THE DEATH OF STANDARDS

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ABSTRACT

We predict the death of standards. While legal scholars have debated the merits of rules and standards in law for decades, advances in technology will give rise to a system where lawmakers rely exclusively on precise rules. This will fundamentally change the nature and structure of law.

Two types of technology facilitate the death of standards. First, predictive technology such as big data and artificial intelligence will vastly improve lawmakers' information. The rapidly improving precision of this technology will ultimately allow the design of specific ex ante rules for virtually every context.

Second, as the complexity of rules grows beyond human processing capabilities, communication technology will simplify things and provide citizens with clear directives. Rules that take into account thousands of pertinent factors will be instantly communicated to a citizen as a simple yes or no message – a green or red light.

Meanwhile, the cost of standards will not be impacted in the same way. The ex post nature of standards will continue to create uncertainty costs. The cost trade-off between rules and standards will, therefore, change and the justification for using standards will dissipate.

While others have explored narrower effects of predictive technology, we foresee a wholesale change in the way society structures and thinks about law. The role of judges and lawyers will be diminished. The famous academic debate about rules and standards will become irrelevant. Other debates about autonomy, limitless rulemaking, and the ethics of entrusting machines with legal decisions will gain greater importance.

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INTRODUCTION

We predict the death of standards. The cause of death will be technological innovation. As predictive and communication technologies continue to improve, clear rules will become increasingly prevalent and standards will eventually disappear from our legal system.

Imagine a world where lawmakers can enact a catalog of precisely tailored rules, specifying the exact behavior that is permitted in every situation. The lawmakers have enough information to anticipate all contingencies, such that the letter of the law and the spirit of the law become one and the same. Now imagine that a citizen faced with a legal decision is informed of how to comply with the relevant legal rule before she acts. In this world, the citizen does not have to weigh the reasonableness of her actions; nor, does she have to search for the content of a legal rule. This is the future of law.

Controversial as it may seem, we argue that this evolution of standards into rules is inevitable. While today we have only glimpses of the necessary technology, the long-run path forward is undeniable. Indeed, many expect that within twenty years alone the ability of computers to process information will increase to one thousand times what it is today.[1] By the end of the century, that trend would bring it to well over one trillion times today's level.[2] And, as we explore throughout this article, the information capabilities that result will usher in a system of micro-rules that replace

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[1] *See infra* Part II.A.2. This estimate is based on a trend known as Moore's Law. *See generally* Gordon E. Moore, *Cramming More Components Onto Integrated Circuits,* ELECTRONICS 114, April 19, 1965 (setting out the premise of Moore's law); Mark Lundstrom, *Moore's Law Forever?* 299 SCIENCE 210, 210 (2003) (explaining Moore's Law and its implications for electronic systems).

[2] There may be reasons to think that growth will abate at some point. Lundstrom, *supra* note 1 (exploring the limitations on Moore's law); *see also* Daniel Martin Katz, *Quantitative Legal Prediction—Or—How I Learned to Stop Worrying and Start Preparing for the Data-Driven Future of the Legal Services Industry,* 62 EMORY L.J. 909, 914-915 (2013) (providing an overview of Moore's Law and collecting sources). But there is no strong evidence that that point is coming soon.

standards and fundamentally change the nature and structure of law.

When they enact laws, drafters engage in a trade-off between using rules and using standards to achieve a desired goal.[3] Rules provide a precise ex ante statement of the content of the law, whereas standards give only vague guidance and rely on ex post adjudication to provide the specific content of the law.[4] But rules introduce ex ante decision costs and error costs. The lawmaker must identify and set out the precise commands necessary to achieve a certain legislative goal or enact poorly calibrated rules that are over- and under-inclusive.[5]

Standards, on the other hand, generate ex post decision and error costs. In certain circumstances, these costs may be less than the decision and error costs of rules because they are only incurred when an actual dispute arises. The adjudicator, therefore, has greater information about the precise context of the legal question and is less likely than

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[3] The trade-off occurs on a more particular level. Any given law may use rules for some components and standards for others. *See* Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557, 561 (1992). Moreover, legal commands can be pure rules or pure standards, or they can mix the attributes of rules and standards in varying degrees. *Id*. at 561 n.6. For demonstrative purposes, we follow convention in discussing the rules-standards decision as a binary choice.

[4] The literature on this distinction is vast. *See generally id*. at 559-560 (explaining the distinction and collecting sources); Frederick Schauer, *The Tyranny of Choice and the Rulification of Standards, 14* J. CONTEMP. LEGAL ISSUES 803, 803 n. 1 (2005) (same); *see also* Cass R. Sunstein, *Problems with Rules*, 83 CAL. L. REV. 953, 961-962 (1995); WARD FARNSWORTH, THE LEGAL ANALYST: A TOOLKIT FOR THINKING ABOUT THE LAW 163-71 (2007); JOSEPH RAZ, PRACTICAL REASON AND NORMS (1990); *see also* Isaac Ehrlich & Richard A. Posner, *Economic Analysis of Legal Rulemaking,* 3 J. LEGAL STUD. 257 (1974); Kathleen M. Sullivan, *The Supreme Court, 1991 Term – Forward: The Justices of Rules and Standards*, 106 HARV. L. REV. 22 (1992).

[5] *See* Kaplow, *supra* note 3, at 562; Schauer, *supra* note 4, at 803-04; Frederick Schauer, *The Convergence of Rules and Standards*, 2003 NEW ZEALAND L. REV. 303, 305-309 (2003); Sunstein, *supra* note 4, at 992.*See* Colin S. Diver, *The Optimal Precision of Administrative Rules,* 93 YALE L. J. 65, 67, 73-74 (1983) (exploring the costs of rulemaking and defining under- and over-inclusiveness). What we call calibration is similar to what Diver calls congruence. *Id.* at 67.

an ex ante legislator to make an inclusiveness error.[6] But standards also introduce new uncertainty costs. Regulated actors do not know ex ante whether their behavior will be deemed to comply with the law.[7]

Technological innovations of two types will alter this balance in the trade-off between rules and standards. First, consider *predictive technology*. Innovations in big data and artificial intelligence will make it increasingly easy to predict the outcomes that certain behavior will produce. Lawmakers will be able to gather and rapidly process information. They will ultimately have the ability to update the law instantly[8] based on all relevant factors in the same way that courts currently do over the span of many years.[9] This reduces the decision and error costs of ex ante rules.

Second, changes in the way lawmakers communicate these complex rules to regulated parties will further advance the death of standards. From the vast catalog of rules generated by predictive technology, *communication technology* will be able to identify the rules applicable to an actual situation and inform the regulated actor exactly how

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[6] *See* Kaplow, *supra* note 3, at 562-63; Sunstein, *supra* note 4, at 1003-1004. These comparisons assume unbiased lawmakers and judges. We discuss bias *infra* Part II.

[7] Kaplow, *supra* note 3, at 569, 575-576 n. 42, 587-588; Sunstein, *supra* note 4, at 974-977; Duncan Kennedy, *Form and Substance in Private Law Adjudication*, 89 HARV. L. REV. 1685 (1976); *see also* Richard Craswell & John E. Calfee, *Deterrence and Uncertain Legal Standards,* 2 J.L. ECON. & ORG. 279 (1986) (modeling the costs of uncertain standards). All laws – rules or standards – also impose other compliance costs such as the cost of understanding the law itself and the cost of understanding the facts on the ground. We discuss below how these general compliance costs interact with the primary technological phenomenon on which we focus in Part I.

[8] There may be an optimal rate of change in law. This factor would be part of any "reasonableness" algorithm. *See infra* Part III.B

[9] *See* Oliver Wendell Holmes, Jr., *The Path of the Law,* 10 Harv. L. Rev. 457 (1897). In the current state of affairs, a standard becomes a rule once enough cases had been litigated. *Id*.; *see also* Anthony Niblett, *Case-by-Case Adjudication and the Path of the Law*, 42 J. LEGAL STUD. 303 (2013); Schauer, *supra* note 4, at 808-09 (arguing that there is a skewed convergence along the rules-standards continuum pushing standards towards); Schauer, *supra* note 5, (observing generally a convergence of rules and standards in the hands of enforcers and interpreters). We predict that standards will become rules immediately but the rules will still update with every single transaction.

to comply with the law. It will be able to translate all the information into a single behavioral directive that can be followed immediately. Rules that may be complex and dense from the perspective of the lawmaker will appear simple and easy to follow from the perspective of the regulated individual. In a sense, all of law will be translated into green and red lights. Interestingly, technology will not have the same effect on the standards side.[10] The legal uncertainty of standards will remain.

Taken together, these technologies can provide behavioral prescriptions finely tailored for every possible scenario. We call these micro-rules. Micro-rules provide the benefits of standards without any of the costs. For example, lawmakers with a specific legislative objective in mind will be able to specify up front the exact actions that constitute medical malpractice,[11] the approved manner of disposal for any hazardous material,[12] and exactly what constitutes a "vehicle" in the famous vehicles-in-the-park example.[13]

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[10] While technology may initially reduce uncertainty costs for standards, it will do so through a process that ultimately transforms those standards into rules. We discuss the various mechanisms by which standards become rules in Part I.

[11] Omri Ben-Shahar & Ariel Porat, *Personalizing Negligence Law,* (unpublished manuscript) (2015) at 14 (discussing the application of a standard in medical malpractice).

[12] Kaplow, *supra* note 3, at 563 (discussing standards for handling hazardous materials).

[13] *Compare* H.L.A. Hart, *Positivism and the Separation of Law and Morals*, 71 HARV. L. REV. 593 (1958) (proposing the vehicles-in-the-park example); *with* Lon L. Fuller, *Positivism and Fidelity to Law—A Reply to Professor Hart*, 71 HARV. L. REV. 630 (1958) (critiquing Hart's analysis of the example). The famous example of a sign that says "no vehicles in the park" looks like a rule. But the example is famous and continually revisited because it can be read in some contexts (by some people) as essentially importing a standard: ex post adjudication of what constitutes a "vehicle" in marginal cases. *See generally* Frederick Schauer, *A Critical Guide to Vehicles in the Park*, 83 N.Y.U. L. REV. 1109 (2008). Textual ambiguity like this can be avoided in the future we predict. Lawmakers can implement a policy objective perfectly through an algorithm that produces micro-rules for every situation. *See infra* Part I. Instead of a rule and a sign that says "no vehicles in the park," there will be a sensor that gathers information about the situation and notifies each individual – perhaps through a digital sign or perhaps though an application on their smartphone or other wearable technology – whether a particular object is allowed in the park at that time. On the

This is a positive rather than a normative point. One might think of perfect calibration to legislative goals as problematic in a system with multiple branches and checks and balances. Indeed, our prediction implies a reduced role for judges. Institutional reforms may be necessary to preserve the judicial role in some form. Others may view granular precision of rules as a threat to privacy and autonomy. The easier it is for the government to learn information about the behavior of the individual and use technology to predict outcomes, the more the government can micromanage to achieve desired social results. Finally, some may have concerns about ethics in a world where many important decisions are automated. The death of standards will bring with it the death of deliberation in many areas that may be important to the moral health of individuals or a democratic society.[14] We do not take a side on these normative questions. We do, however, try to flag the areas where the thorniest normative questions will arise.

The primary contribution of this article is to explore the most far-reaching effects of technology on the general structure of law. This contribution connects with two related strands in the law-and-technology literature. The first looks at the effects that predictive technology has on the legal services industry.[15] The second looks at the nature of default

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challenges to lawmakers in choosing and programming the specific policy objective, see *infra* Part III. On the importance of these developments for debates about legal realism, see *infra* Conclusion.

[14] *See, e.g.,* Seana Valentine Shiffrin, *Inducing Moral Deliberation: On the Occasional Virtues of Fog¸* 123 HARV. L. REV. 1214, 1222, 1244 (2009) (arguing that standards provide opportunities for ethical decision making that is important to the moral health of individuals and society).

[15] RICHARD SUSSKIND, TOMORROW'S LAWYERS: AND INTRODUCTION TO YOUR FUTURE (2013) (predicting effects of technology on electronic document review, virtual hearing procedures, and the like); RICHARD SUSSKIND, THE END OF LAWYERS? RETHINKING THE NATURE OF LEGAL SERVICES (2010) (predicting that technology will change the way legal services are provided); Katz, *supra* note 2 (predicting the automation of legal advice); Bruce H. Kobayashi & Larry E. Ribstein, *Law's Information Revolution*, 53 ARIZ. L. REV. 1169 (2011) (predicting that the commodification of legal services); William Henderson, *A Blueprint for Change* 40 PEPP. L. REV. 461 (2013) (exploring trends in legal markets and how law schools should respond to them); See also Larry E. Ribstein, *The Death of Big Law*, 2010 WISC. L. REV. 749 (2010) (predicting the

rules.[16] We agree with those who have suggested that technology will affect the day-to-day tasks of lawyers (and other professionals).[17] And there is no question that personalized default rules and personalized negligence standards are a "wave of the future."[18] We suggest, however, that these strands understate the momentous effect that the coming technological revolution will have on law.

By connecting this growing literature on technology and the law to the literature on rules and standards, we show that the same technology that will bring us automated compliance lawyers and personalized default rules will also bring about the demise of standards.[19] That change in the form of law will have broader consequences than retail personalization of law. Indeed, it is likely to bring wholesale institutional changes to our entire system of laws. It may even lead to the obsolescence of judges.[20]

The paper proceeds as follows. In Part I, we set out our general prediction and provide demonstrative examples. In Part II, we explore the feasibility of the technology. In Part III, we discuss implications and broader consequences of our thesis. A final section concludes.

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demise of big law firms); William D. Henderson, *From Big Law to Lean Law*, 38S INT'L REV. L. & AND ECON. 5 (2013) (exploring the changing trends in markets for legal services).

[16] *See, e.g.,* Ariel Porat & Lior Jacob Strahilevitz, *Personalizing Default Rules and Disclosure with Big Data*, 112 MICH. L. REV. 1417 (2013). Porat & Strahilevitz provide a comprehensive theory of personalized default rules. Their analysis provides a deep analysis of how big data can effect the design of specific laws. We jump off from that point to explore the wholesale effects of technological advances. *See also* Ben-Shahar & Porat, *supra* note 11; Cass Sunstein, *Deciding By Default*, 162 U. PA. L. REV. 1 (2013); George S. Geis, *Experiment in the Optimal Precision of Contract Default Rules,* 80 TUL. L. REV. 1109 (2005).

[17] *Compare* Katz, *supra* note 2, *with infra* Part II.

[18] Sunstein, *supra* note 16, at 57.

[19] Porat & Stahilevitz note that the dichotomy of personal and impersonal rules is not the same as the dichotomy of rules and standards. Porat & Strahilevitz, *supra* note 16, at 1457-58. Personalized defaults can be rules or standards. And impersonal defaults also come in both forms. *Id*. Beyond that observation, Porat and Strahilevitz focus their attention on the personal-impersonal dichotomy. Our analysis suggests, however, that all laws – both personal and impersonal – will ultimately gravitate toward complex micro-rules.

[20] *See infra* Part III.

I. TECHNOLOGY WILL TURN STANDARDS INTO RULES

In this Part we spell out how technology will affect the administration and structure of legal content. We outline two different types of technology that will lead to a dramatic reduction in the cost of implementing and using ex ante rules. The analysis is presented in three sections. First, we briefly review the distinction between rules and standards and outline the cost choices presented by the dichotomy. Second, we set out our core theory that technology will fundamentally change those cost choices. We provide two examples to demonstrate how predictive and communication technologies lead to standards ossifying into rules. Third, we discuss how the evolution of standards to rules can take place through different branches of lawmaking or can even be driven by private actors with access to predictive technology.

A. Background: Rules vs. Standards Generally

Rules are precise and ex ante in nature. Rules indicate to an individual whether certain behavior will violate or comply with the law.[21] When a rule is enacted, effort must be undertaken by lawmakers to give content to the law before the individuals act. Standards, on the other hand, are imprecise when they are enacted. The content of the law comes after individuals act, as judges and other adjudicators determine whether the individual's specific behavior violates the standard.

Generally, lawmakers incur both error costs and decision costs when enacting a law. Error costs arise when a law is over- or under-inclusive. The law allows behavior that should be prohibited, or prohibits behavior that should be allowed. Errors can be avoided when lawmakers exert effort to get the law right. But this requires information and deliberation and imposes decisions costs on the lawmakers.[22]

Error and decision costs arise in different ways for rules and standards. The classic models in the rules-versus-

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[21] Standards are found wherever vague and ambiguous terms such as "reasonable," "material," or "excessive" are used in the law. *See*, Schauer, *supra* note 4, at 804-05; Schauer, *supra* note 5, at 306-09.

