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Anthony Casey

Anthony Niblett

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# FOCUS FEATURE: ARTIFICIAL INTELLIGENCE, BIG DATA, AND THE FUTURE OF LAW

Anthony J Casey\* &  
Anthony Niblett\*\*

SELF-DRIVING LAWS†

*Machines refine and improve products. Artificially intelligent machines will soon have the same effect on the law. Future developments in artificial intelligence and machine learning will dramatically reduce the costs currently associated with rules and standards. Extending this insight, we predict a world of precisely tailored laws ('micro-directives') that specify exactly what is permissible in every unique situation. These micro-directives will be largely automated. If the state of the world changes, or if the objective of the law is changed, the law will instantly update. The law will become 'self-driving.' The evolutionary path towards self-driving laws will be piecemeal and incremental. At first, machine-driven algorithms will merely be used to guide humans, but, over time, law will increasingly reflect principles and prescriptions developed by machines. We explore three extensions. First, we examine the possibility that the technology is not merely used to provide information about the state of the law but is also used as means of command by the state. Second, we ask how these technological changes will affect contracting behaviour. Third, we examine the effect of micro-directives on social norms.*

*Keywords:* artificial intelligence, big data, law, future, micro-directives, algorithms, contracts, norms

## 1 Introduction

Machines refine and improve products. Artificially intelligent machines will soon have the same effect on the law. In this article, we ask how future developments in artificial intelligence, machine learning, and big data will affect the production of law and the structure of law. We predict that these new advancements will fundamentally change the way we, as a society, choose to govern behaviour.

\* Assistant Professor of Law and Mark Claster Mamolen Teaching Scholar, University of Chicago Law School

\*\* Assistant Professor and Canada Research Chair in Law, Economics, and Innovation, Faculty of Law

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We have elsewhere argued that these technological advancements will lead to the death of rules and standards.<sup>1</sup> To be more precise, we have argued that these advancements will lead to the death of the costs of rules and to the death of the costs of standards. Rules are clear, but they are static and rigid. Rules are likely both over- and under-inclusive. They can be improved by taking into account particular facts of a situation. Standards are flexible and allow the lawmaker to take into account the circumstances of a specific case. But standards are judged after the citizen has acted, giving rise to legal uncertainty at the time of action. Further, subjective biases of human judges may generate legal inconsistency. Standards can be improved by alleviating the uncertainty and informing citizens how to comply with objectively stated laws.

We envision a world where lawmakers use machines to refine the law, improving on both rules and standards. Ultimately, law will exist in a catalogue of precisely tailored directives, specifying exactly what is permissible in every unique situation. In this world, when a citizen faces a legal decision, she is informed of exactly how to comply with every relevant law before she acts. The citizen does not have to weigh the reasonableness of her actions nor does she have to search for the content of a law. She follows a simple directive that is optimized for her situation. We call these refined laws ‘micro-directives.’

These micro-directives will be largely automated. If the state of the world changes, or if the objective of the law is changed, the vast array of micro-directives will instantly update. These laws will be better calibrated, more precise, and more consistent. The law will become, for all intents and purposes, ‘self-driving.’

In the first Part of this article, we outline how micro-directives will be used to govern behaviour in the future. In the second Part, we explore the likely evolution towards a world of micro-directives. We examine how reductions in the cost of information will first change human behaviour and then how the law, over time, will become machine-produced directives. In the third Part of the article, we explore three extensions: the possibility of automatic penalties, how technology will change contracting behaviour, and the effect of micro-directives on social norms. A final Part concludes the article.

1 Anthony J Casey & Anthony Niblett, ‘The Death of Rules and Standards’ (2017) 92 *Ind L Rev* [forthcoming] [Casey & Niblett].

II *Automated micro-directives*

## A THE REDUCED COST OF INFORMATION

At the heart of our thesis is information. The cost of information drives the lawmaker's choice between using a rule and using a standard. Where citizen behaviour is frequent and predictable, rules (such as speed limits) are preferable because lawmakers have, *ex ante*, the necessary information to regulate behaviour. Where citizen behaviour is infrequent and heterogeneous, standards (such as reasonable care) are preferable because lawmakers can, *ex post*, take into account additional information to determine whether the behaviour complies with, or violates, the law.

