizing human agency.¹⁰⁶ Indeed, even if autonomous vehicles ever became safer than the human-driven ones for which these regulations were designed, outstanding regulatory hurdles might delay their introduction.¹⁰⁷

Entire legal regimes may also be rendered overinclusive by technological developments. In early tort litigation, proving causation was the main bar to recovery. But with the Industrial Revolution came a proliferation of machines with “a marvelous capacity for smashing the human body,”¹⁰⁸ which in turn created “an accident crisis like none the world had ever seen.”¹⁰⁹ In response to an influx of cases that obviously

102. See, e.g., *id.* at 114–15; BJ Ard, *Notice and Remedies in Copyright Licensing*, 80 MO. L. REV. 313, 368 (2015) (“[C]opyright’s damages cap of \$150,000 exceeds the median value of a home in many parts of the country.”).

103. See *infra* Section IV.C.3.

104. See Philip E. Ross, *A Google Car Can Qualify as a Legal Driver*, IEEE Spectrum (Feb. 10, 2016), 1–2, <https://spectrum.ieee.org/cars-that-think/transportation/self-driving/an-ai-can-legally-be-defined-as-a-cars-driver> [<https://perma.cc/9TV6-SGL5>].

105. 49 C.F.R. pt. 395 (2013).

106. The legal regime governing autonomous vehicles may simultaneously be underinclusive, insofar as it might not incorporate sufficient safety requirements to account for new risks, such as those associated with human/machine interface design. See Samuel D. Adkisson, *System-Level Standards: Driverless Cars and the Future of Regulatory Design*, 40 U. HAW. L. REV. 1, 27–29 (2018).

107. See *id.* (describing the costs and uncertainty involved in requesting exemptions from NHTSA regulations).

Of course, it might be possible for the new manifestations of a technology to sidestep this issue entirely by disclaiming similarity with the earlier, regulated form. Autonomous vehicles makers might argue that these are not “vehicles” within the terms of the extant statutes. Depending on the specificity of the extant law and the similarity of the newer technology, this strategy will not always succeed.

108. See LAWRENCE M. FRIEDMAN, *A HISTORY OF AMERICAN LAW* 467 (2d ed. 1985).

109. John Fabian Witt, *Toward a New History of American Accident Law: Classical Tort Law and the Cooperative First-Party Insurance Movement*, 114 HARV. L. REV. 690, 694 (2001).

met the causation requirement and threatened to overwhelm the courts, and possibly in the interest of protecting fledgling industries perceived as vital to national development, courts raised the bar.¹¹⁰ Instead of simply having to prove that the defendant had caused an injury, tort plaintiffs now needed to establish that defendants failed to act with reasonable care.¹¹¹ In response to perceived overinclusion, strict liability gave way to a negligence regime.

Finally, should enforcement become cheaper or easier, overinclusion may also manifest as socially undesirable overenforcement, discussed further below.

b. Overinclusion Issues

As with underinclusive laws, overinclusive laws may have problematic first- and second-order effects. First, the social cost of complying with an overinclusive law may not be justified. This will sometimes manifest as a direct, tangible expense, such as the economic cost of observing unnecessary safety regulations. But this also encompasses broader, second-order social costs, like the fact that these added expenses may deter a manufacturer from producing socially valuable goods. Ideally, laws are tailored to capture the benefits of technology and minimize its social costs, but technological developments may transform even the best-crafted rule into problematically overinclusive law.

Overinclusive laws also enable unintended overenforcement. For example, the proliferation of internet-connected devices has enabled a new level of corporate surveillance and an unprecedented ability to enforce end-user licenses and terms of service.¹¹² Companies have always been able to learn about their consumers from their actions, but now they are able to identify violations of previously underenforced or unenforceable provisions in real time.¹¹³ Even should those with the ability to enforce an overinclusive law elect not to do so, they will have

110. See FRIEDMAN, *supra* note 108, at 468 (suggesting that judges recognized a need to protect new industries, like factories, mines, and railroads); MORTON J. HORWITZ, *THE TRANSFORMATION OF AMERICAN LAW, 1780–1860*, at 99–100 (1977) (same).

111. See Donald G. Gifford, *Technological Triggers to Tort Revolutions: Steam Locomotives, Autonomous Vehicles, and Accident Compensation*, 11 J. TORT L. 71, 76–77 (2018) (concluding that the development of the negligence regime can be explained by “technology in and of itself” and resulting factors, including “the increased severity of injuries resulting from the proliferation of new machinery”).

112. Crotoft, *supra* note 67, at 596–600.

113. *Id.* (discussing how vehicle rental and leasing companies now use GPS trackers to determine if cars are driven outside proscribed boundaries).

gained valuable discretionary powers that they may exercise in self-serving, discriminatory, or otherwise problematic ways.¹¹⁴

When the wider public views an overinclusive law as unfair, it may also foster noncompliance and discretionary underenforcement. As noted above, advances in home-copying technologies have expanded copyright law to encompass both its customary regulation of industry actors and the activities of everyday consumers.¹¹⁵ A consumer who purchases a hardcopy book has the right to read it, sell it, or lend it to a friend.¹¹⁶ Not so with an e-book, where the act of transferring the book or merely reading it may constitute prohibited “copying.”¹¹⁷ The perceived overreaching of the copyright industries — who have leveraged their rights to restrict the use of digital works like e-books, MP3s, and video games — has prompted consumers to question the legitimacy of the copyright regime and reduced their willingness to comply with it.¹¹⁸ For similar reasons, enforcers may be reluctant to apply the full letter of a seemingly unfair law.¹¹⁹ As noncompliance and discretionary underenforcement erode a law’s perceived legitimacy, overinclusive law may undermine the rule of law more generally.¹²⁰

Granted, there are situations where expansive rules best accomplish the legal regimes’ aims. Bans, for example, are often intentionally broad. Rather than attempting to create a law that can evolve in tandem with social shifts, a society enacts a ban when it has determined that there is reason to permanently mark a particular technology or activity as verboten.¹²¹ At the international level, treaties and customary inter-

114. Cf. Sarah A. Seo, *How Cars Transformed Policing*, BOS. REV. (June 3, 2019), <http://bostonreview.net/law-justice/sarah-seo-how-cars-transformed-policing> [<https://perma.cc/K4X7-M2CN>] (arguing that automobiles contributed to the expansion of police officers’ discretionary power, enabling discriminatory enforcement).

115. See *supra* notes 100–102 and accompanying text.

116. See Jessica D. Litman, *Real Copyright Reform*, 96 IOWA L. REV. 1, 14 (“Throughout the nineteenth and twentieth centuries, the idea that copyright law constrained how readers may read books, how listeners may listen to music, or how viewers could watch television programming would have been seen as a radical expansion.”).

117. Ard, *supra* note 102, at 322 (“Whenever a user runs software, reads an e-book, or listens to an MP3, her computer copies some part of the work into its working memory.”).

118. Litman, *supra* note 116, at 15–16.

119. Dan Kahan, *Gentle Nudges vs. Hard Shoves: Solving the Sticky Norms Problem*, 67 U. CHI. L. REV. 607, 608 (2000) (arguing that governmental actors may not apply laws that conflict with social norms if penalties are perceived as unduly severe).

120. This is particularly damaging in the international law context: by implicitly fostering noncompliance and underenforcement, obsolescent and obsolete rules risk bolstering the misconception that international law somehow isn’t really law. Rebecca Crootof, *Jurisprudential Space Junk*, in *RESOLVING CONFLICTS IN THE LAW: ESSAYS IN HONOUR OF LEA BRILMAYER* 106, 107–09 (Chiara Giorgetti & Natalie Klein eds., 2019) (discussing the issues with “laws on the books that are theoretically in force but actually simply clutter and confuse the relevant legal regime”).

121. See *id.* at 114–18 (discussing international bans).

national humanitarian law ban the use of weapons that cause “superfluous injury or suffering.”¹²² This broad rule disincentivizes states from investing in developing weapons that might risk being classified as causing needless pain. Additionally, the fact that a law is on the books but never enforced does not necessarily indicate a problem. A law banning the use of lead paint in homebuilding might have 100% compliance, but this would be an indicator of success rather than redundancy, and the law would remain necessary to steer paint manufacturers and contractors away from the hazardous product despite the temptation of its lower price. Still, even a ban is subject to becoming problematically overinclusive should later technological developments or social shifts alter its foundational assumptions.

3. Evolving Aims

Normative uncertainties prompt questions regarding how best to achieve a law or legal regime’s primary purpose, which may in turn encourage a rearticulation or even a reconsideration of what that purpose should be.

Sometimes the purpose remains constant, but the problem manifests in an unexpected way. For example, Lina Khan argues that antitrust law is now ill-suited to regulate modern, platform-enabled monopolies like Amazon.¹²³ Traditionally, antitrust law was presumed to outlaw monopolistic business practices in order to prevent monopolies from harming consumers by charging outrageous prices.¹²⁴ Accordingly, the touchstone of antitrust analysis was the impact of any given business practice on price. As Khan explains, Amazon has largely evaded antitrust regulation because it drives down prices for consumers, even while it engages in predatory pricing strategies, industry domination, and limits consumer choice.¹²⁵ Technological developments have showcased antitrust law’s underinclusiveness — that it does not cover the full range of anti-competitive behavior that ultimately harms consumers.

Sometimes the popular understanding of a law’s main aim evolves. The shift from strict liability to a negligence regime for accidents is a

122. Rule 70. WEAPONS OF A NATURE TO CAUSE SUPERFLUOUS INJURY OR UNNECESSARY SUFFERING, INT’L COMMITTEE RED CROSS, http://www.icrc.org/customary-ihl/eng/docs/v1_rul_rule70 [<https://perma.cc/82XB-97B4>] (noting that this customary prohibition has been reiterated in numerous treaties and states’ domestic policies).

123. Lina M. Khan, Note, *Amazon’s Antitrust Paradox*, 126 YALE L.J. 710 (2016).

124. See generally ROBERT H. BORK, *THE ANTITRUST PARADOX: A POLICY AT WAR WITH ITSELF* (1978) (identifying antitrust law’s objective as maximizing consumer welfare through lowering prices); but see WILLIAM N. ESKRIDGE & JOHN FEREJOHN, *A REPUBLIC OF STATUTES* 126–27 (2010) (critiquing this analysis).

125. Khan, *supra* note 123, at 716–17.

story of a legal response to perceived overinclusiveness, as U.S. tort law began to prioritize protecting industries over ensuring victim compensation.¹²⁶ The 1960s product liability revolution — itself spurred by the rise of mass manufacturing¹²⁷ — was a reactionary expansion of industry liability in response to the perceived underinclusiveness of the contracted regime.¹²⁸

Of course, assessments of whether a law or legal regime is ineffective will depend on who is conducting the assessment and what they believe the regime's underlying purpose is or should be. Today, advocates for fairness in algorithms are wrestling with what that term requires.¹²⁹ Should, say, facial recognition technologies be equally accurate for all demographics within a population?¹³⁰ Or is there something fundamentally unfair about the way facial recognition empowers some entities and disadvantages others that weighs against permitting its use at all?¹³¹

* * * * *

Ultimately, successful resolutions of both application and normative uncertainties are contingent on having a regulatory regime and institutions that can evaluate, enact, and enforce preferable responses. But how can we determine which entity is best able to do so?

D. Institutional Uncertainties

All laws are grounded on assumptions about the state of the world; when a technological development complicates or upends those assumptions, legal actors must evaluate whether and how laws still apply. Institutional uncertainties exist when there are questions about the adequacy and effectiveness of regulatory entities, either singly or in combination, to respond to these application and normative uncertainties. Instead of the substantive legal issues raised by application or normative uncertainties, these uncertainties raise institutional design issues that are simultaneously descriptive and normative: Do the legal actors

126. See *supra* notes 108–111 and accompanying text.

127. *Escola v. Coca Cola Bottling Co.*, 150 P.2d 436, 443 (Cal. 1944) (Traynor, J., concurring).

128. *Greenman v. Yuba Power Prods., Inc.*, 377 P.2d 897, 902 (Cal. 1963). Products liability law has since continued to evolve, mostly in ways that again contract industry liability. See, e.g., James A. Henderson, Jr. & Theodore Eisenberg, *The Quiet Revolution in Products Liability: An Empirical Study of Legal Change*, 37 UCLA L. REV. 479, 481 (1990) (identifying changes in products liability decisions favoring defendants).

129. Pasquale, *supra* note 19.

130. *Id.*

131. *Id.*

possess the authority, competence, and legitimacy to resolve the application and normative uncertainties before them? How should questions arising from overlapping institutional jurisdictions be addressed? When is a new institution needed?

One type of institutional uncertainty arises when no existing individual or combination of institutions appears to have the authority, competency, or legitimacy to govern certain artifacts, actors, or activities. The perceived inadequacies of extant institutions may prompt calls for a different regulator — or an entirely new form of regulation. Railroad governance provides an early but instructive example. In the late 1800s, the U.S. Congress faced mounting pressure from the public and the railroads themselves to do something about the railroad industry's perceived unfair competition and unfair business practices.¹³² Congress wanted to regulate shipping rates, but it lacked the economic expertise or ongoing monitoring capabilities to set the correct prices.¹³³ It considered creating a new cause of action for unfair rate-setting but questioned whether generalist courts acting in a case-by-case fashion would have either the competence or the speed to effectively respond to industry practices.¹³⁴ Ultimately, Congress tackled the problem by creating a new regulatory institution — the Interstate Commerce Committee — that was designed to possess the expertise, monitoring capabilities, and capacity for timely action.¹³⁵

Institutional uncertainties may also exist when multiple institutions' regulatory jurisdictions overlap, and it is unclear which has priority in resolving application and normative uncertainties. Often there is no single institution with regulatory control over a particular artifact, actor, or activity; instead, many different entities regulate different aspects, manifestations, or externalities. For example, in the United States, the internet is regulated by "multiple bodies with unique configurations [that] set Internet policy at a technical and civil level," which some have argued is the internet's most interesting public legacy.¹³⁶ While this may create a more comprehensive regulatory mesh, the re-

132. Robert L. Rabin, *Federal Regulation in Historical Perspective*, 38 STAN. L. REV. 1189, 1199 (1986).

133. *Id.* at 1194.

134. Compare H.R. REP. NO. 47-1399, pt. 1, at 2-3 (1882) (arguing for the establishment of a commission rather than a judicially enforceable rule), with H.R. REP. NO. 47-1399, pt. 2, at 4-5 (1882) (arguing the problem could be solved more simply through a judicially enforceable rule against "discrimination" in rates and charges).