[22] Error costs and decision cost can be viewed as flipsides of the same coin.

standards literature conclude that ex post adjudication of standards generates lower error costs and decision costs when the behavior of the regulated actors is infrequent and heterogeneous.[23]

First, when behavior of regulated actors is infrequent, standards generate lower decision costs because the content of the law only needs to be decided in the infrequent event that the relevant context actually arises. Rules, on the other hand, require ex ante decisions about future possible scenarios. Where behavior is infrequent and heterogeneous, lawmakers must make many decisions to write rules that are as precise in application as a standard that is adjudicated ex post. Rules do, however, impose lower decision costs when behavior is frequent and homogeneous. Economies of scale kick in and a law need only be enacted once rather than litigated over and over again.[24]

Second, error costs are lower when behavior is infrequent and heterogeneous because the adjudicator determining the content of the law has more information than the ex ante lawmaker. The adjudicator has additional context not available to the ex ante lawmaker and has the benefit of hindsight in identifying which factors will be relevant.

But this simple model of error costs is complicated by issues of adjudicator competency and bias.[25] It is well established that ex post adjudication suffers from hindsight bias,[26] as well as biases based on the personal

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[23] See e.g., Louis Kaplow & Steven M. Shavell, *Economic Analysis of Law* in ALAN J. AUERBACH & MARTIN FELDSTEIN (EDS), HANDBOOK OF PUBLIC ECONOMICS, Vol. 3, Ch. 25, 1744-45.

[24] Strict application of the doctrine of precedent introduces economies of scale for standards, but it does so in a way that turns the standard into a rule. *See* sources cited *supra* note 9.

[25] *See, e.g.,* Raz, *supra* note 4*;* FREDERICK SCHAUER, PLAYING BY THE RULES: A PHILOSPHICAL EXAMINATION OF RULE-BASED DECISIONMAKING IN LAW AND IN LIFE (1991); *see also* Kaplow, *supra* note 3, at 609 (discussing institutional competence generally).

[26] *See generally* Jeffrey J. Rachlinski, *A Positive Psychological Theory of Judging in Hindsight*, 65 U. CHI. L. REV. 571 (1998); Christine Jolls, Cass R. Sunstein, & Richard Thaler, *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471, 1523-27 (1998); DANIEL KAHNEMAN, THINKING FAST AND SLOW (2013).

characteristics of particular individuals.[27] These biases can manifest themselves in arbitrariness, political favoritism, covert influence, inconsistency, and discretionary justice.[28]

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[27] *See, e.g.,* Jeffrey J. Rachlinski, Sheri Lynn Johnson, Andrew J. Wistrich & Chris Guthrie, *Does Unconscious Racial Bias Affect Trial Judges?* 84 NOTRE DAME L. REV. 1195 (2009) (finding evidence of judicial bias based on race); *see also* Christine Jolls & Cass R. Sunstein, *The Law of Implicit Bias*, 94 CAL. L. REV. 969 (2006) (discussing implicit biases that individuals hold against disadvantaged groups). An ex post adjudicator may be biased in different and perhaps worse ways that an ex ante rulemaker. Hindsight bias and biases based on the personal characteristics of a particular individual are less likely for ex ante rulemaking. The former may be pervasive to all adjudicators and difficult to minimize and the latter may be particularly pernicious and harmful to social objectives.

The possibility of biased adjudicators weakens claims that standards have lower error costs and, as we discuss below, makes it even more likely that the technology that facilitates machine-assisted rulemaking will lead to the demise of standards in law. Ex ante rulemakers may also be biased. See, e.g., Stephen M. Bainbridge, *Mandatory Disclosure: A Behavioral Analysis*, 68 U. CIN. L. REV. 1023 (2000) (noting that the lack of attention to the behavioral biases of regulators); Stephen J. Choi & A. C. Pritchard, *Behavioral Economics and the SEC*, 56 STAN. L. REV. 1 (2003). But the will have different biases. For our purposes the important observation is that machine-created rules are less likely to be biased than humans in making rules or applying standards. Our analysis suggests that given a legislative goal, machines will more faithfully implement that objective. *See infra* Part II. It is possible, still, that judges are de-biasing bad legislative policy. Judges currently have the power to override and influence policy in a way that may be socially beneficial. That power will be lost as standards die. We address these potential concerns in Part III.

[28] See, e.g., Thomas J. Miles & Cass R. Sunstein, *The New Legal Realism*, 75 U. CHI. L. REV. 761 (2008) (finding that political preference, race, gender, and other demographic characteristics sometimes have effects on judicial judgments); Anthony Niblett, *Tracking Inconsistent Judicial Behavior*, 34 INT'L REV. L. & ECON. 9 (2013) (finding that judges in California decide unconscionability cases inconsistently with precedent). See generally, Jeffrey A. Segal, *Judicial Behavior,* in ROBERT E. GOODIN (ED.), THE OXFORD HANDBOOK OF POLITICAL SCIENCE (2011).

It has been argued that these flaws of judges may be partially responsible for the increased flight to agency regulation over the past twenty to thirty years, in spite of the many well-recognized and well-documented flaws of regulators and economic costs of regulation. ANDREI SHLEIFER, THE FAILURE OF JUDGES AND THE RISE OF REGULATION (2012); see also Joshua Schwartzstein & Andrei Shleifer, *An Activity Generating Theory of Regulation*, 56 J. L. & ECON 1 (2013) (modeling the choice

Even when judges believe they are being consistent, their biases and flaws can often affect the outcome and generate error.[29]

A third cost must also be considered: the cost imposed upon the regulated actor in understanding whether her behavior complies with the law. This legal uncertainty is far greater with standards than with simple rules. When regulated by a simple rule, an individual will more likely know whether her behavior is allowed or prohibited.[30] But when regulated by a standard, the individual does not know how any particular judge with wide discretion will apply the standard to the facts.

The choice between using a rule or a standard to achieve a particular policy objective is therefore a question of whether the costs of rules outweigh the costs of standards. We predict that advances in predictive and communication technologies will fundamentally change that tradeoff.

B. Technology will dramatically reduce the cost of implementing ex ante rules

Two types of technology will lead to the death of standards: *predictive technology* and *communication technology*. The first will facilitate lawmakers' efforts to craft precise context-specific rules that provide the nuance and specificity normally associated with standards. The second will allow for the translation of those nuanced and specific rules into simple directives that are communicated to the regulated actors in a timely manner.

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between ex ante regulation and ex post judging where courts commit errors).

[29] *See* Rachlinski et al, *supra* note 27 (exploring the effects of unconscious or implicit biases); Jolls & Sunstein, *supra* note 27, at 970-71 (same); and Kahneman, *supra* note 26.

[30] This assumes that judges (and juries) follow rules. They may, however, import exceptions that turn rules into standards – or ignore the rules altogether. *See* Schauer, *supra* note 5, at 312-314; Schauer, *supra* note 4, at 807. For the most part we bracket the possibility of nullification. But it is worth noting that the developments we explore make nullification less likely as well. *See infra* Part III.A (discussing the diminished capacity for judges to influence and change legal substance and policy). This is yet another way that law will become more rule based.

First, predictive technology will allow lawmakers to sculpt a more perfect ex ante rule. This more perfect rule is one that is both less over-inclusive and less under-inclusive. The rule is the product of a computing process that analyzes data instantly and predicts which rules can precisely achieve a policy objective. The ease in creating these rules will come from the ever-expanding computational power of machines. The consistent trend of the last fifty years suggests that that power will, by the end of this century, be one trillion times greater than what it is today. Even a fraction of that growth would produce the capacity for the developments we discuss.[31]

The result is that, over time, rules will have far lower error and decision costs. Lawmakers will no longer have to think up rules. And judges will no longer have to examine citizens' decisions on a case-by-case basis. And the rules will be precisely calibrated to the policy objective with no chance that judges will introduce bias or incompetence through ex post analysis.

Importantly, as those costs of rules fall,[32] the uncertainty costs of standards will remain near their current levels.[33] That creates a fundamental change in the relative costs of rules and standards. The case for using standards will be weakened where the error costs and decision costs of rules are falling but the uncertainty costs of standards remain high.

Second, communication technology will allow lawmakers to provide citizens with clear notice of these more perfect rules. A set of complex rules tailor-made to every situation without more would pose significant compliance challenges. It is very difficult for people to learn, remember, and process

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[31] *See infra* Part II for more on the feasibility of this technology.

[32] The error cost of rules in some cases may even drop below that for standards. Ex ante machine-aided predictive technology will improve until it outperforms ex post human judging. Of course, there is always the possibility of ex post machine-aided judging. The ex post machine-aided judging will always be at least marginally more accurate than the ex ante machines. But as predictive technology gets better, that margin will become negligible.

[33] In some cases, the ability to predict judicial outcomes will remove uncertainty costs. But that too will transform rules into standards – albeit by an alternative path. *See infra* Part I.C.

all of the requirements of complex rules. Advances in communication technology[34] can reduce or eliminate these compliance costs and prevent uncertainty costs that might otherwise arise. This further drives the evolution of standards into rules by turning hundreds or thousands of specific micro-rules into simple directives that are easy to understand and follow.

To summarize, these technologies combined do the following. First, they create a vast catalog of legal rules that cover every possible scenario. Second, when a regulated actor is in an actual scenario, they identify from this vast web of rules which specific rules are applicable. Third, they translate these rules into a simple directive on how the regulated actor can comply with the law. Fourth, they communicate that directive to the regulated actor in a timely manner.

To demonstrate the point, we present two stylized examples of how these technologies work together to lower the relative cost of rules. We conclude this section by examining the interaction of predictive and communication technologies with the related concept of fact gathering.

1. Example 1: Predictive technology in medical diagnosis

In this subsection, we provide a stylized example of how improved *predictive technology* – technology that allows lawmakers to better predict the outcomes of actions – will foster an environment where lawmakers can craft a more perfect ex ante rule. Using this stylized example, we illustrate how the need for standards is obviated if more perfect ex ante rules can be easily and cheaply created and communicated to the regulated actors.

Suppose you are a legislator. You have the responsibility of determining when doctors should be liable for performing a risky surgery on a patient. How can you best regulate doctors' behavior? How can you best draft a statute that will help doctors understand when their behavior complies with or violates the law? How many of the specific details should you include in the statute? How many of these details can be

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[34] We use this term to denote the technology that can both translate a rule into a usable directive and communicate that directive directly to a citizen.

postponed until we have more information about how doctors behave in each case?

One option is to provide doctors with a clear and simple bright-line *rule* that dictates the circumstances under which surgery should or should not be conducted. This simple rule provides great certainty to the doctors and is easily enforced; either a doctor complied with the rule or she didn't. A simple, precise ex ante rule would be your preferred method if similar patients frequently present with the same symptoms.[35] Under these circumstances, a rule would be preferred because the content of the law can be established just once and there are enormous benefits from economies of scale.

But a doctor's decision to operate on a patient frequently turns on many different factors. A "one size fits all" rule here would likely not be optimal. Any simple bright-line rule you enact will likely be over-inclusive and under-inclusive compared to an optimal decision rule. There will be some patients who receive surgery who do not need it (type I errors); there will also be other patients who do not receive surgery who do need it (type II errors).

To overcome these errors, you may try to write a more complex rule. To formulate this rule, you may try to think up many different scenarios, where you imagine different types of patients presenting with various symptoms. A complex rule is preferred if the cost of thinking and writing the rules is very low *and* the cost of doctors understanding and being able to comply with such a complex rule is also low. But it is often very costly for legislators to think up and write down all contingencies. Further, the more complex the rule you write, the more difficult it becomes for a doctor to follow.[36]

Rather than implement a rule, another option you have is to enact a *standard* and evaluate the conduct of a doctor after the decision to operate (or not operate) has been made.

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[35] *See* Kaplow, *supra* 3, at 573-77 (discussing the importance of frequency in assessing the desirability of rules).

[36] Louis Kaplow, *A Model of the Optimal Complexity of Legal Rules,*11 J. L. ECON. & ORG. 150, 151 1995) (modeling the trade-off between complexity and regulated actors ability to comply); Diver, *supra* note 5, at 73-74 (noting the trade-off between precision and ease of applying and following a law).

That is, the decision to hold a doctor liable is made once all the circumstances of the particular case are known.[37] For example, the legal standard might stipulate that all doctors must take "reasonable care" in determining whether to operate on patients. This provides doctors with greater flexibility to decide whether or not the patient needs surgery.[38] But it also provides an ex post adjudicator with flexibility and discretion to determine what is meant by "reasonable."

If a patient suffers harm as a result of a doctor's decision, then a judge can look at all the facts as they actually occurred and make an informed decision as to whether the doctor took reasonable care. A standard would be better than a rule if patients and symptoms are heterogeneous and the likelihood of two patients with the same background and symptoms is very low.[39]

There are, of course, costs associated with implementing and enforcing a standard. First, the cost of deciding each case is not zero. There are decision costs of learning the best course of action the doctor should have taken in the circumstances. Second, a judge may apply the standard incorrectly, either due to error or to bias. Third – and importantly – unlike a clear rule, a vague standard creates a great deal of uncertainty for the doctor. A doctor may not know how a judge will decide any given case; and cases may be decided inconsistently. If doctors are risk averse, a vague

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[37] As Henry Hart and Albert Sacks note: "The wise draftsman . . . asks himself, how many of the details of this settlement ought to be postponed to another day, when the decisions can be more wisely and efficiently and perhaps more readily made?" HENRY M. HART & ALBERT M. SACKS, THE LEGAL PROCESS: BASIC PROBLEMS IN THE MAKING AND APPLICATION OF LAW 157 (1958).

[38] John Braithwaite & Valerie Braithwaite, *The Politics of Legalism: Rules versus Standards in Nursing Home Regulation*, 4 SOC. & LEGAL STUD. 307 (1995). Comparing nursing homes in rule-based United States and standard-based Australia, Braithwaite, et al. conclude that the flexibility of standards in Australia allows health care professionals to respond to their patients' needs better than professionals merely applying strict rules.

[39] Case-by-case adjudication would be preferred here because the infrequent cost of determining the content of the law ex post is significantly outweighed by the costs of trying to ex ante specify the law in all potential situations, many of which will never arise. Kaplow, *supra* 3, at 573-77.

law can chill socially desirable behavior,[40] and the uncertainty may generate considerable expense in the form of compliance costs.

But in our hypothetical situation, let's suppose that a standard is optimal. Let's assume that the question of surgery rarely arises and that patients are highly diverse, both in terms of health backgrounds and in terms of the symptoms they present. Formulating a detailed rule that covers all these situations and being able to communicate these complex rules to doctors would be difficult; and a simple rule would create high error costs. Case-by-case adjudication is preferred in our example because the infrequent cost of determining the content of the law ex post is lower than the costs of trying to specify the law up front in all potential situations, many of which will never arise.

Now, let's examine how technology will change this tradeoff between rules and standards. Suppose that you learn of the existence of a diagnostic machine that is designed to predict when surgery is required. The machine takes into account relevant facts about the patient,[41] her history, the symptoms, and other information to provide a best guess as to whether the patient requires surgery.

You, the legislator, have access to this machine. How does this machine affect your decision to enact a rule or a standard? The answer turns on two factors. First, how good is the machine at accurately predicting outcomes? If the predictive technology is very powerful and the machine is able to provide precise and accurate information, then this points in favor of using the machine to create a rule, rather than using a standard. Second, can this information be easily communicated to a doctor? That is, can lawmakers provide the doctor with notice of what behavior will comply with or violate the law?

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[40] See Calfee & Craswell, supra note 7, at 298-99 (concluding that uncertainty can reduce socially desirable behavior). Recent work has suggested that uncertainty even distorts the behavior of risk neutral parties. Scott Baker & Alex Raskolnikov, *Information, Strategy, and Optimal Responses to Legal Uncertainty*, (2015) (unpublished manuscript).

[41] In practice, the machine would actually take into account relevant information about the doctor as well, such as his track record with surgeries of the relevant type.

Let's first examine why predictive technology will generate powerful cost savings in the generation of rules. Take these two scenarios:

> *Scenario 1: A terrible predictor*
> In scenario 1, the machine is very poor at predicting when a patient requires surgery. The machine essentially randomizes patients for surgery. The machine generates both type I and type II errors. One might think of the technology as a simple coin toss: heads for surgery, tails for no surgery.

> *Scenario 2: A perfect predictor*
> In scenario 2, the machine can predict with 100% accuracy whether a patient requires surgery or not. The machine instantly examines the patient's history and symptoms, analyzes millions of prior cases, and reads all articles in medical journals. It then makes a perfect prediction. It is better than any human at determining whether it is optimal to have surgery. There are no type I errors: patients who do not need surgery are not operated on. There are no type II errors: patients who need surgery are operated on.

Under scenario 1, the technology should have no effect on your decision as a regulator to implement a rule or a standard. You should implement a standard and determine liability on a case-by-case basis, learning more about doctors' behavior over time.

Under scenario 2, however, a rule becomes much more attractive. The machine's predictions will provide the boundaries of the law. The guidance that the machine generates can be replicated by the legal rules of society. The costs of using rules that we observed in the machine-free world are no longer present. The over- and under-inclusivity associated with simple rules have disappeared. There are no errors (Type I or Type II). And the costs incurred in thinking up and formulating such a complex rule have already been

incurred in developing this machine.[42] The justification for standards – reducing the error costs of rules – is gone. Further, we have an added bonus of zero uncertainty for the doctors. If they follow the machine, they know they will not be held liable.