Technological advances will result in a dramatic reduction in the cost of acquiring and using information. Such technologies will allow lawmakers to better predict outcomes and human behaviour. As the differences in information costs fall away, the distinction between rules and standards will erode. The lawmaker's decision between rules and standards will become unnecessary. A new form of law – the micro-directive – will emerge. The micro-directive provides *ex ante* behavioural prescriptions finely tailored to every possible scenario.

Micro-directives update automatically. If relevant circumstances change, the micro-directive changes. No longer will we need rigid rules; the law will adapt to the new environment. Citizens will no longer have to operate in a world of legal uncertainty, waiting for a judge to determine whether the behaviour was reasonable. Citizens will be informed immediately of what is permissible and what is not.

The technological changes will allow the law to be more precise, better calibrated, more flexible, more consistent, and less biased. The machine-driven algorithms will allow the law to become self-driving. In the same way that self-driving cars anticipate the changes in surrounding circumstances and provide the optimal response, we hypothesize that laws will take specific circumstances into account and provide a tailored statement of what is permissible.

## B USING PREDICTIVE TECHNOLOGY TO MAKE LAW

Consider how improvements in prediction – predictive technology – will foster the rise of micro-directives. Innovations in big data and artificial intelligence will make it increasingly easy to predict outcomes. The costs of collecting, storing, processing, and analyzing data will fall. New machine-learning techniques are outperforming traditional regression

approaches to prediction.<sup>2</sup> Algorithms based on these approaches, using big data, will form the backbone of precise and finely calibrated laws.

Citizens, armed with an increased power of forecasting, will use predictive technology to assess whether their behaviour complies with the law. Corporate directors will be able to use predictive technology to assess whether or not their actions will violate their fiduciary duties to shareholders. Uber drivers can use predictive technology to determine whether or not they are independent contractors or employees for tax purposes. Corporate entities can assess whether a proposed merger will violate anti-trust laws. Here, compliance information is precise and tailored to each citizen's particular circumstance.

To some, this is not 'the law' but, rather, a description of the law at one point in time. Critics may be concerned that if these algorithms are seen as the law, then the algorithms will not change with different states of the world or take into account special or unforeseeable circumstances. But any machine-produced law can be re-calibrated to take into account new circumstances.

A further concern is that an algorithm will simply entrench biases in the law. But predictive technology will not just be used to inform citizens of the existing state of the law. The technology will also be used to change the contours of the law, improving precision and consistency.

Take, for example, how predictive technology will be used to decide whether or not to grant bail to a defendant accused of a crime. Currently, a human judge must weigh many factors, including the seriousness of the alleged crime and whether the defendant has jumped bail before, and the defendant's social and family ties. Based on the information about this particular defendant, the judge must assess whether the defendant will skip bail. The decisions of human judges have been shown to be inconsistent across different judges and infused with racial bias.<sup>3</sup>

Society can improve upon this situation by using analytics of big data and machine-learning technology. We have millions of observations about how criminal defendants actually behave once they are granted bail. Why would we ignore this information? Predictive algorithms give a much more precise and accurate answer as to whether the defendant will skip bail. Not only are these algorithms more accurate than human judges, but they are also more objective, more consistent, and less prone to bias.

<sup>2</sup> See e.g. Jon Kleinberg et al, 'Prediction Policy Problems' (2015) 105 *American Economics Review* 491.

<sup>3</sup> See Shaila Dewan, 'Judges Replacing Conjecture with Formula for Bail,' *New York Times* (26 June 2015), online: <<http://www.nytimes.com/2015/06/27/us/turning-the-granting-of-bail-into-a-science.html>>.