135. See Interstate Commerce Act of 1887, 24 Stat. 379 (1887).

136. Calo, *Lessons of Cyberlaw*, *supra* note 2, at 557 (citing DAVID G. POST, IN SEARCH OF JEFFERSON'S MOOSE: NOTES ON THE STATE OF CYBERSPACE 128-29 (2009); A. Michael Froomkin, *Habermas@Discourse.net: Toward a Critical Theory of Cyberspace*, 116 HARV. L. REV. 749, 856 (2003)).

sulting regulatory landscape may also become too complex for regulated entities to navigate. U.S. administrative agencies are particularly prone to these issues, insofar as ones with different missions often regulate the same subjects, leading to the expansion of an already dense and confusing regulatory thicket.¹³⁷ This “alphabet soup” problem is exacerbated by technological convergence, where innovations combine once-separate items.¹³⁸ Take the humble John Deere tractor: This six-ton piece of software is subject to potentially conflicting regulations from upwards of ten separate agencies.¹³⁹

Technological development may indirectly foster institutional uncertainties by “disrupt[ing] the ideas and justifications offered in support of regulatory intervention.”¹⁴⁰ For example, spurred by an increasing awareness of innovation’s negative externalities, academic arguments for regulatory intervention have shifted focus from a need to respond to market failure to a need to manage risk.¹⁴¹ This tracks a shifting regulatory system that includes more diverse actors (including industry, non-governmental institutions, and civil society organizations) and is better able to grapple with the “multiplicity of societal interests and values” beyond market efficiency.¹⁴²

In contrast to application and normative uncertainties, which can be resolved through some combination of law by analogy or the explicit modification or creation of new rules, institutional uncertainties require a more complex and searching inquiry into the strengths and limitations of different institutional actors and how they function together within a legal system. Accordingly, while institutional uncertainties are a co-equal type of legal uncertainty, we discuss them more fully in a separate paper.¹⁴³

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137. See, e.g., Ohm & Reid, *supra* note 2, at 1674 (noting that, as code is incorporated in more and more devices, “agencies will run headlong into new conflicts with other agencies and with newly uncovered jurisdictional overlaps involving software, thus surfacing unresolved tensions and competing policy priorities”).

138. See *id.* at 1698 (noting, in discussing agency conflicts that might arise in the IoT context, that “[i]nterests in sound cybersecurity policy will run headlong into copyright concerns, interests in patient autonomy into health and safety concerns, and interests in repair and tinkering into environmental and safety concerns”).

139. These vehicles arguably are subject to regulation from the Department of Agriculture, the Department of Commerce, the Department of Transportation, the Environmental Protection Agency, the Consumer Product Safety Agency, the Department of Labor, the Federal Trade Commission, the Department of Energy, the Federal Communications Commission and even the National Security Agency. See *id.* at 1684–86 (documenting the range of agencies with a stake in regulating vehicle software).

140. Brownsword, Scotford & Yeung, *supra* note 8, at 9.

141. *Id.*

142. *Id.*

143. Ard & Crootof, *supra* note 12.

It is tempting to move directly from identifying application, normative, and institutional uncertainties to discussing means of resolving them. There is, however, an often-ignored intermediate step: determining the appropriate regulatory approach.

III. APPROACHES TO LEGAL UNCERTAINTIES

The legal regime within which a tech-fostered legal uncertainty arises and the legal actors charged with resolving that uncertainty will both have underlying assumptions about how best to regulate technological development. For both practical and normative reasons, the common default is the *permissive approach*, which adopts a presumption against enacting new regulation unless and until specific harms have been identified as sufficiently likely and serious. However, the risks associated with a technology are sometimes so probable, significant, or irreversible that a more cautious, *precautionary approach* is preferable. This might take the form of a presumptive ban on a class of technologies or a moratorium on their use until they meet some predetermined standard.¹⁴⁴

Lawmakers are always regulating with incomplete information about the future, but our awareness of the speed and diverse consequences of technological development raises the stakes. Both the permissive and precautionary approaches attempt to reconcile the normative goals of promoting innovation, managing risk, and regulating efficiently in the face of this uncertainty.¹⁴⁵ And both approaches assume — perhaps over-confidently — that regulation can mitigate or even eliminate the harms associated with a technology.

The approaches differ on whether and when we should regulate, ranging from the more *laissez-faire*, permissive approach to a more proactive, precautionary approach. Accordingly, they tend to correspond with different baseline attitudes towards technological development. The permissive approach aligns with a tech-optimist, we-can-fix-it-if-needed attitude; the precautionary approach often reflects a more tech-pessimist, better-safe-than-sorry mindset. Of course, a legal actor's

144. Some might reject this framing and suggest that regulators should adopt a purportedly neutral approach, such as cost-benefit analysis, rather than a presumption for or against regulation. See, e.g., Robert W. Hahn & Cass R. Sunstein, *The Precautionary Principle as a Basis for Decision Making*, 2 *ECONOMISTS' VOICE* 1, 5 (2005). But cost-benefit analysis does not solve the problem. Such analysis takes time, and legal actors must choose whether and how to regulate the technology while the analysis is pending. The implicit upshot of such a proposal — that there should be no regulation until the analysis is complete — is an endorsement of the permissive approach.

145. In contrast with the legal uncertainties raised by technological developments, see *supra* Part II, the concern here is factual uncertainty regarding a technology's direct and indirect effects.

stance may shift from technology to technology,¹⁴⁶ possibly due to assumptions about its intended market or usage: one might feel sanguine about autonomous vehicles and terrified by autonomous weapon systems, or vice versa. But all too often, the selection of an approach occurs at a subconscious — and therefore unconsidered — level, rather than resulting from a realistic assessment of actual risks and the preferable allocation of regulatory burdens.¹⁴⁷

While the selection of a permissive or precautionary approach is often made unthinkingly, it has lasting effects that should be explicitly weighed. Not only will the selected approach influence which response is chosen and how it is employed, it will also create second-order distributive consequences and affect the bounded opportunity to reassess and shift initial regulatory decisions.¹⁴⁸

By providing a methodological structure that asks legal actors to consciously identify the most appropriate stance, our framework encourages lawmakers to better evaluate the tradeoffs associated with relatively permissive and precautionary approaches and make more thoughtful use of this opportunity to steer the development of the law.

A. The Permissive Approach

Just as the ultimate risks of a technology are unknown, so too are its prospective benefits. The permissive approach would delay regulation so as to discover and capture these benefits, addressing harms only as they became apparent. This strategy is apparent in the laissez-faire U.S. regulation of e-commerce, software, and online content, which has allowed platforms to proliferate.¹⁴⁹ Sometimes, the permissive approach may go one step further by directly or indirectly encouraging experimentation. For example, the U.S. Congress paved the way for today's online environment by limiting liability for online service providers who hosted libelous or copyright-infringing content posted by users.¹⁵⁰

Proponents of this wait-and-see approach argue that background, tech-neutral regulatory regimes will handle most issues and that further

146. One might take a permissive approach towards autonomous vehicles and a precautionary approach towards autonomous weapon systems, another the opposite stance on both.

147. Cass R. Sunstein, *The Paralyzing Principle*, REGULATION, Winter 2002-2003, at 35–36 (documenting behavioral biases that may skew regulators' or constituents' perspectives).

148. See *supra* notes 22–23 and accompanying text.

149. See ANUPAM CHANDER, *THE NEW SILK ROAD: HOW THE WEB BINDS THE WORLD TOGETHER IN COMMERCE* 57 (2013) (discussing this permissive legal framework); Calo, *Lessons of Cyberlaw*, *supra* note 2, at 533 (discussing U.S. software regulation).

150. Telecommunications Act of 1996 § 509, 47 U.S.C. § 230; Digital Millennium Copyright Act of 1998 § 202, 17 U.S.C. § 512.

regulation may stifle innovation.¹⁵¹ They presume that, to the extent any tech-specific harms emerge, those harms can be corrected at a later date. By adopting this approach, lawmakers can avoid dedicating precious economic, temporal, or political resources to regulations that might prove superfluous or even risk stifling innovation. In the late 1960s and 1970s, international law commentators anticipated the imminent development of weather modification technologies, and some proposed establishing entirely new international weather modification legal regimes.¹⁵² But these technologies never materialized. Not only would the proposed regimes have been unnecessary, constructing them would also have entailed significant political opportunity costs. Arguably, the permissive approach also enables lawmakers to gather relevant information before acting. If there is a need to regulate after an initial period of forbearance, the resulting rules may be better informed as a result of studying the technology's real-world impact.

But the permissive approach implicates several regulatory timing issues. One standard critique is that it fails to account for unanticipated injurious side effects with long latency periods or irreversible effects, as well as the practical difficulties of redressing unquantifiable harms.¹⁵³ There is also a deeper problem. While delay may lead to rules that are better tailored to the actual harms of any given technology, it does not necessarily result in rules that are more effective. The efficacy of any legal response to technologically created uncertainty is partially a product of its timing.¹⁵⁴ Substantively, a rule enacted later in time will likely be better informed, as the challenges and opportunities of a newer technology are likely to grow more apparent as it enters wider use. Yet delay may blunt the impact of the regulation or even render regulation impossible, if the technological design or use has already stabilized or if significant users have invested in the infrastructure.¹⁵⁵ The more time passes, the more likely it is that the technology's design or uses will become entrenched and therefore resistant to regulation. For example, a lack of cybersecurity regulations means that many internet-connected

151. Innovation scholars tend to agree that the elimination of barriers increases the diversity and quality of inventive activity. *See, e.g.*, BARBARA VAN SCHEWICK, *INTERNET ARCHITECTURE AND INNOVATION* 348 (2012). The major debate is over which barriers are most relevant: one camp paints regulation or other interference by the state as the main obstacle, while the other points to monopolistic business practices and similar excesses of private power.

152. Picker, *supra* note 9, at 187.

153. *See, e.g.*, LATE LESSONS FROM EARLY WARNINGS: THE PRECAUTIONARY PRINCIPLE 1896–2000, at 3 (David Gee et al. eds., 2001) (“That we have all acted too late in many areas is now well known . . . The hazards of [chlorofluorocarbons, synthetic chemicals, and asbestos] were not ‘known about’ until it was too late to stop irreversible impacts.”).

154. A rule's design and content will also affect its ability to dynamically adjust to new scenarios. *See infra* Section IV.C.

155. *See* Bernstein, *supra* note 9, at 924–26.

home appliances, voting machines, and satellites are now vulnerable to hacking.¹⁵⁶ However, because households, states, and countries remain unwilling to spend the money to overhaul these varied systems, we must continue living with these known vulnerabilities for the foreseeable future. Looking forward, some are concerned that background rules will not sufficiently address the growing threats to privacy and civil rights raised by facial recognition technologies.¹⁵⁷ Absent an immediate ban, they fear we may “grow so dependent on [facial recognition] that we accept its inevitable harms as necessary for ‘progress.’”¹⁵⁸

Further, the permissive approach effectively adopts a presumption against regulation. This places the burden of rebutting that presumption on those who would suffer harm from the use or proliferation of a given technology, which implicates both public choice theory and political economy concerns.¹⁵⁹

When the harms associated with the use of the technology fall on the general public, they give rise to a collective action problem.¹⁶⁰ In scenarios where the public at large bears the social costs of the technology, public-choice theory predicts that it will have difficulty mobilizing in favor of regulation.¹⁶¹ Moreover, when the benefits of the technology flow to a concentrated interest group — say, the state that uses it to centralize control or the industries that profit from its use — public-choice theory also predicts that these interests will mount coordinated opposition.¹⁶² This combination of factors leads to a systematic bias against regulation even in scenarios where the harm of the technology is apparent or widespread. The protracted campaign to eliminate lead from gasoline illustrates the point. Health risks to the general public

156. See, e.g., William Akoto, *We Need to Improve Cybersecurity Standards in Space*, SCIENCEWIRE (Feb. 27, 2020), <https://science.thewire.in/space/we-need-to-improve-cybersecurity-standards-in-space/> [<https://perma.cc/S5NJ-QNHJ>].

157. See generally Evan Selinger & Woodrow Hartzog, *The Inconsistency of Facial Surveillance*, 66 LOYOLA L. REV. 101 (2019).

158. Evan Selinger & Woodrow Hartzog, *What Happens When Employers Can Read Your Facial Expressions?*, N.Y. TIMES OP. (Oct. 17, 2019), <https://www.nytimes.com/2019/10/17/opinion/facial-recognition-ban.html> [<https://perma.cc/F99L-ZXGH>].

159. Noah M. Sachs, *Rescuing the Strong Precautionary Principle from Its Critics*, 2011 U. ILL. L. REV. 1285, 1288 (2011).

160. See Daniel A. Farber & Philip P. Frickey, *The Jurisprudence of Public Choice*, 65 TEX. L. REV. 873, 886 n.72. (1987). These difficulties in organization arise because the individual stakes of each member of the public are too small to motivate most people to act; when the costs (or benefits) of using a particular technology fall on a concentrated interest group, the individual stakes for members of that group are higher and they are more likely to organize. See *id.*

161. *Id.*

162. *Id.*

were recognized as early as the 1920s, but industry lobbyists successfully opposed regulation for over 50 years.¹⁶³ The opposition's tactics — especially their obfuscation of data regarding the extent of the caused harm — have since been widely emulated by other industries.¹⁶⁴

Power relations are also at play. When the harm falls on a less powerful group, such as the privacy harms implicit in requiring accused felons to wear ankle GPS monitors, it is less likely to be redressed.¹⁶⁵ Meanwhile, entities with more power are generally better able to mobilize a response. Consider the swiftness with which U.S. lawmakers moved to regulate deepfakes — artificially generated video — which are expected to be used to discredit politicians. Roughly a year after they entered the public consciousness, Congress passed a self-protective law requiring the Director of National Intelligence to notify the Congressional Intelligence Committees any time there is credible intelligence that a foreign entity has or is deploying deepfakes “aimed at the elections or domestic political processes of the United States.”¹⁶⁶ Accordingly, the permissive approach often reinforces pre-existing power disparities.

As a practical matter, the permissive approach is the presumptive response to most technological developments. There are simply too many incremental innovations for lawmakers to evaluate or act on each of them individually without stalling technological development. Many new technologies will be adequately governed by existing law, as well as other modalities of regulation, such as norms and the market. However, sometimes the risks associated with a new technology are so obvious, significant, or irreversible that a more proactive approach is preferable.

163. See, e.g., Jerome O. Nriagu, *Clair Patterson and Robert Kehoe's Paradigm of "Show Me the Data" on Environmental Lead Poisoning*, ENV'T. RES., Aug. 1998, at 71 (documenting the lead industry's successful deployment of a “cascading uncertainty rule” with a “highly skewed cost-benefit concept”). See generally GERALD MARKOWITZ & DAVID ROSNER, *LEAD WARS: THE POLITICS OF SCIENCE AND THE FATE OF AMERICA'S CHILDREN* (2013) (documenting the ongoing political battle across the twentieth century).