Our prediction that technology will lead to the death of standards does not rely on *perfect* predictive technology. Rather, as the predictive technology gets better and better, we move away from the world of scenario 1, and towards the world of scenario 2. There comes a point where the technology is good enough that the costs of using a rule are sufficiently low that there is no longer any need to use a standard.

This tipping point is illustrated below. The figure shows how the costs of using a rule fall as the accuracy of prediction increases. The costs of using a standard also fall – because ex post adjudicators will have better information – but the effect is not as strong. Further, the cost of legal uncertainty that a doctor faces will still remain if the law is a standard. Once the accuracy of prediction exceeds some threshold, x^*, it is better to enact a rule.

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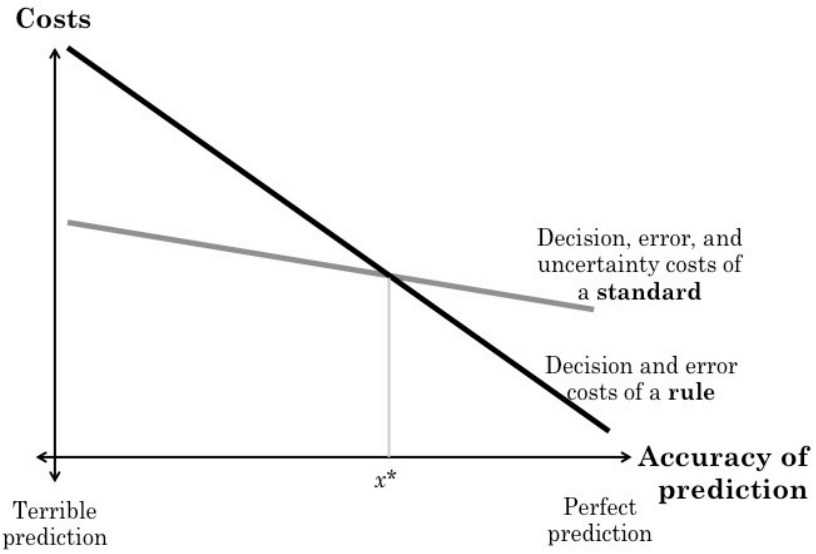
[42] In reality many of the costs for developing the machine may have been incurred by industry for the non-legal benefits that the machine brings. In that sense, the marginal costs of using it for law are negligible. Moreover, even if the machine had to be developed specifically for law, that is a fixed cost that can be averaged across all applications when calculating the per rule cost.



A caveat is necessary. This tipping point can only be realized if the rules generated by the machine can be easily communicated to doctors. That is, the legislator has to be able to provide the doctor with a quick and simple answer to the question of whether the patient requires surgery.

Doctors would find it difficult to follow complex computer-derived rules; regulated actors have neither the desire nor the time to thumb through thousands of pages of legislation and understand complex algorithms. Rather, what is required is some form of technology to allow a doctor to input all the relevant facts about a patient, their history, their symptoms, and receive an instant output that dictates whether or not the patient requires surgery.

Such technology transforms the complex rules generated by the machine into a simple directive that the doctor can follow. One might imagine a web-based program or mobile app, where the doctor can quickly and easily enter all relevant facts, submit the information, and instantly receive a binding ex ante opinion: the patient does (or does not) require surgery.[43] The costs to the doctor in understanding

[43] Examples of this type of technology are popping up all around us. *See, e.g.,* Ron Winslow, *Patients Seeking Alternatives to Statins May Undergo Rigorous Vetting,* WALL ST. J. (July 27, 2015), http://www.wsj.com/articles/patients-seeking-alternatives-to-statins-

the complex rule have been dramatically reduced. Even though the rule is highly complex and based on a sophisticated algorithm, from the perspective of the doctor, the rule is simple: operate or do not operate.[44] We explore the nuances of this communication technology more in our next example.

2. *Example 2: Communication technology in traffic laws*

In this subsection, we provide an illustration of how improved *communication technology* will reduce the cost of implementing rules. Machines can almost instantaneously gather information, process it, and produce a useable output that directs how individuals should behave.

Traffic lights are an example of this type of technology. They communicate the content of a legal rule to drivers at little cost and with great effect. This notice technology – combined with technology for predicting traffic patterns and driver behavior – creates an environment where lawmakers

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may-undergo-rigorous-vetting-1438029636 (describing a software application that guides doctors through the decision to put patients on non-statin cholesterol treatment); Robert McMillan & Elizabeth Dwoskin, *IBM Crafts a Role for Artificial Intelligence in Medicine*, WALL ST. J. (Aug. 11, 2015), http://www.wsj.com/articles/ibm-crafts-a-role-for-artificial-intelligence-in-medicine-1439265840 (describing IBM's planned move into artificially intelligent diagnostics for cancer and other diseases); Joseph Walker, *Can a Smartphone Tell if You're Depressed?*, WALL ST. J. (Jan. 5, 2015), http://www.wsj.com/articles/can-a-smartphone-tell-if-youre-depressed-1420499238 (describing tests of a new generation of "health-surveillance technologies" that can gather information to diagnose illness and asses physical and mental well-being).

[44] It may seem odd at first that lawmakers are in the business of diagnostic technology. But this is no different from what judges do in medical litigation. Judges hear expert testimony and decide ex post whether certain behavior was reasonable. In our example, lawmakers just use expert technology to do that ex ante. It is true that the role of the doctor has changed – diagnostic judgment is less important – but that is the inevitable result of advances in diagnostic technology. Our point is simply that in the hand of lawmakers the technology also changes the role of law. When the technology is only available to the private actors – the doctors in this example – then the evolution of rules into standards takes a slightly different path. We discuss this *infra* Part I.C.

are able to replace vague standards with crisp and increasingly complex rules.

Electric traffic lights communicate to drivers precisely when they are required to stop and when they may proceed. Traffic lights appear to generate a very simple rule: if the light is red, you must stop; if the light is green, you may go. But this rule is simple only from the perspective of the driver. From the perspective of the lawmakers, the underlying rule is complex. The simplest underlying rule may dictate that cars must stop during alternating time intervals. For example, during any given minute, east- and westbound cars might stop between seconds one and thirty and north- and southbound cars might stop between seconds thirty-one and sixty. In more complex examples, the time intervals can vary by intersection, direction of traffic, or time of day.

If promulgated without traffic lights, these rules would be far too complex. Drivers would have to consult tables that matched intersections, times, and direction with prescribed intervals of stopping. They would also have to consult precise clocks to determine when the interval starts and ends.

The traffic light changes everything. From the drivers' point of view, these rules are simple, clear, and easily understood, and the cost of giving notice is low.[45] Electric traffic lights take advantage of significant economies of scale that enable lawmakers to make complex rules, translate them into simple rules, and deliver notice of the required behavior to many drivers at one time.

But the rules implemented though traffic lights are still coarse. Stopping at a red light when an intersection is deserted is wasteful and costly.[46] The rule is still over-

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[45] These stop-go rules would be far more costly if humans operated traffic lights. Indeed, the first gas-powered traffic light used in 1868 in London, United Kingdom, was operated by humans. *The Man who Gave Us Traffic Lights*, BBC (July 22, 2009), http://www.bbc.co.uk/nottingham/content/articles/2009/07/16/john_peake_knight_traffic_lights_feature.shtml.

[46] There are other potential costs such as the increase in the number of "rear end" traffic accidents caused by cars braking as lights turn yellow. We argue that these costs will also die out as the rule becomes more context specific.

inclusive. It would be better if the directive to the driver could change depending on the circumstances (as it does with a standard).

And that is where technology is taking us. Traffic lights in some jurisdictions already contain sensors that detect traffic flow and adjust the timing of red and green lights accordingly.[47] Some traffic lights contain detectors allowing emergency service vehicles to "preempt" the signal and expedite their journey.[48] In the near future, these systems will take into account more variables, such as the number of cars, speed of travel, or type of intersection. They might even take into account personal characteristics of a vehicle's driver or passengers.[49],In the not-so-distant future, a traffic-light system may know that a passenger in a regular vehicle is injured, and give the rushing driver a series of green lights all the way to the hospital.

And yet – while the rules underpinning the operation of traffic lights become increasingly complex from the perspective of the lawmaker – from the perspective of the driver, the rule will still remain very straightforward: a simple stop-go rule.

The forces at work here are ubiquitous. The invention and mass adoption of Internet technology has facilitated instantaneous and cheap communication between

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[47] *See, e.g.,* Ian Lovett, *To Fight Gridlock, Los Angeles Synchronizes Every Red Light*, N.Y. TIMES (April 1, 2013), http://www.nytimes.com/2013/04/02/us/to-fight-gridlock-los-angeles-synchronizes-every-red-light.html (describing Los Angeles's $400 million system of synchronized traffic sensors aimed at controlling traffic flow and reducing gridlock); *see also* Diane Cardwell, *Copenhagen Lighting the Way to Greener, More Efficient Cities*, N.Y. TIMES (Dec. 8, 2014), http://www.nytimes.com/2014/12/09/business/energy-environment/copenhagen-lighting-the-way-to-greener-more-efficient-cities.html (noting Copenhagen's use of lights and sensors aimed at easing mobility and cutting use of fuel as well as achieving more ambitious goals).

[48] US FEDERAL HIGHWAY ADMINISTRATION, TRAFFIC SIGNAL PREEMPTION FOR EMERGENCY VEHICLE A CROSS—CUTTING STUDY, (2006) http://ntl.bts.gov/lib/jpodocs/repts_te/14097_files/14097.pdf, at 1-1 (noting the signal preemption programs in various jurisdictions).

[49] *Cf.* Porat & Strahilevitz, *supra* note 16 (noting the value of personalized laws).

individuals.[50] It also, importantly, allows for immediate communication between lawmakers and individuals.

Why does innovation in communication technology reduce the cost of enacting rules more than the reduction in the cost of enforcing standards? With complex standards, notice of the relevant factors will not always help the individual. She still must consider those factors and figure out whether her behavior complies. The key for complex rules is that technology translates the complex underlying law into a simple directive. Notice of the complex rule is communicated as a simple stop-go directive and nothing more. The simple stop-go directive is by its very nature *always* a rule, not a standard.

3. Fact Gathering

We have assumed fact-gathering technology will remain constant. But fact gathering is really part of predictive technology. Advances in predictive technology include advances in the capacity of both lawmakers and citizens to gather and process additional relevant facts.

Developing complex micro-rules requires the lawmaker to gather relevant facts in the particular case where the rules will be applied. For traffic laws, lawmakers need sensors that can observe the time of day, the weather conditions, the traffic patterns, and the contours of the road.. The more relevant facts that can be processed, the better the prediction and the greater the reduction in error costs. Thus, improvements in fact gathering are part and parcel with improvements in predictive technology. Indeed, there can be no doubt that improvements in predictive technology have been driven by a combination of both analytic capacity and observation or fact-gathering capabilities.

One might ask whether or not the advances in fact gathering could also improve the application of standards. In this view, machine-aided judging would improve as more facts could be taken into account. But that does nothing to reduce legal uncertainty. As long as the judge (man or machine) has significant leeway to apply the law as she or it

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[50] *See infra* Part II.

sees fit, the citizen bears a risk that behavior believed to be permitted will, in fact, be prohibited.

Fact gathering technology is also intertwined with advances in communication technology in ways that favor rules. As more relevant facts can be observed and analyzed, lawmakers can take those into account and enact more complex, more perfect laws.[51] In many situations, a machine can process far more relevant factors than even the most astute human. Technological advances allow the law to require citizens *to act* as if they are taking into account more relevant factors than are humanly possible to take into account. But the value of such complex laws is only captured if citizens understand how to comply. Thus, the law must be translated into a simple directive. This favors rules precisely because the translation process itself turns any standard into a rule.

* * *

To summarize this subsection, technologies that are advancing the accuracy of law are doing so in ways that uniquely favor the use of rules over standards. The reduction in error costs that come from advances in predictive technology (which includes analytics and fact gathering) will reduce the primary justification for choosing a standard over a rule. Moreover, communication technology makes the use of predictive technology more feasible by alleviating any uncertainty that might otherwise be introduced by adopting a complex set of precise micro-rules. While the rules may be numerous and complex, they are translated into simple directives for citizens. Together these developments will lead to the death of standards.

C. The different channels leading to the death of standards

The death of standards will occur through two different channels. In the first channel, lawmakers use the technology to drive the change from standards into rules. In the second,

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[51] There may be some rare instances where humans can process more facts than machines. This category will shrink over time and likely only includes decisions that both arise in unexpected environments – where the technology is not in place to gather facts – and must be made immediately. We discuss self-defense as such an example *infra* Part II.

regulated actors' use of the technology. We discuss each in turn.

1. The death of standards will likely arrive through non-legislative rulemaking (by regulators or enforcement agents)

We have, until now, spoken generally of rulemaking by a legislature. That is by no means the only avenue of rulemaking. Nor is the legislature the only rulemaker with access to technology. In many cases, the rulemaking power is entrusted to a regulator.[52] Those entities can also use technology to create and communicate complex rules to regulated actors.

Indeed, it is likely to be more politically feasible for regulators to go down this path. The legislative process to get from a goal to an enacted computer algorithm is complicated. Pork barrel and horse-trading amendments to an algorithm do not make for successful programming. On the other hand, a regulator tasked with enforcing some standard might easily adopt an algorithm-driven rule system.[53]

The pressures on a budget-constrained regulatory body will push the agency toward adopting technology. Likewise, trends towards cost-benefit analysis and requirements that regulations be shown to be cost justified[54] are likely to accelerate agency adoption. Predictive technology facilitates such cost-benefit analysis, reduces uncertainty costs to the

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[52] From the legislature's perspective, the delegation of rulemaking to an agency or enforcer takes the form of a standard. *See* Schauer, *supra* note 4, at 310. The legislature sets a broad goal and gives the agency the power to fill the content of rules. From the regulated citizen's perspective, however, a rule is a rule – no matter who created it. Our prediction is about the ultimate law that governs behavior – these will be rules. There may be standard-like objectives from one government branch that go into another branch's rulemaking calculus. But when the law reaches the citizen it will be in the form of a rule. And in this subsection we note that the body most likely to set the rule is the enforcer or agency.

[53] *Cf.* Schauer, *supra* note 4, 310-12.

[54] *See generally*, CASS R. SUNSTEIN, THE COST-BENEFIT STATE: THE FUTURE OF REGULATORY PROTECTION (2002) (exploring the rise of cost-benefit analysis in administrative agencies).

regulated actors, and cuts down on ex post adjudication costs.

Extending this line of thought, the role of regulators may become greatly expanded. Congress could enact a standard and direct that these standards be administered by an algorithm-based rule system overseen by regulators or the regulators could themselves decide to implement the standard in that manner.[55]

Advance tax rulings provide an example.[56] As it currently stands, corporations and individual taxpayers may seek clarification of vague standards in the law by asking the tax authority to examine their tax arrangements and determine whether they comply with the code.[57] Individuals and corporations may ask the tax authority to give a ruling on a matter that takes into account a number of factors such as: Am I a resident of the United States for tax purposes? Or, are my workers independent contractors or are they employees?[58]

These advance tax rulings bind the tax authority to the tax arrangements set out in the ruling, but only for the one specific taxpayer.[59] Essentially, that taxpayer is asking the tax authority to turn an ex post standard into an ex ante rule. These advance rulings have a variety of benefits, most prominently by providing greater legal certainty to the taxpayer.[60] They eliminate the uncertainty costs of the standard.[61] But such rulings can be extremely costly to

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[55] This is similar to one half of Schauer's theory of convergence. Shauer notes that legislatures enact standards that agencies turn into rules even when not directed to do so. Schauer, *supra* note 4, 310-12. The difference in our prediction, however, is that the other half of his theory disappears. Technology reduces the tendency and ability of agencies and enforcers to turn rules into standards.

[56] *See generally* Yehonatan Givati, *Resolving Legal Uncertainty: The Unfulfilled Promise of Advance Tax Rulings,* 29 VA. TAX. REV. 137, 144-47 (2009) (describing how advance tax rulings reduce uncertainty); CARLO ROMANO, ADVANCE TAX RULING AND PRINCIPLES OF LAW (2002).

[57] 26 C.F.R. § 601.201 (2002); Givati, *supra* note 56*, at* 149-52 (outlining the process and implications of obtaining an advance tax ruling).

[58] ROMANO, *supra* note 56, at 80.

[59] 26 CFR 601.201(a)(1) & (2); Givati, *supra* note 56, at 149-150.

[60] ROMANO, *supra* note 56, at 77-78.

[61] Givati, *supra* note 56, at 147.

generate.[62] The taxing authority is essentially engaged in personalized rulemaking. It is incurring high ex ante decision costs by enacting a rule that applies to just one taxpayer.[63]

Now imagine the tax authority has created a system where a taxpayer could simply turn to a machine to answer her tax questions. She could, for example, turn to an agency website or a mobile app. She asks the machine whether her tax arrangements will expose her to liability and the machine quickly reads the entire tax code, all relevant cases, all associated regulations, and all relevant advisory opinions. The machine immediately provides an answer to the taxpayer's question.[64]

The tax authority, thus, uses this artificially intelligent machine to provide advance tax rulings. Depending on the underlying objective of the legislature, the tax authority can use the machine to identify optimal rules that allow it to generate more revenue with greater efficiency and fewer distortions of behavior. It can use this technology very broadly to choose very specific rules that are highly calibrated to legislative objectives without introducing compliance costs that would otherwise be associated with such complexity.