Predictive technologies will fill gaps in the law. Micro-directives will be available for every hypothetical situation, eradicating the grey area of law. Justice Benjamin Cardozo, in a famous contracts case, contended that the dividing line between an important and a trivial omission resulting in a breach of a condition ‘cannot be settled by a formula’ and that ‘precise boundaries are impossible.’<sup>4</sup> In the near future, however, predictive technologies will be used to discerning these boundaries. Deep-learning technology will find hidden connections in the law, elucidating principles that do – and, more importantly, should – underpin the law.

Importantly, the new machine-learning techniques will update and adapt to new situations. These models absorb new information and factor in new circumstances. In order to better calibrate predictions, evolutionary algorithms in machine learning operate using principles similar to those used in randomized trials in medicine. Micro-directives, based on these predictive algorithms, will update automatically as the state of the world changes. Laws will update automatically. We move towards a world of self-driving laws.

Human policy makers will still play a crucial role. Just as self-driving cars will determine the safest and fastest route to a destination selected by humans, self-driving laws will determine the optimal way to achieve a policy objective chosen by humans. Even though the micro-directives are automated and update in real time, human lawmakers will be required to set the broad objectives of the law. These broad objectives may look like a standard, but the predictive technology will take the objective and engineer a vast catalogue of context-specific directives for every situation.<sup>5</sup>

#### C USING COMMUNICATION TECHNOLOGY TO BETTER INFORM CITIZENS

Simply having a better calibrated and automatically updating law is not enough, however, for micro-directives to flourish. These new laws must also be accessible to citizens. Imagine a ‘rule book’ for doctors that contained micro-directives covering every possible scenario. This rule book would be enormously detailed but unwieldy. The cost of complying with such detailed rules would be exorbitant.

This is where communication technology comes in. The cost of communicating specific information that updates in real time continues to fall dramatically. This technology will be able to identify which specific micro-directive applies to a particular situation and inform the regulated actor how to comply with the law.

<sup>4</sup> *Jacob & Youngs, Inc v Kent*, 129 NE 889, 892 (NY 1921).

<sup>5</sup> For more on the role that human policy makers will play in this new system, see Casey & Niblett, *supra* note 1.

Regulators will be able to provide instantaneous information about the legality of proposed actions. For example, let us say that an individual wishes to know whether she is an employee or an independent contractor. Under the current system, the individual may ask the regulator for an advance tax ruling, by providing all information to the regulator.<sup>6</sup> But this process can take weeks or even months. In the near future, predictive and communication technologies will enable these ‘rulings’ to be provided within seconds.<sup>7</sup>

These advancements in prediction and communication will be reinforced by other technological advancements in fact gathering and verification. As machines get better at gathering and verifying facts, more and more data will be generated and analyzed. The predictive power will be further enhanced. These fact-gathering technologies will also improve the precision of the communicated micro-directive. The micro-directives will be better tailored as the law-making machines absorb more information about particular scenarios.

### III *The evolution towards self-driving laws*

#### A INCREMENTAL CHANGE

The death of rules and standards will be piecemeal and incremental. An analogy can be drawn to the evolution of self-driving vehicles. Vehicles will not suddenly shift one day from completely human operated to completely self-driving. The evolution will progress incrementally. Many aspects of self-driving vehicles are already standard features in new models. These features include self-parking, lane keeping, automatic braking, adaptive cruise control, and accident avoidance.

At first, the technology simply provided drivers with information. In the 1990s, for example, technology provided drivers with warnings that they were too close to other parked cars. As this technology became standard, newer models provided self-parking technology. Similarly, technology has been introduced warning a driver that she is not keeping to her lane. Soon, the driver will be presented with the option of using technology to automatically stay in the lane. Over time, with increasing acceptance, vehicles will become entirely self-driving.

<sup>6</sup> See e.g. Canada Revenue Agency, online: <<http://www.cra-arc.gc.ca/tx/hm/xplnd/rhng-eng.html>>.

<sup>7</sup> This mechanism of immediate and definitive responses to what are now considered grey areas of law, especially in the field of tax, is a common feature of what Benjamin Alarie calls ‘legal singularity.’ See Benjamin Alarie, ‘The Path of the Law: Towards Legal Singularity’ (2016) 66 UTLJ 443.