164. See, e.g., Sheera Frenkel, Nicholas Confessore, Cecilia Kang, Matthew Rosenberg & Jack Nicas, *Delay, Deny & Deflect: How Facebook's Leaders Fought Through Crisis*, N.Y. TIMES (Nov. 14, 2018) (documenting Facebook's efforts to cover up and deflect blame for security breaches in connection with Cambridge Analytica and the Trump 2016 presidential campaign).

165. See, e.g., Andrea Woods & Jared Keenan, *An Arizona Law Requires Surveillance of People Who Are Presumed Innocent*, ACLU (Aug. 21, 2019), <https://www.aclu.org/blog/privacy-technology/surveillance-technologies/arizona-law-requires-surveillance-people-who-are> [<https://perma.cc/P5JQ-7S97>].

166. National Defense Authorization Act for Fiscal Year 2020 § 5709 (2019).

B. The Precautionary Approach

Criticism of the permissive, wait-and-see approach has coalesced around the “precautionary principle.” Precautionary proponents favor preemptive restrictions over certain classes of new technologies. Again, the selection of a presumption will have critical implications for who bears the burden of arguing for a rule change; here, however, the presumption favors some form of *ex ante* regulation.

Unfortunately, this debate has been muddled by a lack of consensus around what the precautionary principle actually requires. In its weakest form, it merely suggests that a lack of scientific certainty regarding harms cannot be a justification for postponing regulation aimed at mitigating those harms.¹⁶⁷ The strongest version would ban technologies entirely until their safety is firmly established.¹⁶⁸ Alternatively, some describe the precautionary principle as a procedural tool — namely, as a burden-shifting presumption — that favors regulatory restrictions on technologies until proponents justify lifting those restrictions.¹⁶⁹

In the interest of sidestepping the definitional debates surrounding the appropriate characterization of the precautionary principle, we focus instead on describing the precautionary *approach*: a pro-regulation stance that a legal actor may adopt when considering how best to resolve a tech-fostered legal uncertainty. It might be effectuated through a complete ban, a moratorium, or an added burden on permitting the use of a technology, such as a requirement that the proponent demonstrate that the technology’s benefits outweigh its risks or that it meets predetermined safety standards.¹⁷⁰ For example, the U.S. Food and Drug Administration takes a precautionary approach with regard to new drugs: a company must produce evidence that a new drug is safe before it is cleared for marketing.¹⁷¹

167. For example, the Rio Declaration states: “In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” United Nations Conference on Environment and Development, Rio de Janeiro, Braz., June 3–14, 1992, *The Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/5/Rev.1 (June 13, 1992), reprinted in 31 I.L.M. 874, 879 (1992).

168. Sunstein, *supra* note 147, at 33.

169. Sachs, *supra* note 159, at 1288.

170. *Id.* at 1313. Even though a rule may impose a presumptive ban or moratorium, it can be crafted to allow exceptions in circumstances where the risk of not acting exceeds an acceptable threshold. *Id.* at 1323 (“There are numerous examples of permitting, licensing, and preapproval statutes that implement a default prohibition on a certain targeted activity, yet also contain procedures to address known countervailing risks of the prohibition.”); *see also infra* Section IV.C.

171. The 1962 Kefauver-Harris Amendments increased the FDA’s pre-market authority, requiring companies to provide “substantial” evidence of a drug’s safety before it could be cleared for the market. Richard A. Merrill, *The Architecture of Government Regulation of*

There is an obvious and intuitive appeal to avoiding likely, significant, or irreversible catastrophes. Even a technology that seems safe may ultimately prove harmful, and in worst case scenarios — like overfishing, unchecked pollution, and nuclear contamination — harms may prove impractical or impossible to reverse. By slowing the development or proliferation of a technology, we can minimize its harms.

The precautionary approach also facilitates information gathering while extending the time frame during which it is possible to craft effective regulation, undermining the common assumption that the permissive approach is the only one that permits regulators to understand how a technology operates before regulating it. As noted above, new regulation can only do so much when design choices and social understandings of a particular technology are already settled.¹⁷² Banning a technology postpones the stabilization of both a technology's design and its social uses; less dramatic restrictions could be designed to facilitate a period of controlled study or to compel developers to provide information. If regulators ultimately lift restrictions on a technology, they will be both more informed and better-positioned to use law to impact the design and usage norms of the technology as it enters widespread use.

This approach also creates a limited mechanism for correcting overly cautious regulation. If a safe technology is presumptively and incorrectly classified as unsafe, its proponents have a direct interest in establishing its safety. Public-choice theory predicts that a concentrated interest group like this will mobilize to oppose the regulations.¹⁷³ Under either a permissive or precautionary approach, this sort of mobilization is less likely if a technology is erroneously classified as safe.¹⁷⁴

However, the precautionary approach fails to take account of the risks and opportunity costs of not using a technology.¹⁷⁵ For example, the FDA has adopted a precautionary approach towards food irradiation, possibly at the cost of significantly reducing deaths due to bacterial infection.¹⁷⁶ And while further testing may reduce the risk of lethal side effects of a new cancer treatment, the delay may also lead to deaths among those who would have benefitted from it.¹⁷⁷ Again, public choice theory and political economy dynamics suggest that the ability of groups harmed by inaction to engage in regulatory correction will

Medical Products, 82 VA. L. REV. 1753, 1764–65 (1996). This approval required evidence, based on scientific experiments, that the drug was safe for its intended use.

172. See *supra* notes 154–158 and accompanying text.

173. See *supra* notes 159–164 and accompanying text.

174. *Id.*

175. Sunstein, *supra* note 147.

176. James Spiller, *Radiant Cuisine: The Commercial Fate of Food Irradiation in the United States*, 45 TECH. & CULTURE 740, 758 (2004).

177. Sunstein, *supra* note 147, at 34.

depend on their concentration and relative power. But even if the rule is changed following a successful mobilization, that change may be of little comfort to those harmed in the interim.

Ultimately, it would be impractical to adopt a precautionary approach towards all technologies. Legal actors can, however, adopt broad, tech-neutral prophylactic rules for particularly risky or ethically ambiguous classes of technology, such as new medical treatments or human cloning,¹⁷⁸ for industries that have a history of causing harm, such as reckless bankers;¹⁷⁹ or for dangerous kinds of conduct,¹⁸⁰ such as the prohibition on indiscriminate attacks in warfare.¹⁸¹ Here, overlapping rules may explicitly aim to minimize loopholes. For example, privacy advocates urge adopting a precautionary stance with respect to surveillance technologies, data aggregators, and related surveillance practices.¹⁸² While these technologies may not be perceived as inherently risky, advocates argue that precaution is warranted based on how similar technologies have been used.

* * * * *

Which approach should guide rulemaking regarding a specific technology? The answer depends on the risks inherent to the technology or its use cases. Significant or irreversible threats will justify the precautionary approach, while the permissive approach may be more appropriate for generative or unthreatening technologies. The answer will also depend on who is likely to suffer from the proliferation or restriction of the technology and their ability to mobilize for corrective or compensatory regulation.

Equipped with a clearer understanding of the differences and tradeoffs between these approaches, legal actors attempting to resolve a legal uncertainty will be better prepared to consciously identify and publicly justify their regulatory orientation. This sets the stage for the next step: evaluating which specific legal response to employ.

178. Merrill, *supra* note 171.

179. *See, e.g.*, Dodd-Frank Wall Street Reform and Consumer Protection Act (Pub. L. 111-203, H.R. 4173).

180. *See infra* Section IV.C (discussing tech-neutral rules).

181. RULE 11. INDISCRIMINATE ATTACKS, INT'L COMMITTEE RED CROSS, https://ihl-databases.icrc.org/customary-ihl/eng/docs/v1_rul_rule11 [<https://perma.cc/PS3B-R9> (noting that this customary prohibition has been reiterated in numerous treaties and states' domestic policies)].

182. *See, e.g.*, COHEN, *supra* note 10, at 92.

IV. RESPONSES TO LEGAL UNCERTAINTIES

After identifying a legal uncertainty and determining the preferable regulatory approach, a legal actor must determine the most effective legal response.¹⁸³ There is no single best responsive strategy, and legal actors often alternate between responses or pursue several as part of a concerted effort.¹⁸⁴ While specific responses may vary in substance, they conventionally fall into three broad categories: stretching extant law, creating new rules, or (in rare cases) fundamentally reassessing or restructuring the legal regime.¹⁸⁵ Each response is a familiar means of legal evolution, but this Part identifies their distinctive techlaw manifestations and considerations.

While there are obvious parallels between the permissive approach and the stretch-extant-law response, as well as between the precautionary approach and the create-new-law response, the approaches are not necessarily tied to particular responses. A lawmaker could codify a permissive approach by creating new law. As noted above, the U.S. Congress did so by creating safe harbors for online service providers.¹⁸⁶ Meanwhile, a legal interpreter could apply a precautionary approach by stretching extant restrictions to newer technologies. For example, a military legal advisor could reason that the prohibition on the use of indiscriminate weapons bars the use of autonomous weapon systems that cannot discriminate between lawful and unlawful targets.

A. Techlaw Analogies

All responses to tech-fostered legal uncertainties depend on the use of techlaw analogies, either to justify stretching extant law or the need for new law or legal regimes.¹⁸⁷ Regardless of whether a legal actor adopts a more textualist, purpose-driven, or other normative approach

183. This is, of course, an idealized account. In practice, legal actors will often be biased towards or limited to employing the response that most naturally accords with their institutional roles. See Ard & Crootoof, *supra* note 12.

184. Marchant, *Wicked Problem*, *supra* note 10, at 1862–63 (arguing that technological governance is best understood as a collection of “second-best strategies [which] intersect, coexist, and — in some ways — compete”).

185. While any legal actor may adopt a more permissive or more precautionary approach, not all legal actors are free to apply all responses. In general, only designated lawmakers have the authority to create new law or establish new institutions; interpreters usually must make do with law-by-analogy. And in some situations, the two roles may overlap; common law courts are nominally constrained to applying existing rules, but their extension of these rules by analogy effectively creates new rules for future cases.

186. See *supra* note 150 and accompanying text.

187. See, e.g., A. Michael Froomkin, *The Metaphor is the Key: Cryptography, The Clipper Chip, and the Constitution*, 143 U. PA. L. REV. 709, 860–61 (1995) (“The law’s first reaction to a new technology is to reach for analogies . . .”); Surden, *supra* note 9.

to resolving a legal uncertainty,¹⁸⁸ they will almost undoubtedly employ analogical reasoning to reach or support their conclusion. However, in addition to many of the familiar concerns about the use of analogies in legal reasoning, such as their tendency to foster transplantation errors or circumscribe a fuller understanding of the relevant issues,¹⁸⁹ techlaw analogies' multiple, often-conflated roles complicate their use.

Given this, it is not enough to identify particular characteristics of a technology when employing a techlaw analogy. Instead, legal actors must determine which of those characteristics are relevant or "salient" in light of the legal analysis and social context. We draw on Jack Balkin's work to argue that identifying the appropriate analogy requires identifying a technology's "legally salient characteristics," which might entail considering an artifact's architecture and design, what actors are empowered, what activities are enabled, or what social structures and power dynamics are affected.¹⁹⁰ Because this analysis depends on the sociolegal context, techlaw analogies require ongoing reevaluation as time passes, technology evolves, and circumstances change.

188. See, e.g., LESSIG, *supra* note 9, at 160 (describing this in the context of U.S. constitutional interpretation as a choice between two strategies, one focused on the question of what the framers would have done, the second aiming to find a reading of the text that "preserves its original meaning in the present context"); Rebecca Crootoof, *Change Without Consent: How Customary International Law Modifies Treaties*, 41 YALE J. INT'L L. 237, 252–55 (2016) (discussing the strengths of the three primary approaches to treaty interpretation: the textual school, the party intent school, and the teleological school); Kerr, *supra* note 9 (proposing the "equilibrium-adjustment theory," an alternative source of guidance for interpreters that focuses on restoring a status quo ante of relative power among relevant parties).

189. See, e.g., Harlan Grant Cohen, *Metaphors of International Law*, in INTERNATIONAL LAW'S INVISIBLE FRAMES — SOCIAL COGNITION AND KNOWLEDGE PRODUCTION IN INTERNATIONAL LEGAL PROCESSES (Andrea Bianchi & Moshe Hirsch eds., forthcoming 2021), at 1 (arguing that legal metaphors "blind international lawyers to alternative ways of organizing the world" and "prejudge legal outcomes"); Thomas W. Joo, *Contract, Property and the Role of Metaphor in Corporations Law*, 35 U.C. DAVIS L. REV. 779 (2002); Nelson Tebbe & Robert L. Tsai, *Constitutional Borrowing*, 108 MICH. L. REV. 459 (2010) (arguing that constitutional borrowing must be evaluated at four levels: "how well particular legal ideas fit together; how open and notorious the borrowing is; what is lifted and what is left behind; and what, as a practical matter, that creative act yields"); see also Raymond W. Gibbs, Jr., *Taking Metaphor Out of Our Heads and Putting it into the Cultural World*, in METAPHOR IN COGNITIVE LINGUISTICS 145 (Raymond W. Gibbs, Jr. & Gerard J. Steen eds., 1997) ("[M]etaphor is not merely a figure of speech, but is a specific mental mapping that influences a good deal of how people think, reason, and imagine in everyday life.").

190. Jack Balkin observes that legal salience is not a feature of the technology itself, but instead is constructed by a society. As Balkin put it, "[w]hat we call the effects of technology are not so much features of things as they are features of social relations that employ those things." Balkin, *Path of Robotics Law*, *supra* note 6, at 49; Balkin, *Digital Speech*, *supra* note 9, at 2 ("In studying the Internet, to ask 'What is genuinely new here?' is to ask the wrong question Instead of focusing on novelty, we should focus on salience."); see also Mandel, *supra* note 10, at 230 (noting that technologies cannot be categorized purely by their function and arguing they should also be evaluated on how their "function interacts in society").

Further, the framing of the analogical argument will influence whether it seems permissible to use analogical reasoning to resolve a legal uncertainty. If the decision is framed as a selection between this or that analogy and its attendant regime, it will appear to be a question of which existing law should be applied; if the decision is framed as a selection among analogies, all of which are lacking something critical, the implied conclusion will be that new law or a new institution is needed.

1. Multifaceted Roles

We employ analogies in myriad ways. In our personal lives, analogies help us extrapolate from past experiences to understand unfamiliar or complicated concepts or identify potential benefits or dangers. Analogical reasoning is also a fundamental lawyering skill. Lawyers, judges, legal academics, and other legal actors are practiced at matching new fact patterns to older ones, identifying differences, and making arguments as to whether a distinction justifies applying, disregarding, or modifying a precedent. And, in both the personal and legal contexts, analogies are used to advance particular narratives, ranging from an advertiser hawking a “self-driving car,” to a civil society group decrying “killer robots,” to a ride-sharing platform’s lawyer arguing that their client is just a “data company.”