When regulators adopt these technologies, the answers provided by the tax authority essentially become the red or green lights of tax law. Even though the generation of these tax rules is incredibly complex, the rule provided to the individual is simple. Any enforcement agent could adopt such technology and thus the complete translation of

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[62] ROMANO, *supra* note 56, at 277-80.

[63] Givati, *supra* note 56, at 149. As a formal matter the rulings only resolve the relationship between the taxing authority and one specific taxpayer. Further, they have no formal precedential effect for future taxpayers. As a practical matter, however, the taxing authority is required to treat taxpayers consistently and so a de facto precedential value arises – but this does not rise to the level of a binding rule for all future cases. *Id.* (discussing the nuances of the precedential value of advance rulings and surveying the legal scholarship on the matter).

[64] For more on this process, see Benjamin Alarie, *Cognitive Computing and the Future of Tax Law* (unpublished manuscript) (2015).

standards into rules is likely to happen at this stage rather than at the legislature.[65]

Aside from legislators and regulators, there is, of course, a third potential rulemaker: judges. But, as they currently function, judges do not quite fit into this model of rulemaking and notice. To be sure, judges can use artificial intelligence and big data to apply standards or complex rules.[66] But judges are not regularly in the business of providing ex ante notice of the outcomes of hypothetical scenarios.

For better or worse, advisory opinions are frowned upon by the American judicial system. Thus, judges might use the predictive technology to refine the law ex post. But without notice to the regulated actors, those specific rulings impose some of the same costs as standards. For example, if judges announce that all negligence cases will be decided using a computer algorithm,[67] a regulated actor without access to the algorithm would still be faced with nothing more than a standard that imposed uncertainty about how the judges would apply that standard. It would make little difference to

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[65] The Securities and Exchange Commission has a similar program where it provides "No Action" letters that state that the staff will not recommend enforcement actions against the individual or entity seeking guidance. The letter has no binding effect on other individuals or entities and the SEC reserves the right to change its position. For the SEC's statement on No Action letters see http://www.sec.gov/answers/noaction.htm. *See also* Donna M. Nagy, *Judicial Reliance on Regulatory Interpretations in SEC No-Action Letters: Current Problems and Proposed Framework*, 83 CORNELL L. REV. 921 (1998) (describing the no-action letter process). Again, these are examples of regulatory advance rulings. We suggest that as predictive technology makes it easier to automate such rulings and ensure their accuracy, they will be a common mechanism for the adoption of machine-generated micro-rules.

[66] *Cf.* Porat & Strahelivitz, *supra* note 16. ("Under certain circumstances, we want the courts (and advocates in the courtroom) to embrace the science of Big Data as a means of deciding what terms ought to be imported into an ambiguous contract or will.").

[67] The hypothetical scenario is not as fanciful as it may sound. The algorithm here is just a more precise amalgamation of the expert opinions that courts routinely rely on in deciding cases.

the individual that the actual judge happens to be a computer.[68]

Things change if the regulated actors have access to the algorithm that judges will use. In that world, the regulated actors can predict the outcome with precision. If judges commit to using a certain technology that is available to the public, that would be equivalent to providing advance rulings.[69] This would essentially shift their role to that of ex ante regulators. While not implausible, we think the other avenues of legislative and regulatory rulemaking are more likely.

There is another way that judges could be involved in the promulgation of micro-rules. Just as legislatures could set a broad policy objective and delegate the rulemaking to an agency, so too could the courts. In deciding cases, courts can announce a standard that blesses any rule that results from a process aimed at the correct policy objective and that takes into account the relevant factors. The agency could then create an algorithm that does exactly that. This "second-order regulation" by the court would send a message to the agencies on how to design the algorithm to ensure compliance.[70] Here again it would be the agencies and

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[68] It is worth noting that ex post error and inconsistency costs are likely to be lower if the judge is using the algorithm. *See* the example of bail, *infra* Part II.A.2.

[69] In a slightly different but related context, one commentator has suggested that judges could bind themselves to textualist interpretations of statutes by using computers to derive the meaning of text. Betsy Cooper, *Judges in Jeopardy!: Could IBM's Watson Beat Courts at Their Own Game?*, 121 YALE L.J. ONLINE 87 (2011), http://yalelawjournal.org/forum/judges-in-jeopardy-could-ibms-watson-beat-courts-at-their-own-game.

[70] *See* John Rappaport, *Second-Order Regulation of Law Enforcement*, 103 CAL. L. REV. 205, 214 (2015) (defining a second-order judicial decisions as one that "'states its obligations in terms of ultimate goals that must be achieved. The [agent] is then free to achieve those goals in any appropriate way'") (*quoting* STEPHEN BREYER, REGULATION AND ITS REFORM 105 (1982)). This can be done for all standards including those that the court applies pursuant to the Constitution. *See infra* Part III. Rappaport's example of the court's second-order regulation of Fourth Amendment searches, *id.*, is an area where the death of standards will be swift. Machine algorithms will be able to easily determine probable cause, exigent circumstances, bias of officers, and the like better than humans.

enforcers who have the ultimate responsibility for implementing the machine-assisted algorithm to promulgate micro-rules.

2. An alternative cause of death: Private use of technology by regulated actors

Predictive technology will be available to private actors. And, in some cases, private actors may have more advanced proprietary technology than legislatures, regulators, or courts.[71] Private use of predictive technology will lead to standards functioning like rules. There are two main ways this can occur. The outcome is practically the same: standards become rules. But both paths are less direct than the channels discussed above in the previous subsection.

The first path is through the interplay of reasonableness, industry standards, and technology. In our medical example, imagine that the technology that predicts medical outcomes is available not to lawmakers but only directly to doctors. As the technology becomes more accurate we can expect more and more doctors to use it. At some point, it is likely that courts will begin to deem it *per se* unreasonable to not use such advanced technology. Imagine an orthopedic practice today that did not use an x-ray machine[72] or a colorectal specialist who refused to perform colonoscopies in diagnosing colon cancer.[73] As technology becomes more accurate and widespread, the likelihood that courts will base a reasonableness standard on the use of that technology increases. The proliferation of these technologies across industries will cause behavior that complies with standards

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[71] For example, private traders of securities have technology that permits higher frequency trading than regulators can observe and monitor in real time. *See* Eric Budish, Peter Cramton, & John Shim, *The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response*, 130 Q. J. ECON. __ (forthcoming 2015.)

[72] Doctors have frequently been held negligent for failing to order x-rays. *See, e.g.,* Rudick v. Prineville Mem. Hosp., 319 F.2d 724 (9th Cir. 1963) (x-rays would have revealed fractured vertebrae); Webb v. Lungstrum, 575 P.2d 22 (Kan. 1978) (x-rays would have revealed small metal fragment in wound); Betenbaugh v. Princeton Hosp., 235 A.2d 889 (N.J. 1967) (failed to order x-ray of the injured part of the spine).

[73] Doctors who failed to order a colonoscopy have been held negligent. *See, e.g.,* Morse v. Davis, 965 N.E.2d 148 (Ind. Ct. of App. 2012).

to function exactly as if it were complying with a rule promulgated by the predictive technology.

The second path is a softer version of our argument. This path does not require lawmakers to use technology; rather, individuals can use predictive technology to predict the outcomes of ex post adjudication. Predictive technology can be used to provide predictions on how judges will apply a standard. In this way, technology improves on the role of lawyers as compliance advisors.[74] When lawyers provide compliance advice, they are, in part, predicting how ex post adjudicators will apply a standard.[75] As computers can gather and analyze more and more prior cases, they will outperform lawyers at this task. On first blush, this advance would appear to reduce the compliance cost of standards. But it does so in a way that *effectively* turns the standard into a rule, as it reduces the legal uncertainty costs.

Advancements in big data and artificial intelligence will spawn intelligent machines that can predict legal outcomes with great accuracy.[76] These machines will be able to provide advance guidance to citizens as to the legality of their actions.[77] In our traffic example, imagine that traffic is regulated only with yield signs that impose a reasonableness

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[74] *See generally* Christine Parker*, Lawyer Deregulation via Business Deregulation: Compliance Professionalism and Legal Professionalism,* 6 INT'L J. LEGAL PROF. 175 (1999) (exploring the role of lawyers as compliance officers); Michele DeStefano Beardslee, *Taking the Business Out of Work Product*, 79 FORDHAM L. REV. 1869, 1874–81 (2011) (arguing that it is difficult to distinguish between business and law in corporate practice); *see also* Gregory J. Millman & Samuel Rubenfeld, *Compliance Officer? Dream Job,* WALL ST. J. (Jan. 15, 2014), http://www.wsj.com/articles/SB10001424052702303330204579250722114538750 (examining the rise of compliance officers).

[75] On the law-and-economics of ex ante legal advice see Louis Kaplow & Steven M. Shavell, *Private versus Socially Optimal Provision of Ex Ante Legal Advice*, 8 J.L. ECON. & ORG. 306 (1992). *See also* Lynn M. LoPucki & Walter O. Weyrauch, *A Theory of Legal Strategy*, 49 DUKE L.J. 1405 (2000) (discussing the law-and-economics literature of legal culture and legal strategy).

[76] *See* Katz, *supra* note 2 (exploring the power of big data to predict legal outcomes); *see also* Porat & Strahelivtiz, *supra* note 16, at 1436 (same).

[77] *See* Katz, *supra* note 2.

standard.[78] But in this world, consumer technology has advanced to a stage where it can predict when a court will deem yielding to be required under the standard. This technology provides a mechanism for informing the driver when she must stop under the law. The technology gathers the relevant facts, applies the standard to those facts as a judge would, and provides predictive analysis.[79]

Even though we have standards and private-citizen-based technology, the resulting behavior looks *as if* we had public traffic lights with underlying complex rules. As technology makes ex post adjudication more predictable, citizens treat a prediction as a rule. They receive directives ex ante and have little uncertainty about how the law requires them to behave. The changes hasten the demise of standards – at least from the view of citizens organizing their behavior.

This may lead lawmakers to simply enact those predictions as law to make the form of the law conform to actual practice. It is possible, though, that lawmakers may deem fully predictable ex post adjudication to be the satisfactory equivalent of a rule and not take the final step to formalize the rule. But from the consumer's perspective the transformation is already complete. Drivers all stop when the technology in their car gives a signal – the equivalent of a red light.[80]

II. FEASIBILITY

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[78] *See, e.g.,* Mass. Gen. Laws 89 § 9 (2013) (requiring that a driver at a yield sign slow to "a speed reasonable for the existing conditions" and stop "if required for safety"); 625 Ill. C.S. 5 § 11-904(c) (2015) (same); Pierce v. Coltraro, 252 So.2d 550, 552-53 (La. Ct. App. 1971) (noting the standard that applies at a yield sign).

[79] From the driver's perspective, these mechanisms may appear to be one and the same. The driver simply gets a message saying stop. She does not have to even take mental note of the underlying facts.

[80] It is possible that judges, knowing about the predictive technology will (consciously or unconsciously) respond by changing their behavior. If that were true, and assuming that an advanced algorithms could not account for the changes when making predictions, that would suggest that technology for predicting judicial outcomes would lag behind other predictive technology in effectiveness. This alternative path toward the death of standards would, therefore, be less likely than the paths through legislative and regulatory rulemaking.

In this Part, we examine the feasibility of using technology to generate complex legal rules that will replace standards. The Part is divided in two main sections. First, we examine the feasibility of predictive technology. We look at examples where big data and artificial intelligence have been used to generate better predictions and insights than humans ever could provide and we look ahead to where the technology is headed. We look at how such predictive technology has dramatically diminished the need for human discretion.

Second, we examine the feasibility of communication technology. For the most part, this technology is already here and steadily improving. Mobile devices are becoming our first port of call for information. Individuals can easily and quickly communicate with other individuals, and – more importantly for our argument – lawmakers can easily and quickly communicate with regulated actors.

Throughout the two sections, we provide examples of where limitations to the development of technology may slow the death of standards. We argue that these technological limitations are not fatal to the evolution of rules into standards.

A. The feasibility of predictive technology

Our main hypothesis – that technology will result in the rise of rules and the death of standards – implicitly turns on the feasibility of predictive technology. This predictive technology needs to be able to generate an understanding of how regulated actors behave, predict likely outcomes, and specify pathways for how individuals should behave. We suspect that readers will be skeptical about the feasibility of these capabilities.

There are two key takeaways from this section: (1) machines are, in many areas, already better at predicting outcomes and behavior than any human; and (2) this technology is improving so rapidly that the superiority of machines in predicting outcomes will continue to grow at an exponential rate.

Machines can process billions of data points instantly to determine an optimal course of action. Even the most competent, objective humans cannot compete with algorithms generated by big data and artificial intelligence.

We are producing and analyzing ever-increasing stores of data that will provide the backbone of predictive technology. It may be difficult to envision these longer-term trends, but as Bill Gates has noted: "We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten."[81] One can only imagine the extent to which we underestimate the change that will occur in the next twenty years, or by the end of this century.

In this section, we first explore how technological developments will improve the prediction of human behavior by better understanding and analyzing millions of hypothetical situations. We foreshadow the incredible future growth of cognitive computing, artificial intelligence, and evolutionary algorithms to show how these powerful new technologies will expedite the death of standards. We then look at how human discretion is being replaced by computer-based rules in all professions. We argue that law is no different.

1. The power of predictive technology

Big data and artificial intelligence have reached a stage where likely outcomes can already be predicted in almost all aspects of human life.[82] By the end of the last century, computing machines were able to defeat the best grandmasters in chess.[83] A decade later, an artificially intelligent machine destroyed the grandmasters of the television trivia show, *Jeopardy!*[84] Machines outperform

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[81] BILL GATES, THE ROAD AHEAD (1996).

[82] Daniel Katz was one of the first scholars to really explore trends in predictive technology in the context of legal analysis. *See* Katz *supra* 2. Katz's focus was on the impact on the market for legal services, which we discuss *infra* Part III.C.

[83] In 1997, IBM's Deep Blue defeated Garry Kasparov 3½ games to 2½. For commentary on and descriptions of the match, see BRUCE PANDOLFINI, KASPAROV AND DEEP BLUE: THE HISTORIC CHESS MATCH BETWEEN MAN AND MACHINE (1997).

[84] John Markoff, *Computer Wins on 'Jeopardy!': Trivial, It's Not*, N.Y. TIMES (Feb. 17, 2011), http://www.nytimes.com/2011/02/17/science/17jeopardy-watson.html?pagewanted=all.

humans in many areas of life.[85] Machines can predict consumers' taste and[86] advise clients of financial opportunities.[87] In the field of medicine, computers can analyze images and predict the likelihood of cancer.[88]

But today's use of big data and algorithms to predict outcomes is just the beginning. The capacity of computers to process information and collect and store data continues to explode.[89] The Director of Engineering at Google, Ray Kurzwell, recently noted: "There's a very smooth exponential increase in the price-performance of computing going back to 1890 census."[90] As economist Professor William Nordhaus notes, the increase in computer power over the course of the twentieth century was "phenomenal,"[91] improving manual computing power by a factor of between 1.7 trillion and 76

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[85] *See* MARTIN FORD, THE RISE OF THE ROBOTS: TECHNOLOGY AND THE THREAT OF A JOBLESS FUTURE (2015).

[86] *See generally* THOMAS W. MILLER, MODELING TECHNIQUES IN PREDICTIVE ANALYTICS: BUSINESS PROBLEMS AND SOLUTIONS (2014). As an example, artificial intelligent machines can predict wine prices better than wine connoisseurs. *See Quants and Quaffs*, THE ECONOMIST (Aug. 8, 2015), http://www.economist.com/news/science-and-technology/21660405-artificial-intelligence-may-beat-connoisseurship-quants-and-quaffs. Companies such as Amazon, Netflix, and match.com have all used machine learning algorithms to better understand consumer tastes.

[87] *See* Brad Power, *Artificial Intelligence Is Almost Ready for Business*, HARV. BUS. REV. (March 19, 2015), https://hbr.org/2015/03/artificial-intelligence-is-almost-ready-for-business.

[88] IBM's Watson, the same artificially intelligent process that defeated the grandmasters of Jeopardy!, has been used in the medical context. *See* Carl Zimmer, *Enlisting a Computer to Battle Cancers, One by One,* N.Y. TIMES (March 27, 2014), http://www.nytimes.com/2014/03/27/science/enlisting-a-computer-to-battle-cancers-one-by-one.html.

[89] *See* Martin Hilbert & Patricia Lopez, *The World's Technological Capacity to Store, Communicate, and Compute Information,* 332 SCIENCE 60 (2011) (estimating the growth of computing power and capacity). *See also, Data, Data Everywhere,* THE ECONOMIST (Feb. 25, 2010), http://www.economist.com/node/15557443.

[90] *Ray Kurzweil on the Price-Performance of Computing*, WALL ST. J. ONLINE (Aug. 20, 2013), http://www.wsj.com/video/ray-kurzweil-on-the-price-performance-of-computing/C1F2B611-4B92-469C-AA33-3129587EC113.html.