We predict that the evolution of the law towards micro-directives will follow a similar pattern. At first, technology will be used to provide general information to citizens. Then, with increasing acceptance from citizens and lawmakers, the predictions will become the law. We provide three examples of how we expect the evolution to play out.

First, consider the example of judges granting bail. A computer-driven algorithm to predict the likelihood of a defendant skipping bail is already being used in some jurisdictions in the United States. But this algorithm has not completely replaced human judges yet. The transformation will take time. The algorithm is currently used to provide human judges with a better forecast of the risk of flight. Soon, we imagine, the algorithm will provide recommendations as to how the judge should decide. These recommendations could be followed or ignored by the human judge. Yet, as more information is generated, and the evolutionary algorithm updates and becomes a better forecaster, we imagine that judges will increasingly rely on the advice of the algorithm. Over time, with increased acceptance, the algorithm will become the law. The algorithm will effectively replace the judge.

Second, consider how the law of medical malpractice will begin to mirror predictive machine-driven algorithms. Initially, these predictive algorithms will simply provide information, perhaps outlining the likelihood of adverse outcomes if a particular action is taken. Over time, however, the machines will provide recommendations on how to best proceed or warnings on how not to proceed. As these recommendations and warnings become increasingly accurate, and doctors increasingly rely on predictive algorithms to guide their practice, the algorithms will become enshrined in the law. In the same way that it would be negligent for a doctor to ignore an x-ray today, it will become negligent to ignore the advice of the machine. Over time, the algorithm will become the law of medical malpractice.

Third, consider how regulators may use the technology to provide the law directly to regulated actors. A tax regulator could, for example, use machine-learning programs to automatically process questions of tax residency. Predictive programs would analyze how judges have resolved these questions in the past and would allow the regulator to process questions asked of them by taxpayers. As the regulator becomes more confident in the automated responses, the technology will be made available to taxpayers directly. Taxpayers would receive instantaneous legal advice about their affairs. Again, over time, the algorithm becomes the law.

These three examples illustrate the incremental nature of the evolution of the law away from rules and standards and towards automated micro-directives. The speed of the change will depend on the type of law. The evolution will likely be fastest where the costs both of legal

uncertainty and of poorly calibrated laws are high. Such costs are likely greatest in commercial fields such as tax, corporate law, securities, and anti-trust. The pressure to automate laws will be strongest in these spheres. The push towards automation will also be greater where data is already abundant (for example, granting bail) and where the law is more inherently stable. The principles underpinning the law of whether a worker is an independent contractor or an employee for tax purposes have remained relatively stable in Canada for years, but, determining whether particular laws violate the protection of freedom of expression in section 2 of the Canadian Charter of Rights and Freedoms may, initially, prove more difficult for a machine-driven predictive algorithm.<sup>8</sup>

#### B HUMAN SCEPTICISM

The incremental and piecemeal nature of the evolution towards micro-directives is not simply a matter of feasibility. While some predictive algorithms may take some time to update and improve, there are other barriers.

Humans are sceptical creatures. In the same way that driverless cars are frightening to some, the idea of automated machine-produced law is also terrifying. How can we trust the machines to get the ‘right’ answer? How can we trust an algorithm to deliver a law that is just?

Throughout history, humans have held a deep distrust of automated technology. When automated elevators were first introduced, they also were scary. Elevators had for years been ‘driven’ by human operators to guide them to the right level. When elevators with automatic stopping were invented in 1900, some people refused to ride them. Automatic elevators were truly terrifying. How can you trust an automated machine to lift you hundreds of feet above the ground in a tiny metal box? Automatic elevators did not become standard until after the Second World War because of this scepticism. Today, few in the developed world today are frightened of automatic elevators. It took time, but we overcame our scepticism of the technology. As laws become increasingly automated, we believe the scepticism to machine-produced law will also fade away.