In the techlaw context, these different functions are often conflated. A legal actor might analogize a technology to a more familiar one to better understand it and its social uses.¹⁹¹ “Horseless carriages” and “driverless cars” both link a new technology to a prior one while emphasizing a pertinent absence. Legal actors also employ analogies to elucidate a technology’s attendant benefits and risks. “Driverless cars” won’t require you to attend to the road on a long commute — but they also highlight that there is no driver to exercise good judgment when needed. Simultaneously, a legal actor may stress a particular analogy because its associated precedent favors a desired narrative or legal conclusion. Calling an autonomous vehicle a “driverless car” suggests that, in the case of an accident, the accountable actor is missing; calling it a “self-driving car” insinuates that the vehicle itself has some agency, which might operate to deflect attention from relatively remote designers, manufacturers, or sellers.¹⁹² Because whoever wins the “battle of analogies” often wins the war, there are incentives for legal actors to

191. Dan Hunter, *Teaching and Using Analogy in Law*, 2 J. ASSOC. LEGAL WRITING DIRS. 151, 152–67 (2004).

192. See Crootof, *supra* note 67, at 636–38 (discussing how technology may misdirect responsibility for accidents).

promote incomplete or misleading analogies that advance their preferred outcome.¹⁹³

This complicated dynamic was at play in *American Broadcasting Cos., Inc. v. Aereo, Inc.*, where a new technology allowed subscribers to rent small antennas to record and transmit over-the-air television broadcasts to their personal, internet-connected devices.¹⁹⁴ The legal issue was whether this business model constituted copyright infringement; the techlaw analogy issue was whether this new technology was more like prior infringing or non-infringing technologies. Focusing on the fact that the technology enabled users to watch broadcast TV when they desired, Aereo's lawyers argued that it was most akin to a home antenna and DVR — technologies that had been determined to be non-infringing in prior cases.¹⁹⁵ The Court disagreed; emphasizing that Aereo was profiting off of others' content, the majority analogized the technology to cable transmission, which would constitute an infringing performance.¹⁹⁶ The dissent took a third tack. Asserting that the technology merely enabled individuals to engage in prohibited copying of otherwise free content, it compared the technology to "a copy shop that provides its patrons with a library card,"¹⁹⁷ which suggested that the industry was not responsible for users' copyright infringement.

The disagreement over the proper analogy for the Aereo technology also illustrates a broader point: all analogies are incomplete, sometimes in ways that limit our understanding or imagination.¹⁹⁸ Each *Aereo* analogy captured some element of the technology at issue while masking others. This implicit limitation may be inadvertent, or it may strategically advance a regulatory narrative. Calling an automobile a "horseless carriage" elides the fact that automobiles generally require paved roads and infrastructures that wagons may not, creating opportunities for directing, surveilling, and regulating the flow of traffic; calling an autonomous vehicle a "driverless car" implies that they will

193. For example, because the General Agreement on Tariffs and Trade (GATT) requires that "like products" be treated similarly, there is significant litigation around whether a given technology is or is not sufficiently similar to another to justify different rates and treatment. See, e.g., Working Party Report, *The Australian Subsidy on Ammonium Sulphate*, adopted 3 April 1950, BISD II/188 (finding ammonium sulphate fertilizer and nitrate fertilizer to not be "like products").

194. 573 U.S. 431 (2014).

195. *Id.* at 438.

196. *Id.* at 443.

197. *Id.* at 456 (Scalia, J., dissenting).

198. See *Berkey v. Third Ave. Ry. Co.*, 155 N.E. 58, 61 (N.Y. 1926) ("Metaphors in law are to be narrowly watched, for starting as devices to liberate thought, they end often by enslaving it."); see also Froomkin, *supra* note 187, at 861–62 (discussing how four potential analogies for cryptography — car, language, house, and safe — "go beyond putting a positive or negative gloss on encryption; they amount to different definitions of the nature of the thing itself").

operate like individually owned and operated automobiles, instead of as networked nodes on a smart highway or centralized transportation systems. As described in the next section, identifying a technology's legally salient characteristics is a necessary step in evaluating when an analogy's incompleteness renders it unusable.

2. Legally Salient Characteristics

The basic analogical question is whether an artifact, actor, or activity is similar enough to a predecessor that it should be subject to the same legal regime.¹⁹⁹ And sometimes more than one analogy may provide plausible guidance, requiring an assessment of which among them is the best fit.²⁰⁰ To identify whether a techlaw analogy is appropriate, we must distill the technology's legally salient characteristics: its relevant traits in the context of a particular legal uncertainty.²⁰¹

A legally salient characteristic might include some architectural feature, capability, or social use and impact.²⁰² A court evaluating whether a statute written for wagons applies to automobiles might consider the structural differences, or that one may be taken off-road relatively easily while the other is mostly confined to highways, or that both are used as a means of conveyance, or that they generally are used by different socioeconomic groups and for different purposes.²⁰³ Importantly, not all legally salient characteristics are novel. As Jack Balkin has noted, a focus on novelty, rather than salience, risks underestimating the social impacts of a technology.²⁰⁴ The seeming novelty of Uber, Lyft, and other ride-sharing apps distracts from the fact that they are a transportation service and subject to a broad array of regulations.²⁰⁵

199. See Heather Whitney, *Search Engines, Social Media, and the Editorial Analogy*, KNIGHT FIRST AMENDMENT INST. (Feb. 27, 2018), <https://knightcolumbia.org/content/search-engines-social-media-and-editorial-analogy> [https://perma.cc/3RHB-9WU9] (describing this as an “internal” challenge to the selection of an analogy).

200. See *id.* at 237 (describing this as an “external” challenge to the selection of an analogy).

201. While there may be overlap in practice with the “essential traits” identified in an exceptionalist analysis, the concept of “legally salient characteristics” is theoretically distinct. Tech exceptionalists tend to identify design characteristics and extrapolate out from them to identify areas of social change and legal confusion. In contrast, a legal salience approach recognizes that the relevant traits of a given technology depend on the context, which might include the society, the legal regime, and the law being evaluated.

202. Cf. Hunter, *supra* note 191, at 159–67 (distinguishing surface, structural, and purpose-based analogies).

203. See, e.g., *United States v. One Automobile*, 237 F. 891, 892–93 (D. Mont. 1916).

204. Balkin, *supra* note 9, at 2.

205. Cf. Equal Rights Center Files Lawsuit Against Uber for Providing Services That Are Inaccessible to Wheelchair Riders (June 28, 2017) (press release), <https://equalrightscenter.org/press-releases/equal-rights-center-files-lawsuit-uber-providing->

Nor can legally salient characteristics be identified in a vacuum. Instead, we must also consider the underlying goals of the rules or legal regimes at issue, as this will affect the relevance of various traits.²⁰⁶ The fact that both wagons and automobiles have four wheels might be germane in the context of a statute governing axle standards and completely irrelevant in the context of a statute setting speed limits.²⁰⁷ In short, an analogy that is useful in resolving one type of legal uncertainty may not be applicable to another. Similarly, an analogy that is useful at one point in time may be less appropriate at another.

The identification of legally salient characteristics has an inescapable element of subjectivity, as an interpreter's reading of a rule's text or purpose will affect which characteristics they deem to be legally salient.²⁰⁸ Consider a statute that requires the forfeiture of wagons used to transport liquor into prohibited areas.²⁰⁹ If a court applies a strict textualist reading and focuses on the distinction in the means of conveyance, the rule does not apply to automobiles; if the court assumes the purpose is to punish the conveyance of liquor into those areas, it could.²¹⁰ But while analyzing legal salience is complicated by the fact that legal categories are themselves constructs,²¹¹ and while interpreters may disagree about the underlying aims and purposes of a law (or entire legal regime!),²¹² the exercise is not hopelessly subjective. Rather, it

services-inaccessible-wheelchair-riders/ [https://perma.cc/A2G7-EY8K] (arguing that Uber is subject to the requirements of the Americans with Disabilities Act).

206. Balkin, *Path of Robotics Law*, *supra* note 6, at 46 (emphasizing the import of focusing on "what features of social life the technology makes newly *salient*"); Balkin, *Digital Speech*, *supra* note 9, at 2 ("What features of human activity or of the human condition does a technological change foreground, emphasize, or problematize? And what are the consequences . . . of making this aspect more important, more pervasive, or more central than it was before?"); Mandel, *Legal Evolution*, *supra* note 10, at 231 ("Only after examining the basis for legal categories can one evaluate whether the rationale that established such categories also applies to a new technology as well.").

207. *See generally* Kaminski, *supra* note 6 (arguing that legal disruptions are regime-specific).

208. For example, the court in *Zhang v. Baidu.com, Inc.*, 10 F. Supp. 3d 433 (S.D.N.Y. 2014), applied precedent regarding newspapers to search engines, on the grounds that both organized and curated third-party information; commentators have critiqued this decision for ignoring critical distinctions. *See, e.g.*, Genevieve Lakier, *The Problem Isn't the Use of Analogies but the Analogies Courts Use*, KNIGHT FIRST AMENDMENT INST. (Feb. 27, 2018), <https://knightcolumbia.org/content/problem-isnt-use-analogies-analogies-courts-use> [https://perma.cc/74Y3-K9NV] (focusing on newspapers' and search engines' different social roles); Whitney, *supra* note 199 (noting various dissimilarities).

209. *See United States v. One Automobile*, 237 F. 891, 892 (D. Mont. 1916).

210. The court in *One Automobile* ultimately read the statute to not apply to automobiles. *Id.* at 893.

211. Mandel, *supra* note 10, at 230–31.

212. For example, consider the myriad theories undergirding tort law. In many situations, the selection of a guiding theory — be it fairness, civil discourse, or economic efficiency — will lead to different legal analyses and conclusions.

highlights the import of explicit articulations of why and how an analogy is being used.

Analogies' varied roles, inherent subjectivity, and potential for intentional and inadvertent misuse has prompted some to argue we should dispense with their use in the techlaw context altogether.²¹³ But, as discussed above and evidenced by daily practice, analogies are irreplaceable tools for extending the law.

Instead of tossing aside analogical reasoning, legal actors must use it thoughtfully. Sometimes, there is a reason to focus on surface, architectural similarities between technologies at the expense of recognizing a more pertinent difference in a technology's affordances or what social conduct an innovation enables. Alternatively, sometimes there is reason to emphasize one social use at the expense of important design distinctions that introduce new constraints or capabilities. Ultimately, those employing an analogy for a particular technology must consider alternatives,²¹⁴ acknowledge the selected analogy's limitations, and regularly reexamine its fitness.²¹⁵

3. Selecting the Framing

Regardless of whether there are one or more possible analogies, the analogy inquiry's framing will influence which response — extending extant law or creating something new — seems most reasonable. Accordingly, in addition to justifying arguments for why the disputed artifact, actor, or activity is more akin to this or that predecessor, those employing analogical reasoning would ideally acknowledge their choice between a which-analogy or is-there-an-analogy framing.

If the selection of an analogy is framed as a choice between this or that analogy (and their attendant regimes), the primary question will seem to be which should be applied. For example, questions regarding how best to regulate Uber, Lyft, and other ride-sharing apps are often framed as questions of whether the business itself is more like a data

213. Cf. Whitney, *supra* note 199 (arguing against employing analogies when evaluating whether First Amendment protections apply to search engines and social media platforms).

214. It may be helpful to develop a catalogue of analogies for any given technology, to foster a habit of thinking expansively and increase one's willingness to switch among them. See Toby Shevlane & Allan Dafoe, *The Offense-Defense Balance of Scientific Knowledge: Does Publishing AI Research Reduce Misuse?*, 6 ARXIV (2020), <https://arxiv.org/pdf/2001.00463.pdf> [<https://perma.cc/V3HA-RVY9>] (arguing that, "[a]s the discussions around AI misuse mature, the community should grow its toolbox of analogies and concepts").

215. See Lakier, *supra* note 208 ("[A]nalogies will prove useful only to the extent they are used thoughtfully, to illuminate the similarities and dissimilarities that matter for the purposes of the law.").

company or a taxi service.²¹⁶ This framing implies that Uber should be governed either by the legal regimes designed for data companies or taxi services — not necessarily by both. This framing thus resolves an overlap uncertainty by implicitly repudiating the possibility of overlap.

Alternatively, the analogical issue can be presented as a question of whether the technology at issue fits into a pre-existing regulatory category at all. If not, the lack of an appropriate category presumably justifies a call for new law.²¹⁷ In *Parks v. Alta California Telegraph Co.*, for example, the court had to decide whether a telegraph company was sufficiently similar to the postal service to qualify as a common carrier, an extant legal category with defined roles and obligations.²¹⁸ This framing may be used even when there are multiple potential analogies. Take autonomous weapon systems — weapon systems that are capable of independently recognizing, selecting, and engaging targets — which are commonly analogized to just another weapon or, alternatively, to futuristic, Terminator-like robotic soldiers. When evaluating how they may be lawfully used, autonomous weapon systems' legally salient characteristics can be analogized to those of conventional weapons and regulated under extant weapons law.²¹⁹ However, when determining which entity should be held accountable for their malfunctions and accidents, their legally salient characteristics shift, in that (1) unlike a weapon, autonomous weapon systems are capable of acting independently, but (2) unlike a human combatant, they cannot be deterred by the threat of punishment. For accountability purposes, the better analogy would be either child soldiers or animal combatants, both of which share these traits, but neither children nor animals can be held individually liable under international criminal

216. See Abbey Stemler, *The Myth of the Sharing Economy and Its Implications for Regulating Innovation*, 67 EMORY L.J. 197, 215–17 (2017). Again, a considered resolution of these questions will depend on the technology's legally salient characteristics — which will depend on the technology itself, the potentially applicable legal regimes, and the type of uncertainty being addressed. See *supra* Section IV.A.2. For example, it may be justified to determine that increasingly autonomous trucks are “vehicles” for the purpose of speed limit laws and are “servants” in determining whether the parent company should be liable for accidents. Alex Davies, *Self-Driving Trucks Are Now Delivering Refrigerators*, WIRED (Nov. 13, 2017), <https://www.wired.com/story/embarc-self-driving-truck-deliveries/> [<https://perma.cc/D3VM-6XM8>].

217. See *supra* notes 65–68 and accompanying text (identifying this difficulty for the houseboats and internet-connected devices); see also *Wal-Mart Stores v. Samara Bros., Inc.*, 529 U.S. 205, 215 (2000) (finding that the contested design features did not fall into either of two categories that were meant to be exhaustive and inventing a new category for the “*tertium quid*” — the “third thing”).

218. 13 Cal. 422 (Cal. 1859).