[91] William D. Nordhaus, *Two Centuries of Productivity Growth in Computing*, 67 J. ECON. HIST. 128, 128 (2007).

trillion times from 1900-1999,[92] with an explosive trend beginning only after the Second World War.[93]

The growth in computational power has closely tracked Moore's law over the past fifty years.[94] Moore's law is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.[95] This observation has proved remarkably accurate and is now used as a guide to understanding where computing will be in the future.[96] If the trend continues, then within 20 years, computing power will be 1,000 times what it is today.[97] In the same way that city planners have already developed ways of tracking aggregate traffic flows,[98] we predict that lawmakers will be able to collect and use data on how humans behave in almost all aspects of life.

But the growth of data collection and analytics will not be uniform in all areas of law. The evolution from standards to rules will be fastest where the big data is biggest. Indeed, the evolution will be fastest where regulated actors' behavior is more frequent and more homogenous. In these situations, lawmakers will have more data on how individuals behave.[99]

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[92] *Id.*

[93] *Id.* at 142-147.

[94] *See* Moore, *supra* note 1; Lundstrom, *supra* note 1.

[95] *Id.*

[96] Indeed, some suggest that Moore's Law is akin to a self-fulfilling prophecy. *See* Harro van Lente & Arie Rip, *Expectations in Technological Developments: an Example of Prospective Structures to be Filled in by Agency, in* GETTING NEW TECHNOLOGIES TOGETHER: STUDIES IN MAKING SOCIOTECHNICAL ORDER, 206 (Cornelis Disco & Barend van der Meulen, eds. 1998).

[97] As we note above in the Introduction, if this exponential trajectory continues to hold, by the end of this century, computing power will be over one trillion times what it is now.

[98] *See, e.g.,* Todd Litman, *Generated Traffic: Implications for Traffic Planning*, ITE JOURNAL 38 (April 2001). *See also* Thomas Liebig, Nico Piatkowski, Christian Bockermann, & Katharina Morik, *Route Planning with Real-Time Traffic Predictions, in* PROCEEDINGS OF THE WORKSHOP ON MINING URBAN DATA AT THE INTERNATIONAL CONFERENCE ON EXTENDING DATABASE TECHNOLOGY, 331 (2014).

[99] Our argument somewhat mirrors – but extends – the argument of Kaplow, *supra* 3. Kaplow contends that rules are better where regulated behavior is frequent and more homogeneous. We argue that the transition from standards to rules will be faster where regulated behavior is more frequent and homogeneous because this will expedite

Where behavior is less frequent and more heterogeneous, the predictability of behavior will initially be weaker.

We argue, however, that this factor is not fatal to our argument. Artificially intelligent machines will not be bound by some of the limits currently found with using big data.[100] Artificially intelligent machines are not simply programmed with a given structure to anticipate every possible contingency and every possible answer. Rather, artificially intelligent machines are trained to predict, infer, and intuit behavior and adapt to new and unique situations.[101]

Artificially intelligent machines find "hidden" or "deep" connections in unstructured data to provide stronger predictions.[102] In some sense, these machines are capable of "learning."[103] They update to take into account whether their best guesses are correct or not. In doing so, they amalgamate the wisdom of crowds.[104] Artificially intelligent machines marshal this wisdom better than traditional statistical techniques because the machines craft their own learning rules, rather than relying on a potentially biased structure imposed by humans.[105]

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data collection and analysis, leading to greater precision of ex ante information.

[100] *See, e.g.*, Daniela Rus, *The Robots Are Coming: How Technological Breakthroughs Will Transform Everyday Life,* 94(4) FOREIGN AFFAIRS 2 (2015); *but see* Martin Wolf, *Same as It Ever Was,* 94(4) FOREIGN AFFAIRS 15 (2015) (providing a skeptical view).

[101] *See generally* STUART RUSSELL & PETER NORVIG, ARTIFICIAL INTELLIGENCE: A MODERN APPROACH (3d ed. 2009).

[102] *See, e.g.*, Geoffrey E. Hinton, Simon Osindero, & Yee-Whye The, *A Fast Learning Algorithm for Deep Belief Nets,* 18 NEURAL COMPUTATION 1527 (2006).

[103] Machine-learning algorithms learn by recognizing features, concepts, principles, and ideas that humans instinctively recognize but find difficult to program or code. Rather than having to structure a program in order to code rules, the rules are crafted and understood by the artificially intelligent machine.

[104] *See* JAMES SUROWIECKI, THE WISDOM OF CROWDS: WHY THE MANY ARE SMARTER THAN THE FEW AND HOW COLLECTIVE WISDOM SHAPES BUSINESS, ECONOMIES, SOCIETIES AND NATIONS (2004).

[105] Bias may affect algorithms that are based on traditional statistical techniques if some errors are not observable. If the bias is not corrected, errors can be replicated and reinforced by using the algorithm. But recently, a branch of artificial intelligence called *evolutionary computation* has been developed to deal with such problems. Evolutionary algorithms, based on techniques used by evolutionary

2. Predictive technology will displace human discretion

In the near future, more perfect algorithms will begin to displace lawmaker discretion. While this displacement of human discretion may appear novel in the legal sphere, it is simply a manifestation of the *Moneyball* phenomenon.[106]

Moneyball – a book by Michael Lewis on the virtues of the use of data in baseball – elucidates the idea that statistics and data, used correctly, are superior to human judgment. Scouts and coaches in baseball previously relied on the "look" of the player to predict whether a player would make it in the big leagues.[107] But they were wrong. Their hunches were really just manifestations of years of inherited biases, prejudice, and outdated modes of thinking. Taking advantage of this, the Oakland A's used statistical analysis to outperform their rivals.[108]

The lesson is that humans and their hunches are unreliable.[109] Examples can be found everywhere. Insurance companies have developed algorithms that predict the likelihood of accidents far better than humans.[110] From bankers assessing loan applicants[111] and employers hiring

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biologists, use elements of trial and error to search for globally optimal solutions, rather than simply optimizing with the existing space. Candidate solutions are tested using an iterative process. *See* David B. Fogel, *Introduction to Evolutionary Computing, in* EVOLUTIONARY COMPUTATION 1: BASIC ALGORITHMS AND OPERATORS (Thomas Baeck, et al. eds. 2000).

[106] MICHAEL LEWIS, MONEYBALL: THE ART OF WINNING AN UNFAIR GAME (2003).

[107] *Id*. at 32.

[108] With limited financial resources, the A's were able to make the playoffs year after year by performing detailed statistical analyses of players to build a cost effective, winning team that outperformed other teams with far higher payrolls. *Id.*

[109] *See* Kahneman, *supra* note 26.

[110] *See* Berkeley J. Dietvorst, Joseph P. Simmons, & Cade Massey, *Algorithm Aversion: People Erroneously Avoid Algorithms After Seeing Them Err*, 144 J. EXPERIMENTAL PSYCH.: GEN. 114 (2015).

[111] Bank managers who must decide whether or not to give a customer a loan have seen their discretion dissolve. Banks have turned to pre-determined rules about who can borrow and how much they can borrow. The human bank manager is left with little discretion. The algorithm outperforms any individual bank manager in determining the viability of a customer.

prospective employees [112] to commercial pilots flying planes,[113] humans are increasingly placing their trust in machines and finding that outcomes predicted by big data are systematically better than human intuition.

The phenomenon is starting to permeate the field of law. Consider how judges set bail. Previously, the decision to set bail has been based on a standard. The judge weighed up a number of factors, such as the seriousness of the alleged crime, the likelihood of guilt, whether the defendant had jumped bail before, the defendant's social ties and employment situation, the defendant's mental condition, and so on.[114] The list of potentially relevant factors is almost inexhaustible.[115]

But now some jurisdictions are turning to predictive technology to reduce uncertainty and inconsistency in judges' decisions, as well as to reduce the time taken to set bail.[116] A complex algorithm has been developed that seeks

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[112] Employers that use statistical analyses when hiring workers make better hiring decisions than humans that make hiring decisions based on a one-hour interview. *See, e.g.*, Nathan R. Kuncel, Deniz S. Ones, & David M. Kleiger, *In Hiring, Algorithms Beat Instinct,* HARV. BUS. REV. (May 2014); Chen-Fu Chien & Li-Fei Chen, *Data Mining to Improve Personnel Selection and Enhance Human Capital: A Case Study in High-Technology Industry,* 34 EXPERT SYS. WITH APPL'NS 280 (2008).

[113] Commercial airline pilots rely heavily on autopilot technology and are instructed not to take control of the airplane under certain circumstances. For example, the 2009 crash of Air France 447 into the Atlantic Ocean would have likely been prevented if the co-pilot did nothing and did not touch the controls when the plane encountered turbulence. BUREAU D'ENQUETES ET D'ANALYSES POUR LA SECURITE DE L'AVIATION CIVLE, FINAL REPORT ON THE ACCIDENT ON 1ST JUNE 2009 TO THE AIRBUS A330-203 REGISTERED F-GZCP OPERATED BY AIR FRANCE FLIGHT AF447 RIO DE JANEIRO – PARIS (July 5, 2012), http://www.bea.aero/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf.

[114] See, for example, the standard in Massachusetts where bail is determined by examining the alleged crime, the likely penalty, the likely flight risk, history of defaults, family in the area, employment status, and previous criminal records, amongst other criteria. G.L. c.276, § 57.

[115] *Id*.

[116] *See* Shaila Dewan, *Judges Replacing Conjecture with Formula for Bail*, N.Y. TIMES (June 26, 2015), http://www.nytimes.com/2015/06/27/us/turning-the-granting-of-bail-into-a-science.html.

to predict when particular defendants will likely skip bail.[117] The predictive power of this algorithm, which takes into account data on the defendant's characteristics, far exceeds that of any individual judge. This output from the data is more systematic and less likely to reflect bias than an individual judge's hunch. The algorithm reduces error cots (it is better at assessing the likelihood of a defendant jumping bail) and decision costs (judges can simply apply the algorithm).

All of this is to say that it is inevitable that technology will infiltrate and influence all aspects of law. We recognize that our argument runs contrary to the idea that there is something "special" about the law and legal reasoning.[118] Almost every profession thinks their profession is special.[119] In the same way that most drivers believe that they are an above-average driver,[120] humans instinctively believe that judgment and reasoning is special and that technology cannot replicate or replace thought processes or hunches. In *Moneyball*, baseball scouts thought that their ability to pick a future major league star would outperform any statistical analysis.[121] Doctors similarly think that doctors possess special skills.[122] The same is true of teachers.[123] Lawyers

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[117] *Id*. Complex algorithms of this type are already in use in twenty-one jurisdictions across the United States, in places such as Arizona, Illinois, New Jersey, and Pennsylvania.

[118] *See* Joseph Raz, *Reasoning with Rules*, 54 CURRENT LEGAL PROBS. 1 (2001) (asking what is special about legal reasoning).

[119] *See generally* MICHAEL A. BISHOP & J.D. TROUT, EPISTEMOLOGY AND THE PSYCHOLOGY OF HUMAN JUDGMENT, 24-53 (2005) (humans instinctively deny or ignore the success of such technology because of deep-seated cognitive biases, such as overconfidence in our own abilities and judgments).

[120] Iain A. McCormick, Frank H. Walkey, & Dianne E. Green, *Comparative Perceptions of Driver Ability: A Confirmation and Expansion,* 18 ACCIDENT ANALYSIS & PREV. 205 (1986) (about 80% of drivers believe that they are better than the median driver).

[121] *See* Lewis, *supra* note 106, at 29-42.

[122] *See e.g.*, DONALD POLKINGHORNE, PRACTICE AND THE HUMAN SCIENCES: THE CASE FOR A JUDGMENT-BASED PRACTICE OF CARE (2004); Samuel W. Bloom, *Structure and Ideology in Medical Education: An Analysis of Resistance to Change,* 29 J. HEALTH & SOC. BEH. 294 (1988).

[123] *See* Francoise Blin & Morag Munro, *Why Hasn't Technology Disrupted Academics' Teaching Practices? Understanding Resistance to*

too.[124] Perhaps more surprisingly, legal scholars accustomed to looking for biases share this we-are-special belief.

Legal philosophers often contend that law is *necessarily* vague and indeterminate.[125] Other scholars argue that legal reasoning is different from other types of reasoning.[126] Professor Cass Sunstein, for example, suggests that legal reasoning requires an understanding of the principles that underpin reasoning by analogy and has been skeptical that artificial intelligence will be able to replicate this understanding.[127]

Professor Dan Kahan's 2008 address to the graduating class of Yale Law School provides a nice example of the argument that there is something "special" about law.[128] He contends that in order for lawyers to truly understand and evaluate legal reasoning they need years of learning from "grandmasters"[129] – such as professors and senior lawyers – who inculcate students with the power of legal intuition and judgment.[130]

Change Through the Lens of Activity Theory, 50 COMPUTERS & ED. 475 (2008).

[124] *See* Jeffrey M. Lipshaw, *The Venn Diagram of Business Lawyering Judgments: Toward A Theory of Practical Metadisciplinarity*, 41 SETON HALL L. REV. 1 (2011).

[125] *See, e.g.*, TIMOTHY ENDICOTT, VAGUENESS OF LAW, 1 (2000) ("Although not all laws are vague, legal systems necessarily include vague laws.").

[126] Jeffrey M. Lipshaw, *The Venn Diagram of Business Lawyering Judgments: Toward A Theory of Practical Metadisciplinarity*, 41 SETON HALL L. REV. 1 (2011) (arguing that algorithmic judgment cannot replicate legal reasoning).

[127] *See* Cass R. Sunstein, *Of Artificial Intelligence and Legal Reasoning*, 8 U. CHI. LAW SCH. ROUNDTABLE 29 (2001) (suggesting that computer programs do not reason analogically the way humans do).

[128] Professor Dan Kahan's Commencement Address to the Graduating Class of Yale Law School 2008, available at http://digitalcommons.law.yale.edu/cgi/viewcontent.cgi?article=1007&context=ylsca.

[129] *Id*. *See also* Dan M. Kahan, et al., *Ideology or Situation Sense? An Experimental Investigation of Motivated Reasoning and Professional Judgment*, (April 6, 2015) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2590054 (testing whether judges have a unique situation sense expertise based on training and experience).

[130] *Id*.

Professor Kahan compares the profession of lawyers to the profession of chick sexers who determine the gender of one-day old chicks. While there is nothing discernably different about male and female chicks, chick sexers simply know the difference when they feel it. Professor Kahan claims that this "special power to intuitively perceive the gender of a newborn chick" is analogous to how lawyers determine the difference between "good and bad decisions."[131] Professor Kahan argues that lawyers learn how to reason in a special way, and that's what makes the craft of good lawyering so "distinctive" from other professions.[132]

Within two years of Professor Kahan's address, the world of chick sexing had changed dramatically. Predictive technology had been developed that could accurately determine the gender of a chick before birth.[133] Just as the machines defeated the grandmasters of chess and *Jeopardy!*, this new predictive technology bested the chick sexers.

Professor Kahan's address was not about the effect of technology; but the fate of the chick sexers illustrates a major point: there is nothing so special individual human intuition that makes it immune to technology. Individual human intuition can be replicated by technology (which is after all created by humans) – even when the individuals themselves cannot adequately describe their intuitive process.

It is shortsighted to believe that the legal profession is special and that lawyers and judges are immune from predictive technological advances. This shortsightedness hinges on a bias that leads one to believe that only a human can deliver such wise judgments and decisions. Yes, lawyers require judgment. Yes, judges require judgment. But, the judgment of one human is outweighed by a decision

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[131] *Id*.

[132] *Id*.

[133] *Hey Little Hen,* THE ECONOMIST: ONLINE EXTRA (Feb. 9, 2010) http://www.economist.com/node/15491505. This new predictive technology relies on the detection of estrogen as detected by a fine needle inserted into the yolk of an egg.

generated by technology that takes into account millions of judgments and decisions.[134]

To see where this is all going for law, consider how artificially intelligent machines may turn one of the most classic statements of a standard in U.S. legal doctrine into a rule. In *Jacobellis v. Ohio*, Justice Potter Stewart found it very difficult to precisely pin down what distinguished pornography from non-pornography in determining the threshold test of obscenity.[135] Instead, he simply wrote: "I know it when I see it."[136]

Justice Stewart's view suggests that distinguishing between pornography and non-pornography is something that humans can do, but it is difficult to write an ex ante rule that clearly defines the line. Justice Stewart preferred to leave the determination as a standard, to be resolved later.

Artificially intelligent technology can already recognize and analyze images.[137] Now, it is not just a judge who can "see it." In the near future, artificially intelligent machines will be able to develop clear rules that generate immediate predictions of the legality of materials (e.g., "this image is/is not pornographic").[138] While the law on the books may still

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[134] *See* Surowiecki, *supra* note 104. One might also note that judgment is about making the right decision in the absence of full information about outcomes. One the outcomes are known, that sort of judgment is unnecessary.

[135] Jacobellis v. Ohio (1964), 378 U.S. 184.

[136] *Id.* at 197 (Stewart J, concurring).