Can a machine actually do the tasks currently performed by legislators, regulators, judges, and lawyers? Almost everyone thinks his or her profession is special. Humans instinctively believe that their judgment and reasoning is special and that technology cannot replicate or replace their particular skill. Doctors, teachers, and baseball scouts all believe that

<sup>8</sup> *Canadian Charter of Rights and Freedoms*, Part 1 of the *Constitution Act*, 1982, being Schedule B to the *Canada Act 1982* (UK), 1982, c 11.

they uniquely possess special skills that cannot be automated.<sup>9</sup> Lawyers are no different.<sup>10</sup> The belief that the legal profession is special and that lawyers and judges are immune from displacement by technological advances hinges on a bias that leads one to believe that only a human can deliver such wise judgments and decisions.

But human decision makers are flawed and biased. The biases and inconsistencies found in individual judgments can largely be washed away using advanced data analytics. The judgment of one human judge is outweighed by the wisdom of a decision generated by predictive technology that takes into account millions of judgments and decisions.<sup>11</sup> Even if a machine-produced law is not perfectly unbiased, as long as it is less biased than a law produced by individual humans, the result will be net beneficial. Plus, the decisions generated by the machine will be far more consistent than human judgments. Finally, even if a machine-produced law were to entrench biases, reprogramming a machine to correct for bias will be far easier than reprogramming and de-biasing many human judges.

#### C OTHER ROADBLOCKS AND CONCERNS

The rise of micro-directives will bring enormous institutional upheaval and autonomy concerns that may present additional roadblocks in the evolution of the law. The death of rules and standards produces a shift in the balance of our political institutions, greatly diminishing the power of the judiciary. As the number of cases and controversies litigated falls and the interpretation of policy becomes unnecessary, the opportunity afforded to judges to use cases to make policy statements and impact

9 See generally Michael A Bishop & JD Trout, *Epistemology and the Psychology of Human Judgment* (Oxford: Oxford University Press, 2005) at 24–53 (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). On medicine, see e.g. Samuel W Bloom, ‘Structure and Ideology in Medical Education: An Analysis of Resistance to Change’ (1988) 29 *Journal of Health and Social Behavior* 294. On education, see Françoise Blin & Morag Munro, ‘Why Hasn’t Technology Disrupted Academics’ Teaching Practices? Understanding Resistance to Change through the Lens of Activity Theory’ (2008) 50 *Computers and Education* 475. On baseball scouts, see Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* (New York: Norton, 2003).

10 See Jeffrey M Lipshaw, ‘The Venn Diagram of Business Lawyering Judgments: Toward a Theory of Practical Metadisciplinarity’ (2011) 41 *Seton Hall L Rev* 1; Cass R Sunstein, ‘Of Artificial Intelligence and Legal Reasoning’ (2001) 8 *U Chicago L Sch Roundtable* 29 (suggesting that computer programs do not reason analogically the way humans do).

11 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* (New York: Anchor House, 2005).

opinion will diminish. On the other hand, the opportunities for judges to inject bias and error will also diminish.

The normative concern here raises a separate question about whether machine-aided algorithms can implement policy objectives. The question is whether there is an independent branch of government with the power to question the policy decisions of the *ex ante* lawmakers. When the lawmakers decide on legislative objectives and parameters for the machine algorithms, do we want a separate branch of government to review these decisions? If we do, the reduced role of the judiciary is troubling.

There are also broader consequences for individual citizens. Privacy would no doubt be affected since machines need to gather data about human behaviour in order to make decisions. The capability of machines to invade privacy will increase. These concerns are exacerbated when a government uses the information it gathers in conjunction with technology to predict future actions by an individual.

Individuals may choose to ignore micro-directives in the same way that many individuals today choose not to have cell phones and other communication devices. While the micro-directive merely provides information about how to comply with the law rather than a command,<sup>12</sup> there are ethical questions of holding individuals liable for laws that may change rapidly and when individuals are not informed of these changes.