219. However, the weapons analogy has one significant lacuna: All weapons must undergo a legal review, but there is no precedent for how to evaluate a weapon system with emergent capabilities. Rebecca Crotoft, *Autonomous Weapon Systems and the Limits of Analogy*, 9 HARV. NAT'L SEC. J. 51, 65 (2018).

law. This framing thus highlights a legal gap, which one of us has argued must be addressed through the creation of new law.²²⁰

The which-analogy or is-there-an-analogy framings are not predetermined; depending on the narrator's biases or understanding of the rule and technology, the same artifact, actor, or activity could be presented either way.²²¹ Accordingly, different legal actors will strategically employ different framings to advance their preferred policy outcomes. For example, the ongoing debate over whether gig workers should be classified as employees or independent contractors could be framed as an overlap to be resolved by determining whether these workers are more analogous to employees (the analogy preferred by labor advocates) or independent contractors (the one preferred by industry). Alternatively, the regulation of gig workers could be characterized as a gap necessitating new law on the grounds that no pre-existing law or legal regime squarely covers workers with this unique set of characteristics.

* * * * *

Techlaw analogies are most familiar in discussions of whether and when it is possible to extend extant law, but they are relevant to all responses to legal uncertainties. Lawmakers use analogies in evaluating the likely effectiveness of different regulatory structures and must consider how amenable to analogical reasoning new laws will be. Meanwhile, a lack of appropriate analogies may signal a need for a broader legal reassessment.

B. Extend Extant Law

Of the three potential responses to legal uncertainties — using analogies to stretch extant law, creating new law, or reassessing a legal regime — legal actors overwhelmingly favor the first.²²²

There are a host of potential explanations for this preference. It might simply be that legal interpreters' comfort with existing categories and regimes fosters reluctance to recognize new ones.²²³ From an ad-

220. *Id.* at 58–59.

221. *Cf. supra* Section II.B.3 (discussing different rhetorical framings for houseboats and internet-connected devices).

222. Mandel, *supra* note 10, at 238. This may partially explain the staying power of Judge Frank Easterbrook's "Law of the Horse" argument. Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. LEGAL FORUM 207 (1996) (arguing against developing increasingly specialized rules and legal fields in response to new technologies).

223. Mandel, *supra* note 10, at 238 (observing that "availability and representativeness heuristics lead people to view a new technology and new disputes through existing frames,

ministrative perspective, extending existing rules is the simplest approach;²²⁴ proceeding by analogy often allows us to apply a law without having to examine or agree upon its first principles or ultimate purposes.²²⁵ Others have noted that the preference for extending extant law may just be a matter of cost-savings.²²⁶

However, due to the multifaceted nature of techlaw analogies — in that they are often simultaneously used to better understand a technology, to highlight or distinguish potentially relevant precedent, and to advance policy narratives — those employing them to stretch extant law must do so carefully.²²⁷ An analogy that accomplishes an immediate aim may gloss over critical distinctions in the architecture, social use, or second-order consequences of a particular technology, establishing an understanding with dangerous and long-lasting implications.

1. Dangerous Analogies

Rotely extending old rules to newer technologies without wrestling with legally relevant differences in a technology's design or social use is a recipe for ineffective or even dangerous law. At best, by ignoring pertinent differences between technologies, legal actors may simply create ineffective rules. The 1930 London Naval Treaty and 1936 London Protocol both equate submarines with surface warships, requiring them to comply with the general prohibition against neutralizing enemy merchant vessels without first ensuring the safety of their passengers and crew.²²⁸ But because those drafting rules for warships did not anticipate the existence of small, underwater boats — features that make it impossible for submarines to take additional passengers onboard or

and the status quo bias similarly makes people more comfortable with the current legal framework.”).

224. *Id.* at 238.

225. Cass R. Sunstein, *Incompletely Theorized Agreements*, 108 HARV. L. REV. 1733, 1771 (1995) (“A key task for a legal system is to enable people who disagree on first principles to converge on outcomes in particular cases.”); *see also* Lakier, *supra* note 208.

Unfortunately, this may sometimes result in lawmakers applying old rules to new technologies too quickly, as may have happened with laparoscopic surgery. Calo, *Lessons of Cyberlaw*, *supra* note 2, at 560 & n.289.

226. *See, e.g.*, Dan L. Burk, *Algorithmic Fair Use*, 86 U. CHI. L. REV. 283, 287 (2019).

227. Many of the ideas discussed in this Section were earlier explored in debates over the appropriateness of the “place” metaphor for the internet. *See, e.g.*, Julie E. Cohen, *Cyberspace as/and Space*, 107 COLUM. L. REV. 210 (2007); Dan Hunter, *Cyberspace as Place, and the Tragedy of the Digital Anticommons*, 91 CAL. L. REV. 439 (2003); Mark A. Lemley, *Place and Cyberspace*, 91 CAL. L. REV. 521 (2003); *see also* Orin S. Kerr, *The Problem of Perspective in Internet Law*, 91 GEO. L.J. 357, 357 (2003) (arguing that courts provide a useful “external” perspective on what the internet actually is, as contrasted with the “internal” perspective of a user).

228. Treaty for the Limitation and Reduction of Naval Armament, Apr. 22, 1930, 46 Stat. 2858, 112 L.N.T.S. 65; Procès-verbal Relating to the Rules of Submarine Warfare Set Forth in Part IV of the Treaty of London of 22 April 1930, Nov. 6, 1936, 173 L.N.T.S. 353.

safely escort enemy vessels to a nearby port — these requirements were widely ignored during World War II.²²⁹

The under-considered use of an analogy may also result in bad law. As many have noted, legal actors regularly overlook the differences between the internet and physical space in applying rules developed for the latter to the former, with problematic side effects. In U.S. domestic law, courts have applied the “trespass to chattels” doctrine to create tort liability for spam emails — as well as for useful spiders, scrapers, and non-commercial emails.²³⁰ In international law, some are arguing that foreign cyberoperations constitute violations of state sovereignty, which would transmute minor and even routine interferences into prohibited interventions, permitting the affected state to employ unilateral escalatory countermeasures.²³¹ Over time, an inapt analogy may even be employed to achieve aims that contradict its original purpose. The internet was once celebrated as a separate “place” that existed outside of the jurisdiction of “meatspace” sovereigns. As John Perry Barlow famously declared, “Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind You have no sovereignty where we gather.”²³² But some argue that the “place” metaphor has since facilitated the application of property rules to once-shared zones.²³³

Using analogies inappropriately to extend extant rules can also create new dangers. Today, there is a heated debate within the AI research community regarding the respective benefits of open or restricted research norms.²³⁴ Many are borrowing assumptions and conclusions from vulnerability disclosure norms in software development to argue for more open research practices.²³⁵ However, because they have not considered the relative ease of patching discovered software vulnerabilities, there is little awareness of how employing this analogy may

229. Jane Gilliland, Note, *Submarines and Targets: Suggestions for New Codified Rules of Submarine Warfare*, 73 GEO. L.J. 975, 985 (1985); see also Crootof, *supra* note 120, at 114 (“The rules governing surface warships simply did not make sense for submarines, and attempting to import them whole-cloth rendered them dead letter.”).

230. See, e.g., Hunter, *supra* note 227, at 483–86; Lemley, *supra* note 227, at 527–29.

231. Crootof, *supra* note 37, at 630–31.

232. John Perry Barlow, *A Declaration of the Independence of Cyberspace*, ELEC.FRONTIER FOUND. (Feb. 8, 1996), <https://projects.eff.org/~barlow/Declaration-Final.html> [<https://perma.cc/RU5P-W5YB>].

233. E.g., Hunter, *supra* note 227, at 446 (terming this the “Cyberspace Enclosure Movement” and arguing that “[p]rivate interests are reducing the public ownership of, and public access to, ideas and information in the online world,” which in turn results in the “tragedy of the digital anti-commons”).

234. Shevlane & Dafoe, *supra* note 5, at 4–5 (concluding that the AI offense-defense balance is akin to biological research, hardware vulnerabilities, or nuclear engineering research).

235. *Id.* at 1.

result in publication practices that asymmetrically benefit malicious actors.²³⁶

2. Analogical Entrenchment

Inapt analogies may become firmly entrenched despite their problematic or even dangerous consequences. First, the benefits of stability provided by any given option may outweigh its negative consequences. Second, the choice of a legal regime affects how the technology subsequently develops. The fight over how best to classify cryptocurrencies, for example, will not only determine which and how extant rules apply, but also incentivize some technological developments or social uses and not others.²³⁷ The entrenchment of inapt analogies persists even when it fosters problems the legal regime was originally attempting to eliminate. For example, the conception of cyberspace as a “place” encouraged disability rights advocates to interpret Americans with Disabilities Act regulations governing “places” of public accommodation to apply to web “sites.”²³⁸ While useful in improving website accessibility, this narrowed focus arguably prevented advocates from thinking more broadly about the accessibility of all internet infrastructures — thereby allowing inaccessible practices in the latter to become more entrenched.²³⁹

Inappropriate entrenchment is particularly concerning with newer technologies whose social uses have not yet stabilized, as the early selection of an analogy may determine the governing legal regime regardless of how the technology is ultimately employed. The two treaties subjecting submarines to the same requirements as warships — despite their differing vulnerabilities and capabilities — are technically still binding on the state parties today,²⁴⁰ requiring states to engage in unfortunate legal gymnastics to justify what would otherwise constitute noncompliance.²⁴¹ We are at the cusp of this inflection point in the regulation of internet-connected devices, which permit companies to remotely alter or deactivate household appliances.²⁴² Someone who is

236. *See id.* at 5–6.

237. *See supra* notes 60–63 and accompanying text (discussing how cryptocurrency may be variously considered a currency, security, or commodity).

238. Blake Reid, *Internet Architecture and Disability*, 95 IND. L.J. 591, 594 (2020).

239. *Id.* at 594–95.

240. Howard S. Levie, *Submarine Warfare: With Emphasis on the 1936 London Protocol*, in *THE LAW OF NAVAL WARFARE: TARGETING ENEMY MERCHANT SHIPPING* 28, 59 (Richard J. Grunawalt ed., 1993).

241. *See* Crotoof, *supra* note 120, at 113–14.

242. Crotoof, *supra* note 67.

harm as a result might seek to bring a negligence suit, and in the absence of established duties, courts will consider potential analogies.²⁴³ Given a company's ability to remotely assume control of property and discontinue services, three attractive analogies are repossession agents, public utilities, and landlords.²⁴⁴ The selection among these options will change the scope of the company's duty,²⁴⁵ and liability decisions made now "will create a powerful feedback loop that will forge our future assumptions about IoT companies' obligations and consumer rights."²⁴⁶

* * * * *

Given the many roles techlaw analogies simultaneously perform, the limits of any given analogy, and the risks of employing an inapt one, it is critical that legal actors understand, articulate, and justify their analogical choices — especially when employing a previously used analogy to further stretch law to govern new circumstances.²⁴⁷

Sometimes, however, the analogical options will be insufficient or the associated legal regimes will create more normative uncertainties.²⁴⁸ In such cases, a better response might be to create new law.

C. Create New Law

The future is full of uncertainty: legal actors simply cannot predict all the ways in which technological capabilities will impact society, nor the outcomes and effects of responsive legal evolution.²⁴⁹ While relatively tech-neutral background rules will continue to provide general guidance,²⁵⁰ legal actors will sometimes decide that additional rules are necessary. Lawmakers must then decide how a rule should be designed

243. *Id.* at 627.

244. *Id.* at 627–28.

245. *Id.* at 632.

246. *Id.* at 641.

247. See Crootof, *supra* note 67, at 632 (arguing that "the appropriate analogy for assessing IoT companies' duty toward device users and bystanders must be considered afresh with each new fact pattern").

248. See Crootof, *supra* note 219 (arguing that all of the analogies for autonomous weapon systems are flawed, either because they falsely underemphasize a trait, falsely overemphasize a trait, the underlying justifications for the legal regime do not transfer, or they are not legally useful).

249. Mandel, *supra* note 10, at 241 ("The admonition to be aware of what you do not know and to recognize the limits of foresight is clearly difficult to follow . . . [But] it highlights the need for legal regimes governing new technologies that are flexible and that can change and adapt to new legal issues, both as the technology itself evolves and as our understanding of it develops.").

250. Ohm, *supra* note 9, at 1702.

and what it should govern,²⁵¹ both of which entail tradeoffs between more- or less-flexible structures.²⁵² The choice between tech-specific and tech-neutral law also entails a judgment as to which set of actors — lawmakers or legal interpreters — should decide how the law applies to future developments.²⁵³ By highlighting underexplored assumptions and the implications of these choices in the techlaw context, our framework aims to foster a more informed selection among them.

1. “Future-Proofing” the Law

Lawmakers frequently aim to craft “future-proof” rules that will not be rendered obsolete by continued technological development. Unfortunately, this goal often causes lawmakers to make design and content decisions based on underexplored intuitions regarding the ideal default. When lawmakers must make design choices that affect how easy it will be to amend the rule, stability is often prioritized over flexibility; when lawmakers must determine what content a rule governs, flexibility is often preferred to precision.

At the design level, lawmakers must determine how difficult it should be to amend or overturn the new law. One common assumption is that the harder-to-change rule is generally preferable because it will resist future change; the implicit corollary is that the only reason such rules are not always pursued is the difficulty of enacting these “stronger” rules.²⁵⁴ But while higher bars to creation or modification tend to lend rules more perceived legitimacy or authority,²⁵⁵ these rules are also more likely to foster normative uncertainties. First, precisely because of their perceived strength, harder-to-change rules are subject

251. Granted, while the various design choices articulated below may be available to a full legal system, there are a host of practical limits regarding the amount of choice a particular legal actor has when designing a law. Most obviously, institutional limits dictate what kinds of rules a legislature, agency, or court can create.

252. Similarly, governance institutions themselves can be more or less flexible. We consider questions related to building regulatory systems that are able to evolve — such as the choice of regulator (industry, legislators, agency, and judiciary) and level of regulator (domestic and international) — in Ard & Crotoof, *supra* note 12.

253. See *infra* notes 290–93 and accompanying text.

254. When new negative externalities associated with technological development are plausibly subject to international law, “someone will invariably suggest that the new technology be regulated by a new multilateral international treaty.” Crotoof, *supra* note 120, at 111–12. But these proposals tend to “follow a similar pattern: a discussion about why a treaty would be ideal is followed by the grudging acknowledgement that it is politically infeasible and an assessment of how international law should best limp along until a treaty becomes a more viable possibility.” *Id.*

255. Crotoof, *supra* note 188, at 240 (discussing why international law scholars, practitioners, and judges often inaccurately presume that, in cases of conflict, treaty law will always prevail over customary international law).

to bargains that undercut their original aims.²⁵⁶ Second, while formal stability may stave off explicit repeal, the difficulty of updating them to address changed circumstances puts “stronger” laws at greater risk of ineffectiveness or even obsolescence.²⁵⁷

Lawmakers must also decide on the rule’s content — what artifacts, actors, or activities a rule governs. Again, there is a similar desire to create long-lasting rules, but here, this aim often manifests as a preference for tech-neutral over tech-specific law. Tech-neutral laws are certainly more flexible, as they can be relatively easily extended to cover technological developments as they arise, thereby minimizing application-level gaps. But the benefits of this kind of interpretative flexibility often come at the expense of clarity and narrowed tailoring, giving rise to application and normative uncertainties.