[137] Four Microsoft researchers have developed a visual recognition program that has an error rate of 4.94%, less than that of a human, 5.1%. *See* Kaiming He, Xiangyu Zhang, Shaoqing Ren, & Jian Sun, *Delving Deep into Rectifiers: Surpassing Human-Level Performance on ImageNet Classification*, MICROSOFT RESEARCH PAPER (Feb. 2015), http://arxiv.org/pdf/1502.01852.pdf. According to one report, Japanese cameras are even being used to identify whether subway passengers are intoxicated. Amber Bouman, *Clever Cameras Detect Drunken Railway Passengers in Japan,* ENGADGET (Aug. 13, 2014http://www.engadget.com/2015/08/13/clever-cameras-detect-drunken-railway-passengers-in-japan/.

[138] Just imagine that Justice Stewart identified fifty pornographic images for the computer. At that point the artificial intelligence programs can find deep connections to identify the pattern that is driving the distinction, but that Justice Stewart could not articulate.

look like a standard, humans will behave as though they are governed by a rule.

B. The feasibility of communication technology

Can lawmakers adequately give timely notice of the law to regulated actors? Can they provide these individuals with instant notice of how best to comply with the law? In the same way that traffic lights automatically and instantly let a driver know they should stop, we foresee a world where all laws are reduced to stop-go directives that are instantly communicated to regulated actors. In this subsection, we discuss the types of technology and infrastructure that will facilitate immediate and effective communication of how to comply with the law.

The costs of communication have been almost obliterated by the Internet. The so-called "Internet of Things"[139] is an interconnected network of physical objects and devices that are embedded with electronics and sensors to allow products to be controlled and used remotely by the user or manufacturer. Recent estimates suggest that between 50 billion to 100 billion objects and devices will be embedded with such technology by the year 2020.[140]

Further, mobile applications are becoming the first port of call for gathering and processing information. The number of apps continues to explode. For example, there are over 1.5 million different applications at the Apple App store and nearly 1.6 million Google play applications.[141] There were zero applications in 2008.

Indeed, such pattern recognition is one of the areas where this technology is already way ahead of humans. And it is why the technology is thought to be so valuable as a diagnostic tool.

[139] *See* Kevin Ashton, *That 'Internet of Things' Thing*, RFID J. (Jun. 22, 2009), http://www.rfidjournal.com/articles/view?4986.

[140] Philip N. Howard, *How Big Is the Internet of Things and How Big Will It Get?,* THE BROOKINGS INST. (June 8, 2015), http://www.brookings.edu/blogs/techtank/posts/2015/06/8-future-of-iot-part-1 (estimating 50 billion embedded objects); Maria Farrell, *The Internet of Things – Who Wins, Who Loses,* THE GUARDIAN (August 14, 2015), http://www.theguardian.com/technology/2015/aug/14/internet-of-things-winners-and-losers-privacy-autonomy-capitalism (estimating 100 billion embedded objects).

[141] *See, e.g., Number of Apps Available in Leading Stores as of July 2015,* STATISTICA: STATISTICS PORTAL (August 1, 2015),

The Internet of Things and mobile applications are not, however, simply ways to improve the consumer experience. Lawmakers can use this technology. The Internet will facilitate *immediate* communication between lawmakers, regulators, individuals, and corporations. Take the field of environmental regulation. Regulators could more easily monitor emissions of factories through the Internet of Things. Regulators could instantly determine when factories are exceeding their limits and quickly inform firms operating those factories of the violation.

The example of advance tax rulings above suggest that the IRS will be able to provide immediate compliance information to individuals and corporations using similar technology to the Internet of Things. Regulated actors could enter information into a web-based or mobile application and receive a ruling on device (like a phone) or some wearable technology (like a watch) from the regulator in a timely manner.

Such infrastructure already exists. For example, cardiologists can simply refer to an app, enter in relevant information, and be given the optimal response for a patient.[142] As technology improves on the fact-gathering front, individuals may not even be required to enter much data in the programs; rather, devices will simply recognize the contours of the factual situation and give notice of whether the individual is complying with the law.

Indeed, lawmakers will be able to provide rules even where the individual must act immediately. When individuals must act immediately, it is not possible to consult a lawyer for compliance advice. Rather, the individual acts and the adjudicator examines whether this action was legal or not after the fact. But a world is possible where this standard is replaced by a series of complex rules that are communicated immediately to individuals using the Internet of Things.

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http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/.

[142] *See supra*, McMillan & Dwoskin, *supra* note 43 (noting the availability of such an app launched by the American College of Cardiology in June 2015).

Self-defense provides an excellent example. Imagine you have just killed a man who you believe was trying to rob you. His hand was in his jacket pocket and you thought he might have a fun. But it turns out he did not. Will you be found guilty of murder? Or was this self-defense?[143]

A judge or jury would evaluate the evidence and decided whether your actions were reasonably necessary to defend yourself against an apparent threat of unlawful and immediate violence.[144] But all this analysis takes place *after* you have killed the man. The immediacy of the events means that you have no opportunity to consult with a lawyer before you act.

What if you could have been informed before you killed the man that he did or did not have a gun? What if you could have been told at the time of the robbery that you were or were not permitted to kill the man in self-defense? In the same way that driverless cars can detect animals and temporary stop signs, predictive technology that can "see" and detect the presence of weapons will be available in the near future.

It is only a small step from there to communicating the behavioral prescription to you at the necessary moment. Individuals could wear, such as contact lenses, that instantly analyze the nature of the threats made by the assailant and give you an immediate ruling as to whether you can or cannot legally kill the assailant. Such technology is merely an extension of technology currently being developed by militaries to immediately identify whether combatants are friends or enemies.[145] More mundane uses

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[143] There are, of course, differences in the law of self-defense across different jurisdictions of the United States. For the purposes of this example, these distinctions are meaningless; our point is that there will always be close cases and that technology can assist individuals understand whether they are complying with the controlling law.

[144] DAVID C. BRODY & JAMES R. ACKER, CRIMINAL LAW 130 (2014).

[145] In an attempt to avoid (or, at least, minimize) friendly fire and fratricide, military scientists have developed combat identification (or "IFF," Identification Friend or Foe) technology that can more easily and more quickly identify whether combatants are friendly or enemies. For example, Lockheed Martin recently announced certification to produce an IFF system for aircrews for the United States Depart of Defense. *MEADS System Gains Full Certification for Identifying Friend or Foe Aircraft,* (May 21, 2014) http://www.lockheedmartin.com/us/news/press-

are also probable: Can you turn left at an intersection? Can you cross the street? Can you attempt to board that subway car? And so on.

The Internet of Things drastically reduces the cost of a lawmaker communicating with regulated actors. This increased notice technology strongly favors the increased use of ex ante rules. But the Internet of Things does not just facilitate communication. There is a feedback effect. The devices that form part of the Internet of Things also *collect* data on how individuals and corporations behave. Lawmakers can generate even better predictions of human behavior by harnessing such data.[146] In doing so, the Internet of Things will reinforce the feasibility of the predictive technology.

III. IMPLICATIONS AND CONSEQUENCES

In this Part, we explore some implications and consequences of our predictions. Observing that trends in predictive and communication technology will reduce the cost of ex ante information, we have predicted that standards will no longer be cost justified under the conventional view of rules and standards. Standards impose uncertainty costs that are in some cases justified by lower decision and error costs relative to rules. But as the decision and error costs of rules fall (because ex ante information is cheaper), the relative cost advantage dissipates; rules present the advantages of standards without the uncertainty costs.

This is not a normative claim. We simply predict that the error costs of rules will drop relative to the costs of standards. There are, however, other costs that may arise from a world without standards. While the law will generate less uncertainty, it may be deficient in other ways. Here, we identify four areas where the consequences and potential costs of the evolution of standards toward rules may be

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releases/2014/may/mfc-052114-mead-system-gains-full-certification-identifying-friendfoe-aircraft.html (noting that the technology "provides positive identification of friendly platforms equipped with an IFF transponder. This helps to discriminate between friend and foe.").

[146] *Cf.* Porat & Strahilevitz, *supra* note 16 (discussing fact gathering technology for personalized default rules).

substantial. First, it will change the broad institutional balance of power in our political and legal system. Second, it may change the development and substantive content of legislative policy. Third, the death of standards will transform the practice and training of law. Fourth, it will have moral and ethical consequences for individual citizens, altering their day-to-day decision-making process and changing their relationship with lawmakers and government. In the remainder of this Part, we explore these implications and consequences in general terms. We conclude by noting how the existence of these costs may or may not affect our prediction.

A. The Death of Judging: Institutional changes to the legal system

The death of standards will produce a shift in the balance of our political institutions. The proliferation of clear micro-rules largely obviates the need for ex post adjudication. This reduced role greatly diminishes the ability of judges to influence the law and increases the power of ex ante lawmakers.[147] The change in the structure of the law does leave some room for some ex post evidentiary questions, but even that will be reduced as the technology for observing facts ex ante improves.[148]

When judges decide cases, they do more than simply apply rules or standards. They do not just call balls and strikes.[149] They also have the ability to shift and modify the

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[147] *See* Ehrlich & Posner, *supra* note 4, at 261 ("The legislature's choice whether to enact a standard or a set of precise rules is implicitly also a choice between legislative and judicial rulemaking."). *See also* Schauer, *supra* note 5, at 310 ("According to the conventional wisdom, therefore, the choice between rules and standards . . . is an important and powerful implement of institutional design determining much of who decides what in a complex and multi-institutional society."). In this sense, the death of standards precedes the death of the judicial function.

[148] On the connection between fact-gathering and predictive technologies, see *supra*, Part I.B.3.

[149] Even this umpire role diminishes with the development of technology that aids, augments, and even replaces the judicial roles in fact-finding and verification of evidence. The proliferation of increasing monitoring technology will significantly reduce the need for judges to perform such tasks. *See Confirmation Hearing on the Nomination of John G. Roberts, Jr. to be Chief Justice of the United States Before the S.*

law. This can happen in at least three different ways. First, judges can interpret a law (rule or standard) differently than the ex ante lawmakers intended – assuming those lawmakers even had an identifiable intent.[150] Judges can also choose to ignore rules (and standards) altogether in the guise of interpretation.[151]

Second, judges can influence popular and institutional views about policy objectives. Judges can impact popular opinion by highlighting a particular issue in a case, using their position to make policy statements, or by issuing incremental holdings that generate support for movements

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Comm. on the Judiciary, 109th CONG. 55 (2005) (comparing judges and baseball umpires); Abram Chayes, *The Role of the Judge in Public Law Litigation,* 89 HARV. L. REV. 1281, 1286 (1976) ("[T]he traditional conception of . . . [t]he judge was [as] a neutral umpire."); *but see* Smith v. Farley, 59 F.3d 659, 665 (7th Cir. 1995) ("judges are not umpires, calling balls and strikes") (Posner, J.); Neil S. Siegel, *Umpires at Bat: On Integration and Legitimation,* 24 CONST. COMMENT. 701; KARL N. LLEWELLYN, THE BRAMBLE BUSH, 20-21 (2d. ed 1951) ("the law official functions somewhat like an umpire . . . but not wholly").

[150] On the ability of judges to add their own interpretation, see – amongst many others – Frederick Schauer, *An Essay on Constitutional Language,* 29 U.C.L.A. L. REV. 809 (1982); Michael S. Moore, *The Semantics of Judging,* 54 S. CAL. L. REV. 151 (1981); Robert W. Bennett, *Objectivity in Constitutional Law,* 132 U. PA. L. REV. 445 (1984); Anthony D'Amato, *Can Legislatures Constrain Judicial Interpretation of Statutes?,* 75 VA. L. REV. 561 (1989); STANLEY FISH, IS THERE A TEXT IN THIS CLASS? (1980); *but see* William N. Eskridge, *Overriding Supreme Court Statutory Interpretation Decisions,* 101 YALE L.J. 331 (1991). The idea that legislative intent exists is not obvious. *See, e.g.*, Kenneth A. Shepsle, *Congress Is a 'They,' Not an 'It': Legislative Intent as Oxymoron,* 12 INT'L REV. L. & ECON. 239 (1992)

[151] *See, e.g.*, William Hubbard & M. Todd Henderson, *Do Judges Follow the Law? An Empirical Test of Congressional Control Over Judicial Behavior,* (unpublished manuscript) (2014); Anthony Niblett & Albert H. Yoon, *Judicial Disharmony: A Study of Dissent,* 42 INT'L REV. OF L. & ECON. 60 (2015) (different judges writing different opinions in the same case cite different precedents and lean toward precedents that align with each judges' political preference); Anthony Niblett & Albert H. Yoon, *Friendly Precedent,* 57 WM. & MARY L. REV. __ (forthcoming 2016) (Court of Appeals judges lean towards citing precedents that align with the political composition of the panel); *but see* Anthony Niblett, *Do Judges Cherry Pick Precedents to Justify Extra-Legal Decisions? A Statistical Examination,* 70 MD. L. REV. 234 (2010).

that have broader consequences.[152] Additionally, given the U.S. federal system, decisions of courts in one jurisdiction might have larger social consequences that impact non-judicial change to policy objectives in other jurisdictions.[153] Many think that this role of the courts in challenging stale and entrenched views has a salutary effect on our democracy.[154]

Finally, judges can outright declare policy objectives to be improper or unconstitutional.[155] This judicial review of

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[152] The legitimation hypothesis suggests that public opinion will begin to converge toward the opinion of the court after a court has handed down a decision. *See, e.g.*, Valerie Hoekstra, *The Supreme Court and Opinion Change: An Experimental Study of the Court's Ability to Change Opinion,* 23 AM. POL. Q. 109 (1995); Brandon L. Bartels & Diana C. Mutz, *Explaining Processes of Institutional Opinion Leadership,* 71 J. POL. 249 (2009). There is a prominent literature discussing "backlash" to court decisions that have the opposite effect of the legitimation hypothesis. *See, e.g.*, Michael J. Klarman, *How Brown Changed Race Relations: The Backlash Thesis,* 81 J. AM. HIST. 81 (1994). Others suggest that the effect is more constrained. *See* GERALD ROSENBERG, THE HOLLOW HOPE: CAN COURTS BRING ABOUT SOCIAL CHANGE? (1991). Further, court decisions can polarize opinion. *See* Charles H. Franklin, & Liane C. Kosaki, *Republican Schoolmaster: The U.S. Supreme Court, Public Opinion and Abortion,* 83 AM. POL. SCI. REV.751 (1989); Timothy R. Johnson & Andrew D. Martin, *The Public's Conditional Response to Supreme Court Decisions,* 92 AM. POL. SCI. REV. 299 (1998).

[153] For example, in 2003, the Massachusetts Judicial Supreme Court held that same sex marriage was legal. Goodridge v. Dep't of Public Health, 798 N.E.2d 941 (Mass. 2003). Scholars have debated the effect that this decision had on public opinion and whether the subsequent change in public opinion set the law on a new path, culminating in the Supreme Court of the United States finding a constitutional right to same sex marriage in 2015. *See* PATRICK EGAN, NATHANIEL PERSILY, & KEVIN WALLSTEN, "GAY RIGHTS" PUBLIC OPINION AND CONSTITUTIONAL CONTROVERSY (2008); Jane S. Schacter, *Courts and the Politics of Backlash: Marriage Equality Litigation, Then and Now,* 82 S. CAL. L. REV. 1153 (2009); Thomas M. Keck, *Beyond Backlash: Assessing the Impact of Judicial Decisions on LGBT Rights,* 43 LAW & SOC'Y REV. 151 (2009); MICHAEL J. KLARMAN, FROM THE CLOSET TO THE ALTAR: COURTS, BACKLASH, AND THE STRUGGLE FOR SAME-SEX MARRIAGE (2015).

[154] *See generally* Robert A. Dahl, *Decision-Making in a Democracy: The Role of the Supreme Court As a National Policy-Maker,* 6 J. PUB. L. 279 (1957); ALEXANDER M. BICKEL, THE LEAST DANGEROUS BRANCH: THE SUPREME COURT AT THE BAR OF POLITICS (1962).

[155] Marbury v. Madison, 5 U.S. 138 (1803). *See also* Jack Rakove, *The Origins of Judicial Review: A Plea for New Contexts,* 49 STAN. L. REV.

legislative policy is considered by many to be an integral part of our system of checks and balances.[156]

As the fundamental nature of law will change, so too will these lawmaking roles of judges. Judges will lose their oversight and lawmaking powers. For non-constitutional questions, the interpretive role will disappear entirely.[157] They will no longer have the power to reinterpret or ignore laws. The policy objectives of law will be set by the ex ante rulemakers (legislative or regulatory). And the judiciary – at least if it maintains its current form and structure – will have no opportunity to question or change those policy objectives. The cases for statutory interpretation and filling in the gaps in vague standards will dry up as citizens are simply instructed to obey the simple directive. The concern here is a separate question than whether machine-aided algorithms can implement policy objectives. The question here is whether there is an independent branch of government with the power to question the policy decisions of the ex ante lawmakers.

1031 (1997); Saikrishna Prakash & John Yoo, *The Origins of Judicial Review,* 70 U. CHI. L. REV. 887 (2003).