Automated laws also affect human autonomy. Human autonomy may be increasingly constrained as more and more ethical decisions are shifted from the purview of flawed humans to consistent machines. Moral atrophy may ensue. Individual citizens who simply follow rules and directives may become robotic, mere automatons who fail to appreciate the moral choices that should underlie their actions. The trend towards micro-directives will be real as the cost of prediction and communication falls. The consequences relating to morality, privacy, and autonomy should be addressed before micro-directives arrive.

#### IV *Broader implications*

In this section, we explore three extensions to our thesis. First, we explore the possibility that micro-directives are used not merely to provide information about the law but also to enforce the law. Second, as the cost of information falls, the cost of contracting will also fall. We suggest that citizens will increasingly use micro-directives when ordering their private affairs. Third, we explore how the falling cost of

<sup>12</sup> Later in this article, we discuss how micro-directives might be used as commands.

information may lead to formal micro-directives replacing informal social norms.

#### A AUTOMATIC PENALTIES FOR VIOLATION

We have set out a vision of a world where citizens are informed about the contours of law pertaining to their situation. The micro-directive merely provides a highly tailored rule, not a specific command. Upon receiving the micro-directive, the individuals may still elect to violate the law. For example, upon receiving a micro-directive from a tax regulator that you are an employee, you may still elect to file your taxes as an independent contractor in order to claim more deductions. There will be some probability that you will not be audited and your violation will remain unpunished. Similarly, a doctor may receive a micro-directive that says surgery is not required, but she may disagree with the law. She may perform the surgery. If the patient is not harmed, the doctor will suffer no consequences for ignoring the directive. In the language of Thomas Hobbes, the micro-directive is merely ‘counsel’ rather than ‘command.’<sup>13</sup>

Let us suppose though that the law-making authorities can impose an automatic fine or punishment for violating the micro-directive. In this world of command, fact gathering and verification technologies may permit immediate notification of a violation of a micro-directive. Here, citizens’ actions could attract scrutiny and punishment irrespective of the ultimate consequences. Penalties could become immediately payable for individuals not following the micro-directive. A doctor who wishes to perform surgery in spite of a micro-directive forbidding surgery would immediately pay an automatic fine for disobeying the directive. A jay-walker may have a fine immediately deducted from her bank account. These fines operate as a price for violating the law. There are benefits of such policies. Through this mechanism, the machine would learn about ‘efficient violations’ of the law. The evolutionary algorithm harnesses increasing amounts of information from citizens.

Such commands come at a cost. As Frederick Hayek noted in *The Road to Serfdom*, ‘commanding people which road to take’ is different to providing signposts; it is coercion.<sup>14</sup> Automatic penalties for violation would

<sup>13</sup> Thomas Hobbes, *Leviathan*, ed by Richard Tuck (Cambridge, UK: Cambridge University Press, 1996) at 176: ‘Command is where a man saith, Doe this, or Doe not this, without expecting other reason than the Will of him that sayes it. From this it followes manifestly that he that Commandeth pretendeth thereby his own Benefit . . . Counsell, is where a man saith, Doe, or Doe not this, and deduceth his reasons from the benefit that arriveth by it to him to whom he saith it.’

<sup>14</sup> Frederick A Hayek, *The Road to Serfdom* (London: Routledge Press, 1944) at 74.

pose additional ethical questions that will need to be addressed before the arrival of micro-directives. Would the stigma of illegal behaviour disappear if rich citizens were able to simply pay a fine at the time of acting?<sup>15</sup> Should these automatic penalties be different for the rich and the poor?

A far more dystopian vision is one where lawmakers turn micro-directives into physical restraints on behaviour. Rather than commanding which action should be taken, the individual is restrained from undertaking actions that do not comply with the law. Instead of simply telling the doctor that surgery is not the wisest course of action and that performing surgery will constitute negligence, imagine now that the medical technology required to perform the surgery is automatically switched off, denying the doctor the possibility of performing the surgery. From an ethical and policy perspective, the move from micro-directives to automatic restraint and strict coercion is enormous. While there may be increased compliance and greater certainty, the costs to individual autonomy would be great. Further, a complete ban on violations would be deeply inefficient, as it would dull the ability of a machine-driven algorithm to learn about how well calibrated the law is.