In short, both the design and content-level tradeoffs require careful consideration. Lawmakers — and those arguing for new laws — must clarify why their proposals will best balance a rule’s effectiveness and longevity and think through which actors will best be able to resolve the most likely attendant uncertainties. There will be situations where a more stable, tech-neutral rule is best; there will be many others where it is not.²⁵⁸

2. Design Flexibility

Legal actors create new law in order to resolve application and normative uncertainties, but a rule’s ability to do so successfully will depend on its geographic scope, form, and implementation. Of course, legal actors will only rarely be able to actually choose a rule’s geographic scope or form; still, in the interest of completeness, we briefly outline the different forms rules might take to highlight a few of their relative strengths. We then discuss in greater depth the design choices where legal actors have more agency: implementation options and the tradeoffs they pose for stability and flexibility.²⁵⁹

256. See Laurence R. Helfer & Ingrid B. Wuerth, *Customary International Law: An Instrument Choice Perspective*, 37 MICH. J. INT’L L. 563, 575–76 (2016) (noting that state parties negotiating treaties “may agree to less favorable substantive rules only if those rules are phrased very broadly”).

257. See Crootoof, *supra* note 120, at 109 (arguing that, instead of multilateral treaties, “other, more flexible forms of international lawmaking — namely, soft law and customary international law — will sometimes be far better suited to international technological governance”).

258. Again, lawmakers will be limited by their institutional roles. We simply aim to encourage a more thoughtful evaluation when they are able to weigh different design choices.

259. While these raise questions of institutional fitness and interaction, we explore these issues elsewhere. Ard & Crootoof, *supra* note 12.

a. Geographic Scope and Form

A rule's geographic scope might be international, regional, national, or sub-national; further, a rule may take different forms in international and domestic legal regimes.

The two primary sources of international and intra-state legal obligations are treaties and customary international law.²⁶⁰ While both have a host of practical and political comparative advantages,²⁶¹ one of the main distinctions for our purposes are their respective levels of flexibility. Historically, customary international law was comprised of non-negotiated, long-established, and stable rules governing relations among all states.²⁶² These rules provided the backdrop against which states concluded bilateral, relatively flexible treaties that clarified or modified their respective legal obligations.²⁶³ Today, the rise of multilateral, constitutive treaties and new, swiftly developing customary international law have complicated the international legal order.²⁶⁴ Multilateral treaties — many of which codify older customary international law — are extremely difficult to formally modify; meanwhile, newer customary international law is creating loopholes and exceptions to these multilateral treaty regimes. Layered on top of this web of treaty and customary rules are various forms of “soft law,” non-binding, non-legal agreements on substantive commitments with which parties are expected to comply.²⁶⁵ What soft law lacks in legal force is often made up for in flexibility.²⁶⁶

In U.S. domestic law, rules follow a hierarchy: constitutional provisions supersede “super,” federal, and state statutes²⁶⁷, which in turn

260. Statute of the International Court of Justice art. 38, June 26, 1945, 59 Stat. 1055, 33 U.N.T.S. 993. Treaties are written documents memorializing agreements between two or more states. Vienna Convention on the Law of Treaties art. 2, May 23, 1969, 1155 U.N.T.S. 331. Customary international law is recognized when states generally engage in specific actions and accept that those actions are legally obligatory or permitted.

261. Helfer & Wuerth, *supra* note 256 (applying an instrument choice perspective to identify when states may prefer developing custom to creating treaties).

262. Crootof, *supra* note 188, at 242.

263. *Id.* at 242–43; Helfer & Wuerth, *supra* note 256, at 567 (contrasting treaties, which are negotiated, written and rarely universal, with customary international law, which is non-negotiated, unwritten, and universal).

264. Crootof, *supra* note 188, at 243–47 (discussing how these changes may be traced to developments in travel and communications technologies).

265. See, e.g., Harold Hongju Koh, *Remarks: Twenty-First-Century International Lawmaking*, 101 GEO. L.J. 725, 740–43 (2012) (discussing contemporary U.S. soft law practices).

266. Helfer & Wuerth, *supra* note 256, at 602 (“Soft law is easier and faster to create and modify than custom [or treaties], making it useful for situations of uncertainty and experimentation where flexibility is prized.”).

267. William Eskridge and John Ferejohn argue that certain statutes have obtained the status of “super-statutes”: a “law or series of laws that (1) seeks to establish a new normative or institutional framework for state policy and (2) over time does ‘stick’ in the public culture such that (3) the super-statute and its institutional or normative principles have a broad effect

prevail over common law precedent. The structure is also complicated by alternative sources of rules, including administrative regulations, executive orders, and industry custom.²⁶⁸ Constitutional provisions are difficult to enact and amend; any change requires a supermajority of states.²⁶⁹ While “super statutes” are technically far easier to amend than the Constitution, given that Congress has the same formal power to change them as any other statute, their normative weight renders them more stable than other statutes.²⁷⁰ Meanwhile, common law is celebrated for its adaptability,²⁷¹ administrative regulations allow for greater flexibility than traditional statutes,²⁷² and presidents can create or undo executive orders unilaterally.²⁷³ The move to industry self-regulation has also been motivated by a preference for flexibility.²⁷⁴

b. Implementation

While different rules’ forms have different inherent flexibility, implementation decisions can make a particular rule more or less flexible. For example, treaty drafters can raise or lower the default procedural requirements for formal amendment. In keeping with its constitutive aims, the U.N. Charter has an unusually high bar for amendment, requiring approval of two-thirds of the General Assembly and ratification by two-thirds of the U.N. Member states, including all permanent members of the Security Council.²⁷⁵ Other treaties explicitly anticipate regular amendments, like the Convention on Certain Conventional Weapons, which was intended to be a framework convention and since

on the law — including an effect beyond the four corners of the statute.” William N. Eskridge, Jr. & John Ferejohn, *Super-Statutes*, 50 DUKE L.J. 1215, 1216 (2001). Examples include the Sherman Antitrust Act or the Civil Rights Act.

268. Of course, many states also recognize ratified treaties as domestic law. For example, in the United States “self-executing” treaties may be immediately enforced in courts. *Head Money Cases*, 112 U.S. 580, 598 (1884).

269. U.S. CONST. art. V.

270. Eskridge & Ferejohn, *supra* note 124, at 165–68.

271. See *Norway Plains Co. v. Boston and Me. R.R.*, 67 Mass. 263, 267–68 (1854) (“[W]hen a new practice or new course of business arises, the rights and duties of parties are not without a law to govern them; . . . the common law, will still apply, modified and adapted . . . to the new circumstances.”).

272. See Cass R. Sunstein, *Law and Administration After Chevron*, 90 COLUM. L. REV. 2071, 2088–89 (1990).

273. See generally Kevin M. Stack, *The Statutory President*, 90 IOWA L. REV. 539 (2005) (problematising the presidential exercise of such power without statutory authorization).

274. Jodi L. Short, *The Paranoid Style in Regulatory Reform*, 63 HASTINGS L.J. 633, 674 (2012).

275. U.N. Charter art. 108.

has been augmented by five protocols.²⁷⁶ At the other end of the spectrum, rule makers can force reconsideration by incorporating sunset provisions, which establish a date upon which the law ceases to have effect unless action is taken to extend it.²⁷⁷

Likewise, implementation decisions can constrain or expand a rule's content flexibility. Rather than set all the particulars of a rule by statute, for example, Congress often designates an agency to promulgate or update rules as circumstances develop.²⁷⁸ Or a rule may set forth a general, tech-neutral regulation, but allow relevant parties to request tech-specific exceptions. The DMCA features this sort of arrangement: Its triennial rulemaking process creates an opportunity for regulated or otherwise interested parties to advocate for exemptions from the Act's anticircumvention provisions, and these proceedings have resulted in exemptions for fourteen classes of copyrighted works.²⁷⁹

Implementation choices may also explicitly or implicitly limit how much a rule's content may be expanded through analogical reasoning.²⁸⁰ For example, the Rome Statute establishing the International Criminal Court states that "[a] person shall not be criminally responsible under this Statute unless the conduct in question constitutes, at the time it takes place, a crime within the jurisdiction of the Court," and that "[t]he definition of a crime shall be strictly construed and shall not be extended by analogy."²⁸¹ In contrast, other classes of rules are presumed to be more flexible. Many human rights treaties lend themselves to expansive interpretations, in part because it is generally acknowledged that the meaning of certain rights will evolve over time. A rule's subjectivity to adaptive interpretation is not always widely agreed-

276. Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed To Be Excessively Injurious or To Have Indiscriminate Effects, Oct. 10, 1980, S. Treaty Doc. No. 103-25, 1342 U.N.T.S. 137.

277. See Jacob E. Gersen, *Temporary Legislation*, 74 U. CHI. L. REV. 247, 259–60 (2007). Content-level decisions may also have similar implications for design flexibility, as more tech-specific rules may create *de facto* sunsets. See *infra* notes 318–20 and accompanying text.

278. See *Chevron, U.S.A., Inc. v. Nat. Res. Def. Council, Inc.*, 467 U.S. 837, 843–44 (1984).

279. 17 U.S.C. § 1201(a)(1)(C)–(D); 37 C.F.R. § 201.40 (2021); see also Bryan Casey & Mark A. Lemley, *You Might Be a Robot*, 105 CORNELL L. REV. 287, 360 (2020). As with any administrative process, however, the devil is in the details. Many scholars have documented the flaws that render the triennial review incapable of fully vindicating the public interest goals it was designed for. See, e.g., Woodrow Neal Hartzog, *Falling on Deaf Ears: Is the "Fail-Safe" Triennial Exemption Provision in the Digital Millennium Copyright Act Effective in Protecting Fair Use?*, 12 J. INTELL. PROP. L. 309, 313–14 (2005); Rebecca Tushnet, *I Put You There: User-Generated Content and Anticircumvention*, 12 VAND. J. ENT. & TECH. L. 889, 910–12 (2010).

280. Doing so constrains the possibility of extending the law, as outlined above in Section IV.B.

281. Rome Statute of the International Criminal Court art. 22, July 17, 1998, 2187 U.N.T.S. 90.

upon — indeed, some of the more fraught arguments over the U.S. Constitution is the extent to which it permits adaptive interpretation of certain terms, such as “cruel and unusual punishment” and “unreasonable search and seizure.”²⁸² But incorporating standards or reasonableness tests rather than bright-line rules gives later interpreters more room to maneuver.

Lawmakers can also constrain adaptive interpretations by prioritizing some interpreters over others: A rule may designate an authoritative interpreter to minimize disputes regarding how a rule’s content may be altered over time. The treaty establishing the World Trade Organization, for example, states that the Ministerial Conference and the General Council “have the exclusive authority to adopt interpretations” of the treaty for all state parties.²⁸³ Alternatively, sometimes rulemakers exclude entire classes of legal actors who would have otherwise been able to influence the construction of the rule. For example, a legislature may pass a statute to preempt contrary judicial or agency rulings.

3. Content Flexibility

While lawmakers are often limited from considering the full panoply of design options by their institutional role, they have far more freedom to draft a more tech-neutral or tech-specific rule. Relatively tech-neutral rules apply broadly, regardless of the technologies used. In contrast, a relatively tech-specific rule is more narrowly tailored, either with regard to a particular technology, entities who use that technology, or its use as a means to an end.

We discuss these concepts as binary to emphasize the distinctions between them, but they exist on a continuum.²⁸⁴ Most rules can be rewritten to be more or less tech-neutral or tech-specific. Consider the relative precision of a rule that prohibits using an AK-47 in a park, a rule that prohibits using guns in a park, a rule that prohibits using weapons in a park, and a rule that prohibits activities that might hurt others

282. See, e.g., Brandon L. Garrett, *Constitutional Reasonableness*, 102 MINN. L. REV. 61, 84–104 (2017) (tracing the rise and fall of reasonableness tests across constitutional jurisprudence).

283. Marrakesh Agreement Establishing the World Trade Organization art. IX(2), Apr. 15, 1994, 1867 U.N.T.S. 154, 159.

284. Birnhack, *supra* note 11, at 49. Indeed, some scholars posit that it is ultimately impossible to produce truly tech-neutral rules: “Language cannot be completely technology-neutral; it is impossible to draft legislation with sufficient precision and clarity that addresses every possible future technical variation.” Lyria Bennett Moses, *Understanding Legal Responses to Technological Change: The Example of In Vitro Fertilization*, 6 MINN. J.L. SCI. & TECH. 505, 578 (2005).

in a park.²⁸⁵ Accordingly, we use the terms “tech-neutral” or “tech-specific” to refer to a rule’s relative position along the spectrum of options.

While tech-neutral rules are often conflated with standards and tech-specific rules with “bright line” rules — possibly because both entail design choices that privilege the legal interpreter or lawmaker, respectively — the concepts exist on separate planes.²⁸⁶ Whether a law takes the form of a rule or a standard is a structural design choice; whether a law is more tech-neutral or tech-specific is a content design choice. Accordingly, it is possible to have tech-specific standards (such as a general requirement that those using leaf blowers “exercise courtesy and take reasonable steps to minimize [their] impacts”)²⁸⁷ or tech-neutral rules (such as an ordinance prohibiting noise louder than 50 decibels from 10:00 pm to 7:00 am).²⁸⁸

There is a common assumption that a tech-neutral rule is always preferable to a tech-specific one, usually because the former is presumed to be less likely to become obsolete as technologies evolve.²⁸⁹ As highlighted by the spectrum of rules regarding weapons in the park, this assumption ignores the tradeoff between flexibility and clarity. Because tech-neutral rules are more flexible, they are more likely to continue to apply as technologies change; there is less risk that new technology, actors, or conduct will fall within a regulatory gap. But while tech-specific rules may be more limited, they are likely to be clearer in application and, as a result, sometimes more effective in dealing with the challenges of the selected technology.

285. Some have proposed formal delineations along the tech-neutral–tech-specific spectrum. *See, e.g.*, Chris Reed, *Taking Sides on Technology Neutrality*, 4 SCRIPTED 263, 269–75 (2007) (distinguishing rules which are indifferent to the technology used from rules which are neutral as to how a technology is implemented); *cf.* Casey & Lemley, *supra* note 278, at 356–57 (arguing that, given the difficulty of defining what a robot is, we should create categories for regulating robots by defining “a range of things it falls within or a zone in which it is located”).