[156] *See* JOHN HART ELY, DEMOCRACY AND DISTRUST: A THEORY OF JUDICIAL REVIEW (1980); Barry Friedman, *The Importance of Being Positive: The Nature and Function of Judicial Review, 72* U. CIN. L. REV. 1257 (2004); Larry Alexander & Lawrence B. Solum, *Popular? Constitutionalism?,* 118 HARV. L. REV. 1594 (2005); David A. Strauss, *The Modernizing Mission of Judicial Review,* 76 U. CHI. L. REV. 859 (2009). There are, of course, strong critics of judicial review. *See, e.g.*, William W. Van Alstyne, *A Critical Guide to Marbury v. Madison,* [1969] DUKE L. J. 1; Larry D. Kramer, *The Supreme Court Term 2000-Foreword: We the Court,* 115 HARV. L. REV. 4 (2001); Larry D. Kramer, *Putting the Politics Back into the Political Safeguards of Federalism,* 100 COLUM. L. REV. 215 (2000).

[157] This is the bulk of what judges do. Constitutional questions, while high profile, reflect a small fraction of the judicial caseload. Even in the Supreme Court of the United States, the percentage of cases has not exceeded 50 per cent in recent years. See, RICHARD A. POSNER, HOW JUDGES THINK (2008). The number is far lower in state courts. *See, e.g.*, Robert A. Kagan, *Constitutional Litigation in the United States, in* CONSTITUTIONAL COURTS IN COMPARISON: THE U.S. SUPREME COURT AND THE GERMAN FEDERAL CONSTITUTIONAL COURT, 28 (Ralf Rogowski & Thomas Gawron, eds. 2002) (over the period 1940-1970, only 14.6 per cent of state court cases had constitutional issues); EDWARD V. SCHNEIER & BRIAN MURTAUGH, NEW YORK POLITICS: A TALE OF TWO STATES (2015) (less than 20 per cent of cases involve Constitutional questions).

Moreover, the number of cases litigated will plummet. The question in most cases will simply be whether or not the citizen complied with the simple directive. The case will have two questions: Was the light red? And did the citizen stop? The evidence to answer those questions will continue to be more readily accessible. As the number of cases and controversies litigated falls and the interpretation of policy becomes unnecessary, a judge's ability to use a case to make policy statements and impact opinion will diminish. They will no longer have the opportunities to do so.

One might imagine that the death of standards would play out differently for questions of constitutional law. But the force towards rules will be strong even in that context. In theory at least, constitutional standards[158] are no different from the standards we have discussed throughout this Article. A machine could easily be programmed to tell us whether a particular search was unreasonable, whether certain speech was pornography, whether micro-rules are valid under the commerce clause or some other provision, and so on.

There are institutional structures, however, that may appear to be barriers to the promulgation of constitutional micro-rules. As our regime currently stands, neither Congress nor any agency can dictate that a machine algorithm will decide questions about whether rules are constitutional. The judiciary would surely block any such attempt to eliminate judicial review. As long as *Marbury v. Madison* remains good law, the algorithm would have to come from – or at least be blessed by – the judiciary.

But that could easily happen. While we should not expect the judiciary to implement its own machine-assisted algorithm for these constitutional questions – that is too close to an advisory opinion – the courts could provide precedential guidance to regulated agencies on what types of algorithms would be proper.[159] The courts would essentially provide the policy objective that must guide the rulemaking

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[158] The United States Constitution generally operates through standards. *See* Schauer, *supra* note 5, at 308.

[159] We discuss this type of second-order regulation above. *See supra* Part I.C.1.

technology. This delegation would facilitate the promulgation of micro-rules and the death of standards.

Courts may resist pressures to relinquish that much power. But, as judges lose their power to interpret legislation and change public opinion, the institution will lose strength. A judiciary whose only functions are minimal fact-finding and constitutional review would be a shadow of today's judiciary. Its ability to cling to one last power in the face of change is at best uncertain.

Some may argue that reducing judicial power over policy is a good thing. As the democratically elected branches become more powerful, for example, fears about overreaching by unelected judges will be dampened.[160] Others will no doubt disagree.[161] All can agree, however, that this diminished role of the judicial branch raises complicated questions about institutional design. For those who cherish the active role of judges, alternative mechanisms for that role must be pursued. Perhaps a judiciary that provides advisory opinions on legislative and regulatory policy decisions could be beneficial,[162] preserving the judiciary's oversight power and influence on society.[163] In any event, the question is a serious one that cannot be ignored.

B. The development and substance of policy objectives

In addition to policy decisions moving away from judges, the process by which legislatures and regulators make those decisions will change. So will the very substance of the decisions. As we noted above in Part I.C., regulatory agents will be the primary force behind the shift to micro-rules. Legislatures may very well continue to enact standards, but

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[160] *See, e.g.*, LARRY KRAMER, THE PEOPLE THEMSELVES: POPULAR CONSTITUTIONALISM AND JUDICIAL REVIEW (2004); sources cited *supra* note 156.

[161] *See* sources cited *supra* note 156.

[162] In Canada, the Supreme Court is given the power to issue advisory opinions on the constitutionality of laws. These advisory opinions are known as Reference Questions. *Supreme Court Act*, R.S.C. 1985, c. S-26, s.53.

[163] On the other hand, it is possible that the influence on society requires an actual cases and controversies to make judicial rulings more salient.

they will leave the machine-aided implementation to regulators. Those standards may be nothing more than a statement of the policy objective that should guide the rulemaking machines. Regulators will then translate that broad objective into specific sets of rules generated by machines.

Additionally, the ability to achieve broad goals through machine-derived micro-rules will potentially allow legislatures to state their objectives at increasingly higher levels of abstract social policy. Rather than concern themselves with details of implementation, the legislature will be able to concentrate on the bigger picture. For example, instead of worrying about specific speed limits, the legislature will focus on the purpose of traffic law: does society want laws that reduce accidents, decrease travel time, reduce fuel consumption, or some perfect mix?

At its extreme, learning algorithms aided by big data could be asked to prescribe a vast set of micro-rules covering multiple fields to achieve an even broader social goal, such as maximizing welfare, minimizing accidental death, minimizing wealth inequality, or (more likely) some combination that sets certain acceptable thresholds for these and other social values. This becomes possible because lawmakers no longer have to figure out and set out each precise rule and its connection to other rules. Instead, machines will work out the millions of connected rules that achieve a stated slate of policy objectives. This complex catalog of micro-rules can be targeted to small instances of behavior that fit within a larger web of behavioral actions to achieve a broad goal.

Algorithm-driven laws will automatically and rapidly adapt to the circumstances, optimizing according to the objective of the law. But changes to the law results in winners and losers.[164] Frequent changes to the law may impose additional risks on individuals and may affect the willingness of individuals to invest in projects that may be

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[164] Louis Kaplow, *An Economic Analysis of Legal Transitions,* 99 HARV. L. REV. 509 (1986); Louis Kaplow, *Government Relief for Risk Associated With Government Action,* 94 SCAND. J. ECON. 525 (1989); MICHAEL J. TREBILCOCK, DEALING WITH LOSERS: THE POLITICAL ECONOMY OF POLICY TRANSITIONS (2014).

subject to legal uncertainty.[165] A smart machine will, however, be able to take into account any effects on the values of reliance investments to find a globally optimal solution, rather than a mere locally optimal solution.

Moreover, predictive technology can be used to advise lawmakers on other potential unintended consequences of certain policy objectives. Under today's system, laws frequently have unintended consequences. Laws that change behavior in unexpected ways that undermine the law's goal or disrupt some unrelated area of human behavior in unexpected ways are common.[166]

With the current state of technology, it often takes years before the consequences of a policy decision are fully understood. But as big data and predictive technology improve, lawmakers will be able to more accurately identify these consequences at the time when they make the rules.[167]

The potential for unintended consequences highlights an important facet of the death of standards. Those who set the broad policies in this new world will need to have deep understandings of both social objectives and the way that these technologies work. Machine-assisted rules can only reduce unintended consequences if the machines are programmed to identify the types of consequences about

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[165] The fact that such uncertainty leads to a reduced ex ante investment is a manifestation of the hold-up problem. *See generally* Paul A. Grout, *Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach,* 52 ECONOMETRICA 449 (1984); Jean Tirole, *Procurement and Renegotiation,* 94 J. POL. ECON. 235 (1986); Oliver Hart & John Moore, *Foundations of Incomplete Contracts,* 66 REV. ECON. STUD. 115 (1999).

[166] *See generally* Robert K. Merton, *The Unanticipated Consequences of Purposive Social Action,* 1 AM. SOC. REV. 894. An example of a recent legislative change with unintended consequences occurred when the Ontario government increased access to the small claims court, which had a regressive effect, with richer plaintiffs displacing poor plaintiffs. *See* Anthony Niblett & Albert H. Yoon, *The Regressive Effects of Increased Access to Justice* (unpublished manuscript) (2015).

[167] The technology may, however, get ahead of itself. While predictive technology reduces the chance of unintended consequences for any given rule, it also increases the rate at which rules can be promulgated. If the rate of rule promulgation increases fast enough, unintended consequences may increase even as rules become more accurate. We must know more about how eager lawmakers will be to promulgate micro-rules to understand how significant this risk is.

which policymakers or society care. The humans who instruct machines to create rules must communicate policy objectives to the machines in ways that do not distort the message, and they must "ask" the machines to provide assessments of the consequences of proposed objectives.

If lawmakers do not have a deep understanding of policy consequences and programming, the machines may distort rather than further law. Such concerns animate many science-fiction movies about the fears of artificial intelligence.[168] The current debate about Google driverless cars highlights these concerns. Many have questioned how one should program a self-driving car to deal with ethical decisions about the value of life.[169] Can Google cars, they ask, deal with ethical questions that face human drivers? One commentator notes that humans believe that avoiding a collision with a dog is more important than avoiding a collision with animals that are not pets (like squirrels).[170] But certainly machines – if programmed correctly – could replicate that value judgment and, given the advances in predictive technology, would execute this judgment with greater accuracy than human. On the other hand, if the commentator is wrong – and squirrels are to be avoided with the same care as dogs, then the program can be changed accordingly.[171] The key, then, is in the lawmaker's ability to program that value into the machines.

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[168] Such dystopian visions of the future are found in many popular books and movies. Some examples include: ISAAC ASIMOV, I, ROBOT (1950); 2001: A SPACE ODYSSEY (Metro-Goldwyn-Mayer, 1968), TERMINATOR 2: JUDGMENT DAY (Carolco Pictures, 1991); ROBOCOP (Orion Pictures, 1987). *See generally* Illah Reza Nourbakhsh, *The Coming Robot Dystopia: All Too Inhuman,* 94(4) FOREIGN AFFAIRS 23 (2015).

[169] *See, e.g.,* Patrick Lin, *The Ethics of Autonomous Cars,* THE ATLANTIC MONTHLY (Oct. 8, 2013), http://www.theatlantic.com/technology/archive/2013/10/the-ethics-of-autonomous-cars/280360/; Chris Bryant, *Driverless Cars Must Learn to Take Ethical Route,* THE FIN. TIMES (March 1, 2015), http://www.ft.com/intl/cms/s/0/4ab2cc1e-b752-11e4-981d-00144feab7de.html#slide0.

[170] *A Point of View: The Ethics of the Driverless Car,* BBC MAGAZINE (Jan. 24, 2014), available at: www.bbc.com/news/magazine-25861214.

[171] Janet D. Stemwedel, *Building Self-Driving Cars that Drive Ethically*, FORBES MAGAZINE, (Aug. 5, 2015), http://www.forbes.com/sites/janetstemwedel/2015/08/05/building-self-

Still, some appear to worry that poorly programmed cars will implement a frightening system of social values where they swerve to kill the "wrong" people.[172] Implicit in this critique, however, is the probably false idea that *human* drivers swerve to kill the "right" people. It would seem that the trick in getting all of this right is not in programming the computer, but in somehow agreeing on which people are the "right" ones to kill. That is an age-old moral problem to which we still do not have an agreed-upon answer. Thus, the so-called "trolley problem"[173] is, indeed, a real one for self-driving cars. But that is a familiar critique on the limits of *human* ethics, not on the limits self-driving cars. In other words, it is still a problem for human driven cars too.

In any event, lawmakers of the future must be able to translate society's values into programmable objectives for the machines. The task of identifying those values, it seems to us, will remain a human one.[174]

C. Changes to the practice of law

The observations thus far lead naturally to the next related observation: the death of standards will fundamentally transform the practice of law. For years, a

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driving-cars-that-drive-ethically/ (noting that Google is consulting with moral philosophers).

[172] *See* Tanay Jaipuria, *Self-Driving Cars and the Trolley Problem*, HUFFINGTON POST TECH THE BLOG (June 1, 2015), http://www.huffingtonpost.com/tanay-jaipuria/self-driving-cars-and-the-trolley-problem_b_7472560.html (asking whether cars can make ethical decisions that must value different lives and whether they should favor the life of their owner); Tim Worstall, *When Should Your Driverless Car from Google Be Allowed To Kill You,* FORBES MAGAZINE (June 18, 2014), http://www.forbes.com/sites/timworstall/2014/06/18/when-should-your-driverless-car-from-google-be-allowed-to-kill-you/ (same).

[173] On the trolley problem, see generally, PHILIPPA FOOT, THE PROBLEM OF ABORTION AND THE DOCTRINE OF THE DOUBLE EFFECT IN VIRTUES AND VICES (1978); Judith Jarvis Thomson, *The Trolley Problem,* 94 YALE L. J. 1395 (1985).

[174] There is a possibility that machines could simply observe human behavior and from that deduce what objectives the majority of persons would do and follow that behavior. That would eliminate even the need for human policy considerations. We reject that possibility. Not because the computers cannot do it. But because few would agree that entrenching observed majoritarian behavior is the appropriate objective of law.

chorus of scholars have been pointing out that technology will disrupt and transform the practice of law.[175] We join this chorus to note that as lawmakers adopt micro-rules that are translated and communicated to citizens as simple directives, the role of lawyers will change dramatically. The role of compliance and litigation lawyers will diminish, while the role of a lawyer as lobbyist or policy advisor will grow.

The compliance lawyer today serves as an intermediary who advises a client on how best to comply with a vague standard. The compliance lawyer's expertise is in predicting how an ex post adjudicator will apply the relevant standard to a certain set of facts.

Thus, in our tax example, a client might ask a lawyer whether or not her business arrangement complies with the standards of the tax code. In our medical example, a doctor might ask a lawyer whether her diagnostic procedures would be deemed reasonable under the controlling legal standard. The lawyer reads the relevant law and exercises her judgment, based on education, experience, and other expertise, to provide a prediction. The lawyer might go beyond a yes or no answer and suggest creative ways that a client might alter behavior to increase the likelihood that the adjudicator would find the client in compliance.

Technology will eliminate the need for compliance lawyers. As standards disappear and communication improves, the citizen will simply be told directly whether behavior complies with the law or not. There is no need to consult a lawyer to ask whether a traffic light is green or red. Similarly, litigators will no longer be in the business of arguing about the application of standards, and judges will no longer be in the business of applying them. Rather, litigation will simply be about enforcing the micro-rules.

There will be skeptics. As discussed above in Part II, though technology has already displaced many labor markets, there is a common sentiment that many hold that *their* profession is different and somehow immune to technological disruptions.[176] But simply noting that a

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[175] *See* Katz, *supra* note 2; RICHARD SUSSKIND, TOMORROW'S LAWYERS: AND INTRODUCTION TO YOUR FUTURE (2013); Ribstein, *supra* note 15; and Henderson, *supra* note 15.

[176] *See supra* Part II.A.2.

compliance lawyer's role as information middleman will disappear is not to say that the entire profession of law will be automated. Rather, there will be a shift in the types of tasks that lawyers are charged with. Lawyers will be forced to adapt to the new environment.

Setting the policy directives of a machine algorithm is a complicated thing. To tell a machine that its objective is to minimize traffic accidents without more, could lead to standstill traffic – or, more absurdly, the prohibition of motor vehicles. Instructing the machine to minimize travel times could lead to an abundance of car accidents. A machine can only write rules to meet the objective as it is presented. As we have discussed, the humans who set the objective must be able to understand the consequences of different objectives and must be able to understand which objectives are desirable.

Understanding the implications of different objectives requires not only an understanding of the technology, but also a highly interdisciplinary understanding of human behavior and the goals of our regulatory state. The trend of the last fifty years toward interdisciplinary legal education,[177] with an emphasis on understanding topics such as economics, psychology, philosophy, history, and so on, is one that will serve this new role of lawyers well. We note in passing that recent counter trends toward so-called practical lawyering[178] are likely to be wasted. The idea of

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[177] *See generally* ROBIN L. WEST, TEACHING LAW: JUSTICE, POLITICS, AND THE DEMANDS OF PROFESSIONALISM (2014); Harry T. Edwards, *The Growing Disjunction Between Legal Education and the Legal Profession,* 91 MICH. L. REV 34, 34-5 (1993) (documenting the rise of "law and" movements being taught at law schools); Alex M. Johnson Jr., *Think Like a Lawyer, Work Like a Machine: The Dissonance Between Law School and Law Practice,* 64 S. CAL. L. REV. 1231 (1991); Anthony D'Amato, *The Interdisciplinary Turn in Legal Education,* NULS PUBLIC LAW RESEARCH PAPER NO. 06-32 (2006).