#### B MICRO-DIRECTIVES IN CONTRACTS

The improvements in predictive technology will not just change the way that law is produced by legislators, regulators, and the judiciary. As the cost of information falls, and the accuracy of forecasts improves, the way contracts are produced will also change. Currently, contracts are designed to trade off certainty and flexibility. But in a world with greater certainty about the future, the problems of incomplete contracting will begin to fade away.

When contracting parties have poor information about future contingencies, parties commonly use vague standards to guide future behaviour. Parties use terms such as 'best efforts' or 'reasonable efforts.' But, as information about the future state of the world improves, the obligations of each party can be directed with greater precision. Rules and standards will give way to extremely precise courses of action. In each state of the world, the parties will be informed how best to act in order to preserve the intent of the contract. Contracts will fully specify how each party should behave in any state of the world.

Micro-directives in contracts do not need to be understood and agreed to at the time of contracting, however. Suppose that the parties

<sup>15</sup> Uri Gneezy & Aldo Rustichini, 'A Fine Is Just a Price' (2000) 29 *J Leg Stud* 1.

simply agree to ‘maximize joint surplus’ and agree upon a general principle for splitting the dividends. With this guiding principle, a machine-driven algorithm will be able to automatically update and inform parties of their obligations as the state of the world changes. The contract that governs the behaviour of the parties will essentially be self-driving.

The evolution towards self-driving contracts will, of course, not happen overnight. At first, contracting parties may use information from predictive technologies to provide better advice on how surplus can be maximized. As confidence in the results increases and the benefits of using machine-learning predictions are realized, contracting parties will increasingly rely on algorithms to provide the guidance on how to behave. Over time, the algorithms will become the contracts.

This vision of contracting is, from one perspective, a radical departure from the world of contract law as we know it. Contracting parties no longer need to assent to the particulars of a contract. As long as parties agree to the broad vision, an algorithm will fully describe the obligations of the parties.

But, from another perspective, this is a continuation of the evolution of contracting that we have witnessed over the past few centuries. As the length of contracts continues to grow, covering more and more contingencies, the likelihood that all of the parties have read and understand all of the terms of a contract becomes slimmer. Courts, though, have held that long, unread contracts are still enforceable, provided the terms are reasonable. Our vision of micro-directives in contracting simply extends this principle one step further.

### C LAWS AND NORMS

While we have argued that the technologies will enable greater specification and precision of the law, we do not necessarily predict ‘more’ law. Rather, within the spheres of action where we, as a society, have chosen to govern human behaviour through law, the law will be more efficient and better calibrated. We have focused on scenarios where micro-directives replace grey areas of the law. They are simply replacing vague laws with more certain and better-tailored laws. On this view of the future, the law will not encroach on, or infiltrate, all aspects of human behaviour. Indeed, based on one argument, there may be less law since fewer cases will be litigated.

But given that the cost of producing law is falling, one might expect to see more formal laws produced. When technologies can prescribe behaviour at a low cost, the benefits of using informal mechanisms, such as social norms, may fade in comparison. As a result, the appropriate boundaries between formal laws and social norms will change. Indeed,

one might argue that these technologies will lead not only to the death of rules and standards but also to the death of norms. There will be no ‘norms’ of driving when all of the vehicles are self-driving. All current norms will either vanish or be entrenched in the vehicles’ algorithms.

#### V *Conclusion*

The exponential growth of technology in the coming years will greatly reduce the cost of information. This cost reduction will have a deep and profound impact upon the way that laws are made and communicated to citizens. In this article, we have suggested that, as predictive technologies continue to evolve and improve, the law will increasingly reflect principles and prescriptions developed by machines. Further, technological advancements will mean that these laws – micro-directives – will update automatically.

There will, of course, be scepticism and fear. People will be sceptical that machines could ever replicate human judgment. And people will, initially, be frightened of following a law that has been developed by a machine. But, in the same way that vehicles will soon be self-driving, we predict that laws, too, will be self-driving.