286. In brief, the rules-standards debate weighs the values of *ex ante* certainty and predictability in the application of the law against *ex post* tailored fairness and flexibility. *See, e.g.*, Lawrence Solum, *Legal Theory Lexicon: Rules, Standards, and Principles*, LEGAL THEORY BLOG (Sept. 6, 2009), <https://lsolum.typepad.com/legaltheory/2009/09/legal-theory-lexicon-rules-standards-and-principles.html> [<https://perma.cc/J2ZY-D4XL>].

287. *Second Revised Leaf Blower Local Law 11-15-2018*, TOWN OF OSSINING, N.Y., <https://www.townofossining.com/cms/publications/all-documents/town-clerk/local-laws/1945-second-revised-leaf-blower-local-law-11-15-2018/file> [<https://perma.cc/W8BD-LEUX>].

288. NJDEP–Office of Local Environmental Management, *Noise Ordinance versus Nuisance Code*, THE OFFICIAL WEBSITE OF THE STATE OF NEW JERSEY, <https://www.nj.gov/dep/enforcement/NoiseOrdinancevsNuisanceCodeAug08.pdf> [<https://perma.cc/W42Z-VAEM>].

289. *See* Birnhack, *supra* note 11, at 38–39, 51 (“[I]n practice, we see that technology-neutral legislation is often preferred *a-priori* The advantages of neutrality are taken for granted.”); Reed, *supra* note 284, at 265, 268–69.

Tech-neutral and tech-specific rules are also likely to foster different kinds of legal uncertainties. Tech-neutral laws raise uncertainties associated with overlapping and overinclusive law, while tech-specific laws raise uncertainties associated with gaps as well as both under- and overinclusive law.

In addition, tech-neutral and tech-specific rules allocate enforcement powers to different legal actors, who are differently capable of successfully resolving future uncertainties. Tech-specific rules ensure that the legislature, agency, or other lawmaker retains more power: The more specific the rule, the less discretion is granted to the interpreter. In a tech-neutral regime, in contrast, the regulated entity, prosecutor, judge, executive branch, or other legal actors who interpret and apply the rules are more empowered to decide how the law applies.²⁹⁰ While this power shift may be somewhat constrained with clear descriptions of the rule's aims or purpose, interpreters may more freely ignore those restrictions than more explicitly limited rules. For example, courts have widely recognized that § 230 of the Communications Decency Act is meant to advance free speech values,²⁹¹ yet sites like Airbnb have asserted it to challenge laws having little to do with expression, such as restrictions on short term property rentals.²⁹² Further, lawmakers and interpreters act at different times, which affects their understanding of the regulated artifact, actor, or activity; “the general, technology-neutral law is an *ex ante* regulation, while the specification and application of the general instruction to the facts of the case is conducted *ex post*, on a case-by-case basis.”²⁹³

As a result, deciding between a more tech-neutral and tech-specific rule will require an evaluation of which kinds of legal uncertainties are most acceptable and which entities will be best situated to effectively resolve them as they arise. While we leave a more nuanced account of the relevant considerations for deciding between them for another day,²⁹⁴ this section outlines the relative benefits and drawbacks of the two ends of the tech-neutral–tech-specific spectrum.

290. See Birnhack, *supra* note 11, at 39, 41 (noting that tech-neutral laws shift power from the legislative branch to the judiciary and executive).

291. See, e.g., *Barnes v. Yahoo!*, 570 F.3d 1096, 1099–1100 (9th Cir. 2009); *Zeran v. Am. Online, Inc.*, 129 F.3d 327, 330–31 (4th Cir. 1997). See also 47 U.S.C. § 230(a)(3) (finding that the internet's value lies in its potential as “a forum for true diversity of political discourse” and “myriad avenues for intellectual activity”).

292. See Danielle Keats Citron & Benjamin Wittes, *The Problem Isn't Just Backpage: Revising Section 230 Immunity*, 2 GEO. L. TECH. REV. 453, 463–64 (2018).

293. Birnhack, *supra* note 11, at 41.

294. See Ard & Crotoft, *supra* note 12.

a. Tech-Neutral Rules

Tech-neutral rules are framed broadly, often with the aim of applying to activities or their consequences regardless of the technology employed.²⁹⁵ For example, copyright law restricts unauthorized copying “by any method now known or later developed”; it is indifferent to the means by which this conduct is effectuated.²⁹⁶

One of the main appeals of tech neutrality lies in the intuition that it is more flexible and “future-proof” than those regulating specific technologies.²⁹⁷ The more tech-neutral the laws, the less lawmakers have to act to update the law each time a new device is invented.²⁹⁸ Instead, tech-neutral rules invite interpreters — including the regulated industry, watchdog entities, law enforcement, prosecutors, judges, and adjudicative agencies — to employ analogical reasoning to extend the tech-neutral rule to resolve application uncertainties raised by novel technologies, newly empowered actors, or previously rare conduct.

Indeed, the ability to postpone wrestling with difficult application questions is a standalone strength of tech-neutral rules, insofar as their breadth may allow rulemakers who might disagree on specific applications to reach agreement on broader aims.²⁹⁹ For example, the intuitively appealing idea that all weapon use should be subject to “meaningful human control” may allow states to reach some degree of consensus on the regulation of autonomous weapon systems, notwithstanding the fact that there are wildly different understandings of what that phrase actually requires.³⁰⁰

295. For a more thorough analysis of different kinds of tech-neutral rules, see Bert-Jaap Koops, *Should ICT Regulation be Technology Neutral?*, in *STARTING POINTS FOR ICT REGULATION: DECONSTRUCTING PREVALENT POLICY ONE-LINERS* 77, 83–90 (Bert-Jaap Koops et al. eds., 2006) (identifying four legislative aims in creating “tech-neutral” rules: (1) achieving particular effects; (2) ensuring functional equivalence between different modes of activity, such as online and offline conduct; (3) minimizing discrimination between technologies with similar effects; and (4) future-proofing the law, by drafting flexible laws that do not hinder technological development or require frequent revision).

296. 17 U.S.C. §§ 101, 106(1).

297. Birnhack, *supra* note 11, at 38–39; Koops, *supra* note 294, at 83–90.

298. Eichensehr, *supra* note 9, at 372–74; see also Ashley Deeks, *The Geography of Cyber Conflict: Through a Glass Darkly*, 89 INT’L L. STUD. SER. US NAVAL WAR COL. 1, 17 (2013) (explaining that the U.S. government often has “an inherent institutional instinct . . . to anchor novel legal situations in existing bodies of law and practice, and to reason by analogy Particularly where the analogies are quite reasonable (as they are between kinetic and cyber activities), it often is easier to draw from existing rules than to craft new ones from whole cloth.”).

299. See, e.g., Joseph A. Grundfest & A.C. Pritchard, *Statutes with Multiple Personality Disorders: The Value of Ambiguity in Statutory Design and Interpretation*, 54 STAN. L. REV. 627, 628 (2002) (explaining how “legislative ambiguity” facilitates compromise).

300. Rebecca Crotoof, *A Meaningful Floor for “Meaningful Human Control”*, 30 TEMP. INT’L & COMP. L.J. 53, 53–54 (2016).

Tech-neutral rules are useful when there are concerns about a technology or the side-effects of its use, but lawmakers have insufficient information to evaluate the scope or likelihood of the problem. Accordingly, tech-neutral rules mitigate the risks of a permissive approach, by prohibiting certain activities that will obviously lead to harms while allowing lawmakers to gather data and craft better informed, tech-specific rules at a later date. Tech-neutral rules can also address situations where technology is evolving, such that the definition of the relevant technology is contested. For example, the word “robot” encompasses a host of different technologies used in different ways in different environments,³⁰¹ causing some to argue for more tech-neutral regulation to minimize legal gaps.³⁰² Where tech-neutral rules are successful in heading off anticipated and unanticipated harms, they help avoid investment in piecemeal (and sometimes less effective) or unnecessary regulation.³⁰³

Broader rules may also promote innovation.³⁰⁴ By minimizing discrimination between different technologies that achieve similar results, like various kinds of e-signatures, tech-neutral rules incentivize developers to create superior alternatives.³⁰⁵ Indeed, tech-neutral rules may promote beneficial innovation by prescribing aspirational standards and not dictating a single route to compliance. For example, Rwanda adopted performance-based regulations for civilian drones that emphasize a safety threshold but invite companies to experiment in meeting the requirement.³⁰⁶ To the extent they avoid privileging one technology over another, tech-neutral rules may also reduce the likelihood of technological lock-in.³⁰⁷

Particularly in legal regimes where there may be some doubt as to whether any law applies to a new technology, tech-neutral rules help

301. Calo, *Lessons of Cyberlaw*, *supra* note 2, at 529 (“Few complex technologies have a single, stable, uncontested definition. Robots are no exception.”).

302. Casey & Lemley, *supra* note 278, at 342 (arguing for regulating acts rather than entities — or, in other words, “regulate verbs, not nouns”).

303. *See* Koops, *supra* note 294, at 77.

304. Birnhack, *supra* note 9, at 44 (“Technology-neutral legislation enables a breathing space for innovation and avoids the problem of being worked-around.”). *But see id.* (also observing that “the open-ended nature of a technology-neutral legislation might have a chilling effect on developers of technology”).

305. *Id.* at 43–44; Ohm, *supra* note 9, at 1691–92.

306. Jack Bright & Samantha Stein, *African Experiments with Drone Technologies Could Leapfrog Decades of Infrastructure Neglect*, TECHCRUNCH (Sept. 16, 2018), <https://techcrunch.com/2018/09/16/african-experiments-with-drone-technologies-could-leapfrog-decades-of-infrastructure-neglect/> [<https://perma.cc/PY8F-3NFV>] (“Rather than the government saying ‘you have to use this kind of technology to stop your drone,’ [the government] would say, ‘your drone needs to be able to stop in so many seconds.’” (quotations omitted)).

307. Birnhack, *supra* note 9, at 43–44. *But see* Reed, *supra* note 284, at 267–68 (discussing how tech-neutral rules might indirectly discriminate between technologies).

avoid dangerous legal gaps. International law, for example, is often understood as being consent-based; proponents of this view argue that states that have not agreed to be bound by a rule are not obliged to follow it. Accordingly, technologies that enable new conduct — like sending satellites into orbit or engaging in cyberoperations — regularly raise the question of whether existing law applies at all.³⁰⁸ In such cases, tech-neutral rules make it easier to justify the application of old laws to new artifacts, actors, and activities.³⁰⁹

However, tech-neutral rules create numerous legal uncertainties. A tech-neutral rule may be less likely to create a legal gap, but its general language will raise application questions regarding how the law should be applied in different scenarios. Interpreters are familiar with addressing these types of issues,³¹⁰ but sometimes a tech-neutral law is so vague that it becomes meaningless.³¹¹ Tech-neutral rules may also easily become overinclusive as interpreters use analogies to stretch law too far or as technological advances change conduct and possible outcomes. As we discuss above, overinclusive laws risk ineffectiveness, as they may become costly and underenforced. Further, and somewhat counterintuitively, the existence of an overinclusive rule may make it more difficult for legal actors to enact needed legislation as new harms are recognized. Due to both a perception that there is relevant law and a reluctance to revisit old drafting compromises, lawmakers may be less able to revise extant law than to draft entirely new rules.

Because they are premised on a set of assumptions made in a particular technological moment, even laws that are facially tech-neutral may ultimately prove ineffective in the face of future technological developments that expose their technology-contingent assumptions.³¹² Road safety laws that nominally include any vehicle often presume a conventional automobile with a human driver; thus, laws mandating that trucks make regular rest stops so the driver can sleep may prove overinclusive if applied to autonomous vehicles.³¹³ The common law

308. Eichensehr, *supra* note 9, at 357.

309. *Id.* at 372 (justifying stretching extant law to new situations on the grounds that, sometimes, “imperfect law is preferable to no law at all”).

310. The process of doing so, however, may render laws that are tech-neutral on the books tech-specific in practice, as the interpreter must often identify the most analogous technologies. Birnhack, *supra* note 9, at 39–40 (discussing how the process of applying tech-neutral law to new situations requires interpreters to determine the most analogous technologies); see also Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1156 (2002) (“[W]hile patent law is technology-neutral in theory, it is technology-specific in application.”).

311. Koops, *supra* note 294, at 9–10.

312. See Birnhack, *supra* note 9, at 28 (“New technologies expose how the current law was shaped around a particular vision of technology, snapshotted in its past social context, even if a seemingly neutral language was applied.”); Reed, *supra* note 284, at 275 & n.59.

313. See *supra* notes 103–107 and accompanying text.

faces the same challenge. The venerable *ad coelum* doctrine in property — which traditionally protected a landowner’s airspace “up to the heavens” — is entirely tech-neutral on its face. Yet it was founded on the assumption that no one could make practical use of the air; with the advent of airplanes, U.S. courts waved away the rule as the product of “an age of primitive industrial development.”³¹⁴

b. Tech-Specific Rules

While often undervalued in discussions of regulating technology, tech-specific laws have a number of strengths that may make them preferable to more tech-neutral versions.

If nothing else, tech-specific laws are clear. As a result, they make it easier to resolve application uncertainties as to whether and how the law applies to an artifact, actor, or activity. This clarity may also make compliance easier, as the entities governed by the rule will better understand their obligations. Precision is especially important in areas where fundamental rights are at stake. In criminal law, for example, the rule of lenity requires clarity as a prerequisite to imposing criminal liability and depriving an individual of liberty. Tech-specific laws, like those that criminalize particular types of weapons or drugs, provide this needed clarity.

Tech-specific laws may also be more carefully tailored to the issue the lawmaker intends to address.³¹⁵ For example, motorcycles, conventional automobiles, and tractors all pose different safety and emissions concerns; it will generally be easier and more effective for regulators to address these distinct concerns by promulgating separate rules for each class of vehicle than through a comprehensive, tech-neutral rule for all motor-driven land vehicles.

Tech-specific rules also allow lawmakers to limit the abilities of later actors to expand or evade regulations. States tend to craft narrowly tailored weapons treaties to limit later expansive interpretations, largely because they are unwilling to relinquish their ability to develop or use unanticipated future weapons.³¹⁶ Similarly, legislatures might draft

314. *Johnson v. Curtiss N.W. Airplane Co.*, U.S. AVIATION REPORTS 42 (Minn. Dist. Ct. 1923) (reprinted in *Current Topics and Notes*, 57 AM. L. REV. 905, 908–11 (1923)); see Lora D. Lashbrook, *The Ad Coelum Maxim as Applied to Aviation Law*, 21 NOTRE DAME L. REV. 143, 146 (1946).

315. Birnhack, *supra* note 9, at 41–42 & n.57 (citing scholars arguing for tech-specific laws to address surveillance, nanotechnologies, and RFID).