[178] *See* WILLIAM M. SULLIVAN, ANNE COLBY, & JUDITH WELCH WEGNER, THE CARNEGIE FOUND. FOR THE ADVANCEMENT OF TEACHING, EDUCATING LAWYERS: PREPARATION FOR THE PROFESSION OF LAW 12 (2007); R. Michael Cassidy, *Beyond Practical Skills: Nine Steps for Improving Legal Education Now,* 53 BOSTON C. L. REV. 1515 (2012); Joe Palazollo, *Law School Program Emphasizes Practical Skills*, WALL ST. J. (Jan. 4, 2015), http://www.wsj.com/articles/law-school-program-emphasizes-practical-skills-1420419113.

training lawyers solely in practical skills is wasteful when the skills required are likely to change rapidly. The understanding of policy should remain the focus of the legal endeavor because human individuals must set the high-level policy objectives for the law.

D. The broader consequences of these technologies on individuals

The death of standards will raise major concerns about privacy, autonomy, and the ethics of human decision-making.

1. Privacy

Most obviously, as with all applications of big data, the use of data gathering to predict outcomes raises privacy concerns.[179] These concerns have been addressed extensively in other contexts.[180] In our context, the potential for invasions of privacy is high. Government controlled machines will be gathering data about individual behavior and using that information in two ways. First, it will use the information to assess an individual's behavior and provide a legal directive. Second, it will use the information as part of its aggregated data that goes into setting the micro-rules.

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[179] *See, e.g.*, Farrell, *supra* note 140 (investigating the effect of the Internet of Things on privacy and autonomy, suggesting that they will become the preserve of the powerful).

[180] The literature on this new topic is already vast. *See* BIG DATA, PRIVACY, AND THE PUBLIC GOOD: FRAMEWORKS FOR ENGAGEMENT (Julia Lane, et al. eds. 2014); Lisa M. Austin, *Privacy and the Question of Technology,* 22 LAW & PHIL. 119 (2003); Porat & Strahilevitz, *supra* note 16, at 1467-68; Omer Tene & Jules Polonetsky, *Privacy in the Age of Big Data: A Time for Big Decisions*, 64 STAN. L. REV. ONLINE 63 (2012); Omer Tene & Jules Polonetsky, *Big Data for All: Privacy and User Control in the Age of Analytics,* 11 NW. J. TECH & INTELL. PROP. 239 (2013); Paul M. Schwartz, *Information Privacy in the Cloud*, 161 U. PA. L. REV. 1623 (2013); Paul Ohm, *The Underwhelming Benefits of Big Data,* 161 U. PA. L. REV. ONLINE 339 (2013); Paul Ohm, *Broken Promises of Privacy: Responding to the Surprising Failure of Anonymization*, 57 U.C.L.A. L. REV. 1701 (2010); Paul Ohm, *Sensitive* Information, 88 S. CAL. L. REV. __ (forthcoming 2015); Richard A. Posner, *Privacy, Surveillance, and Law*, 75 U. CHI. L. REV. 245 (2008); Daniel J. Solove, *Data Mining and the Security-Liberty Debate*, 75 U. CHI. L. REV. 343 (2008).

Stop light cameras and GPS tracking already create the ability for the government to know a citizen's comings and goings. These capabilities to invade privacy will increase. And the concerns become greater when the government uses the information it gathers in conjunction with technology to predict future actions by an individual.[181]

There is a trade-off here.[182] The more limitations placed on the government's ability to gather information, the weaker will be its ability to create precise micro-rules.[183] Moreover, there may privacy-based calls for the halting of micro-rules because the mere prediction based on aggregate data violates principles of privacy.

The debate and policy choices on privacy here are likely to track general debates and choices about privacy and big data. One can also expect that as individuals continue to waive privacy in private-law contexts,[184] public law will be given additional freedom to gather information that facilitates the evolution from standards to micro-rules.

2. Autonomy

As lawmakers promulgate more precise micro-rules to advance broad policy objectives, the scope of law can expand. Take, for example, a broad policy objective that seeks to increase productivity. In the hands of a powerful algorithm, legal directives like that could dictate virtually every decision in a citizen's life. Smart traffic lights could decide who goes first based on productivity levels. Smart restaurants could dictate what a citizen is allowed to eat for

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[181] The United States government has started to investigate the benefits and costs of using big data. *See* EXECUTIVE OFFICE OF THE PRESIDENT, BIG DATA: SEIZING OPPORTUNITIES, PRESERVING VALUES, May 2014.

[182] Porat & Strahelivitz, *supra* note 16, at 1467-68.

[183] *Cf.* Porat & Strahelivitz, *supra* note 16, at 1467-68 (noting the tradeoff between privacy protections and "granular personalized default rules"). As predictive technology gets better, less and less personal data will be necessary to create precise micro-rules. But some information gathering will always be necessary.

[184] S*ee* Porat & Strahelivitz, *supra* note 16, at 1468 (noting that "most consumers bring strongly pragmatic perspectives to privacy tradeoffs, and they are increasingly willing to share information about them- selves when the benefits from sharing are increased and the threats from sharing are diminished").

breakfast.[185] This presents real concerns for individual autonomy.[186]

But these concerns are not directly objections to the use of predictive technology. Rather they are objections to reckless lawmaking or to overreaching. Lawmakers have to understand what objectives to use in setting micro-rules. Improving productivity might be one policy objective, but there may be other objectives that should be factored in, such as respecting certain spheres of individual decision-making. If principles of human autonomy require the law to allow humans to make certain decisions even when those decisions are inconsistent with other social values, then the lawmakers must be aware of those limitations and avoid encroaching on them when they set policy objectives. This reinforces the importance of lawyers and lawmakers as interdisciplinary policy experts.

The well-trained expert lawmaker might still overreach. That is a more serious concern. The technologies we have described provide the tools for almost limitless rulemaking. A goal to increase productivity at all costs is difficult to enact through legislation today – the information costs are too high. But that will not always be the case. As the information limits on rulemaking fall, it will only be political

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[185] There is no doubt that such outcomes would be controversial as the debate over the "broccoli" analogy in the Affordable Care Act litigation demonstrated. *See* James B. Stewart, *How Broccoli Landed on the Supreme Court Menu*, N.Y. TIMES (June 23, 2012), http://www.nytimes.com/2012/06/14/business/how-broccoli-became-a-symbol-in-the-health-care-debate.html?_r=0. Another example can be found in New York City's "big-soda ban." *See* Michael M. Grynbaum, *New York's Ban on Big Sodas is Rejected by Final Court*, N.Y. TIMES (June 26, 2014), http://www.nytimes.com/2014/06/27/nyregion/city-loses-final-appeal-on-limiting-sales-of-large-sodas.html.

[186] The concept of autonomy in law and philosophy is deeply controversial. *See, e.g.,* SARAH CONLY, AGAINST AUTONOMY: JUSTIFYING COERCIVE PATERNALISM (2013). Professor David Strauss has noted that "autonomy is a notoriously vague notion; there is a danger that any attempt to justify a principle in terms of autonomy will slip into question-begging assertions about the nature of truly free and rational human beings." David A. Strauss, *Persuasion, Autonomy, and Freedom of Expression*, 91 COLUM. L. REV. 334, 354 (1991). Still, there is no question that individual autonomy is implicated by the power of the state to create limitless micro-rules to achieve virtually legislative objective.

costs that restrain those in power. As in our discussion of the diminished role of judges, this once again counsels in favor of attention to institutional structures as the evolution away from standards progresses.

A final and perhaps even deeper concern is that lawmakers may turn the rules into *actual* physical restraints on action. Rather than tell you that the light is red, the technology of the future may simply prevent your car from moving. A self-driving car with no driver override could be entirely in the control of the lawmaker.[187] As the Internet of Things continues to expand, this could be true of most of daily actions.

This is not a move that we predict in this paper, but it may be seen as the next step. Indeed, from a technological perspective, the move from micro-rules to automatic restraint is small; but, from an ethical and policy perspective, the move is enormous. The benefits of such a move include increased compliance and increased certainty; but the costs arrive by way of loss of individual autonomy. One might think such a rule were appropriate if the restraint kept a gun from firing in a situation that would be murder.[188] But things would be different if the rule related to other something less malicious like parking in an illegal spot outside a hospital in an emergency or something mundane like crossing a neighborhood street. Our argument about the death of standards does not imply the death of individual autonomy through prior restraint. These are changes that need to be addressed separately.

3. Ethics

There may be additional concerns that the death of standards will erode moral decision-making. Some argue

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[187] Additional concerns would arise if individuals do not know who owns the controlling technology. *See* Dan Gillmor, *In the Future, the Robots May Control You, and Silicon Valley Will Control Them,* THE GUARDIAN (May 13, 2014), http://www.theguardian.com/commentisfree/2014/may/13/internet-of-things-software-privacy-silicon-valley (noting that autonomy, security, and privacy seem to be an after-thought of the move towards the Internet of Things).

[188] We only use this as an example. No doubt certain gun-rights activists would find this to be a severe affront to autonomy.

that individuals who solely follow rules and directives will become robotic – mere automatons who fail to appreciate the moral choices that should underlie their actions.[189] This is a point made by Professor Shiffrin.[190] Forcing individuals to engage in moral deliberation may be important to the moral health of individuals or of a democratic society. If this is true, the death of standards will bring with it significant costs. We are skeptical that anyone could stop this evolution, so the appropriate response is likely to seek out alternative outlets for human moral deliberation and take that into account in the process of determining the appropriate boundaries of the law.

Finally, people are generally uncomfortable with allowing machines to make important ethical decisions. As discussed above, the debate about Google driverless cars demonstrates this.[191] In that context, many have already begun to ask whether it is acceptable for a machine to make complex ethical decisions about life or death.[192] If we bracket Professor Shiffrin's concerns about moral atrophy, the source of concern appears to arise from a sense that humans have a unique ability to make ethical decisions.[193] It should be noted, however, that even when a machine is making an algorithmic calculation these are human decisions. Humans decide which values the machine considers. Humans tell it what its objective is.

But that does not alleviate the concern. The usefulness of this sort of technology is that it can make decisions in scenarios that are unexpected. There is perhaps an ethical

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[189] *See, e.g.*, Evan Selinger & Brett Frischmann, *Will the Internet of Things Result in Predictable People?*, THE GUARDIAN (Aug. 10, 2015), http://www.theguardian.com/technology/2015/aug/10/internet-of-things-predictable-people (noting that people will essentially become programmable, like machines).

[190] *See Shiffrin*, *supra* note 14. *Compare* LARRY ALEXANDER & EMILY SHERWIN, THE RULE OF RULES: MORALITY, RULES, AND THE DILEMMAS OF LAW (2001) (investigating the dilemma created by individuals following their own unconstrained moral judgment and disobeying rules that themselves restate moral principles in concrete terms).

[191] *See supra* Part III.B.

[192] *See supra* Part III.B.

[193] *See, e.g.*, Lin, *supra* note 169 (noting that humans are presumed to be able to make ethical judgments where computers have an untested track record).

value in having a human making that instant decision rather than placing ourselves on a course of action that cannot be reviewed in the moment. We suspect that a large part of what is going on here is lingering skepticism about accuracy concerns, which we addressed in Part II. People often trust human hunches more than complex machine decisions even in the face of evidence that the machines are more accurate. Perhaps it is a fear of the unknown. But as we have noted above, there is little evidence that humans will be systematically better at making these decisions than machines.

Still a deeper philosophical problem remains. It may be "better" – not in a consequentialist sense but rather a deontological sense – for human individuals to make these decisions in the moment. Something that makes us human might be lost when lawmakers collectively make value judgments in advance.[194] This may be at the root of the squeamishness with which people view artificial intelligence.

We do not propose solutions to these ethical problems. But they are pressing ones that will face lawmakers in the future. The current trend is plainly toward ex ante micro-rules that reduce in-the-moment ethical decisions. To understand whether that is a good thing, lawmakers must engage with philosophers and ethicists on these questions as the evolution to machine-derived micro-rules progresses.

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Before concluding, it is worth noting an implicit assumption in our prediction: the implications and consequences we discuss here will not themselves prevent the death of standards. One might think that if the institutional upheaval and autonomy concerns are great enough, lawmakers will reject the move to rules. We do not see this happening. The growth of predictive technology is robust. The lure of accuracy ("getting things right") and the regulated actors' desire for certainty are powerful forces that will dominate political and legal debates. The more nuanced

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[194] *See generally* MACHINE ETHICS (Michael Anderson & Susan Leigh Anderson, eds. 2011).

considerations we discuss in this Part will, we think, be sidelined.

In that sense, our prediction is about the law's current course. Those that believe the costs of our predicted evolution of law are unacceptable should focus on methods of alleviating these costs or finding means to intervene and change that evolutionary path.

CONCLUSION

As machines become increasingly intelligent, and continue to outperform human judgment, the influence of artificial intelligence will spread far and wide. The technologies we have discussed are already being used by doctors to detect cancers, by consumers to optimize their search for products, and by financial advisors in providing advice.

The legal system will not be immune from this trend. We have suggested throughout this this article that this technological revolution will dramatically alter the foundational structure of law as we know it. Predictive technology will generate greater ex ante information that can be used by lawmakers to write highly specific, complex rules. And individuals will receive notice of these complex rules in a simple form thanks to technological advances in communication. This will be the death of standards.

These developments will have profound implications for the role of judges, legislators, regulators, lawyers, and individuals in the legal system. But beyond that, we will have to change the way we think and talk about law. Take, for example, the classic debate between legal realists and legal formalists.[195] Without ex post adjudication, this debate

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[195] *See generally* Steven M. Quevedo, *Formalist and Instrumentalist Legal Reasoning and Legal Theory*, 73 CAL. L. REV. 119 1985); BRIAN Z. TAMANAHA, BEYOND THE FORMALIST-REALIST DIVIDE: THE ROLE OF POLITICS IN JUDGING (2010). On American legal realism, *see* Brian Leiter, *American Legal Realism, in* THE BLACKWELL COMPANION TO PHILOSOPHY OF LAW AND LEGAL THEORY (Dennis Patterson, ed. 2010); Karl N. Llewellyn, *Some Realism About Realism,* 44 HARV. L. REV. 1222 (1931); GRANT GILMORE, THE AGES OF AMERICAN LAW (1977); WILFRED E. RUMBLE, AMERICAN LEGAL REALISM (1968); ROBERT SUMMERS, INSTRUMENTALISM AND AMERICAN LEGAL THEORY (1982). On formalism, *see generally,* Frederick Schauer, *Formalism*, 97 YALE L. J. 509 (1988);

changes radically. As standards disappear and judges have progressively less influence, legislative intent will be entrenched and concretized in the catalog of micro-rules.

On the other hand, technology that vastly improves ex ante information will breathe new life into old law-and-economics models that began with an assumption that lawmakers and citizens have full information. Friction in these models caused by imperfect and asymmetric information has provided a fertile source of material for critics, both inside and outside the field of law and economics. But these models will be given renewed importance. Similarly, the public choice literature will have an increased emphasis on how legislators choose objectives, rather than how they implement laws, while academic interest in subjects such as judicial behavior will dissipate.

All of this is to say that legal institutions of all types will change radically. We are witnessing an information revolution. And, like other technological revolutions, it will precede a legal revolution. The industrial revolution, for example, saw human labor replaced by machine labor and the cost of transportation fell markedly with inventions such as the steam engine. It greatly reduced transaction costs and had widespread impact on all spheres of law including contract law,[196] property law,[197] employment law,[198] criminal law,[199] and tort law.[200]

The information revolution has already resulted in dramatic changes in the world of commerce. For example,

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Ernest J. Weinrib, *Legal Formalism: On the Immanent Rationality of Law*, 97 YALE L. J. 959 (1988).

[196] *See, e.g.*, P. S. ATIYAH, THE RISE AND FALL OF FREEDOM OF CONTRACT (1979); GRANT GILMORE, THE DEATH OF CONTRACT, Ch. 1 (1974).

[197] For example, to see the feedback effect between intellectual property and the industrial revolution, see Joel Mokyr, *Intellectual Property Rights, the Industrial Revolution, and the Beginnings of Modern Economic Growth*, 99 AM. ECON. REV. 349 (2009).

[198] Clark Nardinelli, *Child Labor and the Factory Acts,* 40 J. ECON. HIST. 739 (1980).

[199] *See, e.g.*, Douglas W. Allen & Yoram Barzel, *The Evolution of Criminal Law and Police During the Industrial Revolution,* 27 J.L. ECON. & ORG. 540 (2011).

[200] *See, e.g.,* Joel Franklin Brenner, *Nuisance Law and the Industrial Revolution,* 3 J. LEGAL STUD. 403 (1974).

companies such as YouTube, Uber, and Airbnb have disrupted and uprooted heavily regulated and stable industries. It will lead to similar disruption of the legal services industry, but the effect on law will be much deeper and far wider. This next technological revolution will affect the very structure of legal commands and the way we, as a society, choose to govern the behavior of citizens.