316. WILLIAM H. BOOTHBY, *WEAPONS AND THE LAW OF ARMED CONFLICT*, 146–47 (2016) (arguing that it is illegitimate to stretch weapon-specific prohibitions, given that states only join treaty bans after “careful, even painstaking, scrutiny” of the definitional text).

tech-specific rules to limit an industry's ability to imaginatively reinterpret regulatory requirements.³¹⁷

And while tech-specific rules may be relatively short-lived, requiring frequent legislative and agency reactivation, their impermanence may itself be a strength. As Paul Ohm notes, tech-specific laws incorporate a *de facto* sunset: "[T]ech-specific rules serve one unappreciated benefit: they sunset when new technologies are introduced. A law that governs only the use of a telephone, for example, will not govern the use of the Internet."³¹⁸ This approach allows lawmakers to capture the benefits of a sunset provision — namely, its ability to mitigate the difficulties of regulating despite inadequate information — without the arbitrariness of picking an expiration date that may bear no relation to changes in the use or format of the relevant technologies.³¹⁹ Further, to the extent the lawmaker is crafting the rule with insufficient information, it may be preferable to create a rule with a shorter lifespan to balance out the possibility that it does more harm than good.³²⁰

Of course, tech-specific rules also have drawbacks. While some legal rules may fade into obscurity without incident or productively spur rulemakers to act, tech-specific laws may also easily create legal gaps and underinclusive rules.³²¹ These uncertainties may be mitigated if lawmakers regularly revise the law, but the practical difficulties of doing so increase the likelihood that tech-specific legal regimes for certain artifacts, actors, or activities will ultimately foster under-regulation.³²² Additionally, while tech-neutral laws encourage legal actors to propose eyebrow-raising, expansive interpretations, tech-specific laws increase avoision and other attempts to circumvent regulations.³²³

Nor is tech-specific law immune to becoming overinclusive, especially when enacted early in the development cycle of a new technology. A rule may be carefully tailored to the particular costs and benefits

317. Laws that are overly specific may nonetheless create the opportunity for industry to sidestep regulation through avoision. *See supra* notes 94–95 and accompanying text.

318. Ohm, *supra* note 2, at 1701.

319. *Id.* at 1710–13.

320. Birnhack, *supra* note 9, at 42 (noting that legislation that might have negative side effects is preferably narrow); *see also* Ohm, *supra* note 9, at 1706 (discussing how “bad” legislative rules are worse than “bad” judge-made rules, given that the former both apply more broadly and are more difficult to revise).

321. *See* Ohm, *supra* note 9, at 1692–94 (discussing how tech-specific laws become underinclusive over time).

322. The resulting confusion about what the law is may have a second-order effect of chilling innovation. *See, e.g.*, MICHAEL A. CARRIER, INNOVATION FOR THE 21ST CENTURY: HARNESSING THE POWER OF INTELLECTUAL PROPERTY AND ANTITRUST LAW 132–33 (2009) (explaining how uncertainty in copyright law chills innovations in communications technology); Birnhack, *supra* note 9, at 43 (discussing how tech-specific rules “might cause a technological lock-in: the chosen technology will be used even if there are superior technologies.”).

323. *See supra* Section III.C.1.b; *see also* Birnhack, *supra* note 9, at 44.

of the technology at that moment in time, yet impose unnecessary costs as the technology changes. Consider elevator regulations — some still in force — that require having or accommodating operators on each elevator.³²⁴ This rule addressed important safety and worker protection concerns when elevators required manual operation, but it is an anachronism today.³²⁵

Tech-specific rules may foster rulemaking disagreement, as legal actors may disagree both on the specificity required and on particular applications. Simultaneously, the narrow scope of some tech-specific laws may enable relatively easy passage, as they may escape notice. They may also manifest as self-serving, under-the-radar regulations, pushed through by well-informed, concentrated lobbyists.³²⁶ For example, after intensive lobbying efforts, in 2013 California created a new regulatory regime for “transportation network companies” with fewer obligations than existing taxi laws to govern companies like Uber, Lyft, and other ride-sharing apps.³²⁷

Some tech-fostered legal uncertainties may be resolved by stretching the law or creating new rules. Sometimes, however, the technological change may be a catalyst of deeper legal transformation, one that fundamentally reshapes an entire legal regime.

D. Reassess the Regulatory Regime

In extreme cases, tech-fostered social change may prompt a fundamental reassessment of a legal regime’s aims or purposes by rendering once-dependable assumptions inaccurate, fostering broader social shifts, or encouraging the recognition of rights. Legal actors often respond to these foundational changes by swapping, modifying, or creating institutions.

324. See, e.g., N.Y. Lab. Law § 203-a (McKinney 2019) (“Every passenger elevator operated and maintained for use by the public shall be equipped or furnished with a seat, collapsible or otherwise, for the use of the operator when the elevator is not being operated . . .”).

325. See, e.g., Frank Gibbard, *Blame It on the Elevator Pilot: Dark Tales of Entry-Level Negligence*, 43 COLO. LAW. 55, 55–56 (2014) (noting the historical safety needs as well as the more recent obsolescence of the position).

326. Conversely, tech-specific laws may face political obstacles to the extent the regulation of a particular technology imposes costs on a specific industry; public-choice theory predicts that the industry will mobilize in opposition while the general public will face difficulty in mobilizing support. See Farber & Frickey, *supra* note 159, at 886 & n.72.

327. Veena Dubal, *Rule-Making as Structural Violence: From a Taxi to Uber Economy in San Francisco*, L. & POL. ECON. (June 28, 2018) <https://lpeblog.org/2018/06/28/rule-making-as-structural-violence-from-a-taxi-to-uber-economy-in-san-francisco/> [<https://perma.cc/84DR-7QJY>]. These rules were swiftly replicated nationally and internationally. *Id.*

As with individual laws, entire legal regimes can be grounded on assumptions rendered inaccurate by technological development.³²⁸ As discussed above, much of U.S. firearm regulation depends on being able to control or at least keep a record of the point of sale. But if individuals can 3D-print their own guns from home, they can bypass the regulatory regime entirely.³²⁹ This activity has made the limits of existing law much clearer: With the advent of 3D-printers, any legal regime premised on government monitoring or intervention at the point of sale — such as those governing firearms, drugs, or even houses — must reassess its aims and mechanisms for achieving them.

Tech-fostered social change can also prompt a reconceptualization of a regime's foundational aims or principles. Just as the machines of the Industrial Revolution forced courts to rethink tort liability,³³⁰ industrialization prompted a parallel transformation in property.³³¹ Blackstone's view of property rights as absolute may have worked for an agrarian society,³³² but it stood in the way of industrialists whose activities — laying rail lines, polluting, or even flooding lands for a mill — necessitated interfering with others' property rights.³³³ Spurred in part by technological developments, the courts reshaped property doctrine to advance economic progress, replacing property absolutism with an attempt to balance competing rights.³³⁴

The principles and commitments exposed through such reassessment may not be entirely new; technological change may also allow legal actors to expressly recognize previously implicit concerns, commitments, or rights.³³⁵ Take Samuel Warren and Louis Brandeis's *The Right to Privacy*, one of the most famous articles in the techlaw

328. If the uncertainties surrounding a technology prove sufficiently challenging, they may expose the limitations of both the existing legal regime and the institutions that administer it. See *supra* notes 132–35 and accompanying text (detailing the creation of the Interstate Commerce Committee in response to Congress's inability to regulate railroads effectively).

329. See Desai & Magliocca, *supra* note 45, at 1701–02 and *supra* notes 44–47 and accompanying text.

330. See *supra* notes 108–11 and accompanying text.

331. See HORWITZ, *supra* note 110, at 31–108; KARL POLANYI, *THE GREAT TRANSFORMATION: THE POLITICAL AND ECONOMIC ORIGINS OF OUR TIME* 69–76 (1944).

332. Even in that setting, Blackstone's view was more a caricature than an accurate statement of the law. See Carol M. Rose, *Canons of Property Talk, or, Blackstone's Anxiety*, 108 YALE L.J. 601, 631 (1998).

333. Morton J. Horwitz, *The Transformation in the Conception of Property in American Law, 1780–1860*, 40 U. CHI. L. REV. 248, 278 (1973); see BJ Ard, *More Property Rules than Property? The Right To Exclude in Patent and Copyright*, 68 EMORY L.J. 685, 728–29 (2019).

334. See Horwitz, *supra* note 332, at 290. This transformation also reflects the political economy: the vision of economic progress the courts adopted decidedly favored moneyed interests.

335. JACK PARKER & DAVID DANKS, *HOW TECHNOLOGICAL ADVANCES CAN REVEAL RIGHTS*, http://www.andrew.cmu.edu/user/cgparker/Parker_Danks_RevealedRights.pdf [<https://perma.cc/YQ4Y-ZZZY>]; Surden, *supra* note 9.

canon.³³⁶ No court had previously acknowledged such a right, but in searching the law of defamation, intellectual property, and tangible property, they explicated a more general “right to be let alone” that had come under threat in the wake of the portable camera.³³⁷ Once this right was made explicit, courts developed it through tort law and legislatures codified it.³³⁸

Sometimes, regime reassessment will result in shifting regulatory power from one institutional actor to another. When courts and legislatures proved unable to sufficiently respond to the privacy and data security challenges that followed the rise of the internet, the FTC entered the void.³³⁹ As proponents of this approach have argued, the FTC’s monitoring and enforcement expertise situate it to coordinate industry self-regulation as data-collection practices develop and its enforcement authority yields a de facto body of privacy common law.³⁴⁰

Alternatively, reassessment may spur institutional creation or modification. As discussed above, the U.S. Congress responded to the need for agility and subject-matter expertise in regulating competition among railroads by creating the first independent administrative agency.³⁴¹ Congress has since regularly charged agencies with regulating other high-tech industries. In the early 1900s, it entrusted pharmaceutical regulation to the Bureau of Chemistry (precursor to the Food and Drug Administration),³⁴² smallpox vaccines to what would become the National Institute of Health,³⁴³ and radio regulation to the Federal Radio Commission (precursor to the Federal Communications Commission).³⁴⁴ Today, lawmakers and scholars frequently call for new and specialized domestic agencies or international institutions — or new strategies for coordinating among them — to address the alleged inadequacies of generalist regulators like the courts.³⁴⁵

336. Warren & Brandeis, *supra* note 87.

337. *Id.* at 195.

338. Danielle Keats Citron, *Mainstreaming Privacy Torts*, 98 CAL. L. REV. 1805, 1821–24 (2010); Robert C. Post, *The Social Foundations of Privacy: Community and Self in the Common Law Tort*, 77 CAL. L. REV. 957, 958–59 (1989).

339. See Daniel J. Solove & Woodrow Hartzog, *The FTC and the New Common Law of Privacy*, 114 COLUM. L. REV. 583, 590–99 (2014).

340. *Id.* at 598–99, 619–25.

341. See *supra* notes 132–35 and accompanying text.

342. Wesley J. Heath, *America’s First Drug Regulation Regime: The Rise and Fall of the Import Drug Act of 1848*, 59 FOOD & DRUG L.J. 169, 196–97 (2004).

343. MICHAEL WILLRICH, *POX: AN AMERICAN HISTORY* 77, 81, 179, 307 (2011).

344. TIM WU, *THE MASTER SWITCH: THE RISE AND FALL OF INFORMATION EMPIRES* 82–84 (2010).

345. See, e.g., Calo, *Lessons of Cyberlaw*, *supra* note 2 (arguing that a new U.S. agency is needed to regulate robots); Press Release, Confronting a Data Privacy Crisis, Gillibrand Announces Landmark Legislation to Create a Data Protection Agency (Feb. 13, 2020), <https://www.gillibrand.senate.gov/news/press/release/confronting-a-data-privacy-crisis-gillibrand-announces-landmark-legislation-to-create-a-data-protection-agency>

As these examples show, reassessment of a legal regime raises significant institutional questions. Many of the features of technological change that pose difficulties for making and updating substantive law reappear as challenges to the competence, authority, and legitimacy of existing institutions.³⁴⁶ We explore these questions in greater detail in a subsequent article.³⁴⁷

* * * * *

This Article presents the various regulatory responses to tech-fostered legal uncertainties — stretch extant law, create new law, or reassess the legal regime — as if they exist as clear and separate categories, much as a torts casebook might present the different elements of negligence or an international law class might present the various options states have for influencing other states. But, in all of these situations, reality is far more complicated. While we describe the responsive options as existing on a spectrum from least to most dramatic, they may be employed in concert. Further, an institution’s capabilities and incentives will affect its choice of responses.

V. CONCLUSION

The popular science fiction series *Black Mirror* explores potential near-term social impacts of various technologies. Most viewers understand the name to refer to the omnipresent screens that increasingly surround us — and which are less and less often deactivated and dark. But there was another, earlier “black mirror”: Landscape painters regularly used slightly convex glass with black backings, which had the effect of “convey[ing] a relatively wide-angled view on a small-scale surface.”³⁴⁸ This black mirror “reduce[d] the glare of bright lights [so that] subtle tones of the mid-range and detail in the dark ones would emerge.”³⁴⁹ Similarly, by raising application, normative, and institutional uncertainties, technology grants us a new perspective on our world, enabling a more nuanced grasp of our social and legal systems’ hidden details.³⁵⁰

[<https://perma.cc/2XJ2-NXC3>]; Crotoft, *supra* note 37; Ohm & Reid, *supra* note 2; Tutt, *supra* note 2.

346. Cf. Jack M. Balkin, *The Crystalline Structure of Legal Thought*, 39 RUTGERS L. REV. 1, 62–63 (1986) (observing how the same debates that arise around the adoption of the rule tend to recur in attempts to apply and refine it).

347. See Ard & Crotoft, *supra* note 12.

348. Christina Spiesel, *Technology’s Black Mirror: Seeing, Machines, and Culture*, INT’L J. SEMIOTICS LAW 1 (2020) (citing MARTIN KEMP, *THE SCIENCE OF ART* 199 (1990)).

349. *Id.*

350. *Id.*; cf. Liu, Maas, Danaher, Scarcella, Lexer & Van Rompaey, *supra* note 4, at 43 (arguing that tech-fostered legal disruption “defamiliarises and therefore facilitates a re-evaluation . . . that might lead to new understandings of the law”).

We have offered a methodological structure for purposely resolving tech-fostered legal uncertainties, and in doing so we have highlighted how each one presents an opportunity to shape legal evolution. Legal actors must consider which uncertainties should be addressed, whether to adopt a more permissive or precautionary approach, the appropriate legally salient characteristics and framing of analogies, whether extant law can be employed, how new laws will be designed and what they will cover, and when a legal regime should be fundamentally reassessed. Of course, the resolution of any legal uncertainty will raise others: The use of analogies risks problematic entrenchment, creating new law fosters different kinds of subsequent legal uncertainties, and reassessing legal regimes may throw entire legal fields and their institutions into disarray. These dynamics are inherent to the iterative, co-constructing relationship between law and technology. But by highlighting relevant considerations, fostering a deeper understanding of the implications of different choices, and enabling us to learn from the past and each other, this framework will allow us to engage more thoughtfully in this iterative process.