



Research Report

Closing the Loop: Agile Approaches to Emerging Technology Legislation

October 2026

How to read this report

This report is organized into six sections:

- The [executive summary](#) provides a brief summary of the key findings from the study and the recommendations;
- The [study background](#) explains the impetus and scope of the report;
- [Key concepts](#) provides definitions for important or specialized terms used throughout the report;
- [Introduction: innovation vs. regulation](#) provides an overview of the policy issues around regulating emerging technologies;
- [Innovation in regulation](#) covers the study findings, including:
 - the [agile policy cycle](#),
 - [roadblocks to emerging technology regulation](#),
 - a [toolkit of agile policy instruments](#),
 - and a discussion of [how these approaches have been and could be applied in Virginia](#);
- [Closing the loop: recommendations for agile legislation](#) sets out several goals and associated policy options for approaching emerging technology policy in a more iterative and adaptive way.

The report can be read as a continuous document, or readers can skip to sections of interest.

Executive Summary

Emerging technologies present unique challenges for policymaking. By definition, such technologies are new or have new capabilities and are characterized by their rapid speed of development and market diffusion and by a high degree of uncertainty about their potential opportunities and risks. Examples of emerging technologies include advances in artificial intelligence (AI), quantum computing, fintech, nanotechnologies, synthetic biology, and robotics. Key information that could contribute to developing effective policy options for these novel technologies is often lacking—information such as established methodologies for measuring and mitigating risks, robust scientific evidence about harms and their underlying causes, or tried and tested policy interventions to address risks and harms in the real world. In the face of such scientific, technical, economic, and social uncertainty, lawmakers often struggle to regulate these technologies when there are favorable policy windows to do so, leading to policy paralysis or a wait-and-see approach. This study examines why the traditional, *status quo* policy process fails and explores a collection of alternative approaches to policymaking under conditions of uncertainty, often called “agile regulation” or “agile governance.” Agile approaches proactively introduce flexibility, evidence-generation, experimentation, and learning into the policy process, offering legislatures ways to take action on emergent technological issues while technologies are still evolving and maturing.

From linear to loop: the agile policy process

The default, traditional approach to policymaking treats binding rules as the end point of policymaking, so for good reason, governments have developed rule-making processes that introduce friction at the earliest stages of policy development in the interest of transparency and accountability. Sources describe this policy process as a “one-and-done” or “regulate-and-forget” approach in which the heavy lifting takes place before a policy is adopted and implemented, and there is limited or no evaluation and revision later. This linear process, which starts with an observed policy issue and ends with a permanent rule, is not well-suited to developing emerging technology policy because of the many unknown unknowns about emerging technologies when policy is being developed. It contributes to the false dichotomy that pits regulation against innovation, setting up an unsubstantiated and stultifying either-or: either rules to protect the public or innovation to benefit the public.

Therefore, for at least the last few decades, policy scholars and practitioners have been discussing and experimenting with agile approaches to technology regulation. These efforts have been spurred in large part by the advocacy of the Organisation for Economic Co-operation and Development (OECD), of which the U.S. is a member. Agile regulation, which encompasses the policymaking role of both legislatures and regulatory agencies, entails policy practices and instruments that collectively convert the

policy process from a linear path to a cycle or a loop. The policy loop is enabled by experimenting alongside technology innovators to quantify risks and develop safeguards, generating new evidence to inform potential policy options, and learning from policy implementation.

The report details how approaching policymaking as a loop helps overcome the three main categories of regulatory roadblocks that legislatures face in confronting emerging technology issues. The roadblocks are timing, information, and learning. Timing roadblocks include the pacing problem, where technology development and diffusion often outpace regulation. Informational roadblocks include the disproportionate concentration of expertise and research funding within private technology companies. Learning roadblocks include the challenge of technologies that evolve, change, or even learn themselves, once they are deployed in the real world, surfacing a need to continually update policy instruments to deal with new capabilities and risks. In traditional linear policymaking, any one or combination of these roadblocks can undermine good policy. But building policy with an eye toward iteration and learning can overcome many regulatory impasses without resorting to blunt policy instruments meant to simply slow innovation down so regulation can keep pace.

Agile policy instruments and applications in Virginia

A number of specific agile policy instruments are examined in the report, including horizon scanning, sandboxes, sunrise and sunset clauses, and pilots, among others. While any or all of these instruments could contribute to a more agile policy loop, no single instrument is a silver bullet, guaranteeing better policy on emerging technologies. The policy objectives, context, and availability of human and institutional resources will all factor into which policy instrument is most appropriate to the policy question at hand, and every instrument has strengths and weaknesses. As the report explains, policymakers adopting an agile instrument need to consider how to put the requisite conditions in place to ensure the instrument successfully leads to legislative learning and mitigates (rather than exacerbates) the regulatory roadblocks emerging technologies present.

Some of the agile instruments discussed in the report are already used in various policy domains in Virginia, such as pilots, studies, and workgroups. To achieve more temporal nimbleness, legislatures can leverage Section I bills, budget amendments, and enactments. However, interviews surfaced several challenges in utilizing these instruments effectively within the real-world constraints of the policy process, such as the limited availability of actionable data for policy review and truncated timelines for policy experimentation due to the hybrid nature of the legislature. And on the whole, these instruments have not been employed as part of a coherent agile governance agenda or with the overarching goal of creating actionable feedback loops for the legislature to act on. Additionally, few of these instruments

have been proposed in recent legislation on emerging technology, such as AI. These findings point to promising opportunities to apply agile instruments more consistently and precisely to overcome regulatory roadblocks.

Recommendations: Closing the Loop

In its idealized form, agile governance is a whole-of-government approach that would entail a significant re-configuration of practices, institutions, and expectations. Regulatory studies describe it as nothing short of a total culture shift in how regulation is developed, implemented, and evaluated. But under real-world constraints, governments can take a more incremental approach, and the recommendations in this report were developed with this pragmatic outlook.

The overarching recommendation is to approach emerging technology legislation with the objective of “closing the loop”: developing every emerging technology policy with a view toward generating actionable information that can feed back into the policy process, allowing the policy to adapt to changing conditions. Closing the loop means defining at the outset: what new information is needed and how to get it, any responsibilities for ongoing oversight, clear plans for evaluation, and meaningful reporting requirements to decisionmakers with the power to act on new information. Approaching every policy, regardless of how ambitious or narrow, with a mindset of closing the loop offers an array of better options for overcoming regulatory roadblocks than wait-and-see or regulate-and-forget. The policy options at the end of this report suggest several realistic steps the Commission can take to exercise more agility on emerging technology policy issues:

(1) Build the Commonwealth’s capacity for agile regulation

- Consider introducing a budget amendment to build out the enforcement and oversight capacity of the Office of the Attorney General for technology policies because this is the office increasingly tasked with regulatory responsibilities for emerging technology issues;
- Consider asking JCOTS to convene a workgroup in 2027 to study what additional regulatory oversight is needed for emerging technology and where this oversight responsibility should be situated within government.

(2) Provide resources on best practices and agile instruments for policymakers

- Consider asking JCOTS to produce a one-page brief for DLS, Committee chairs, and caucuses with JCOTS-endorsed best practices for emerging technology legislation;
- Consider consulting JCOTS staff on strategies for answering key policy questions and

continuing progress along the policy loop, especially when an emerging technology bill is facing considerable roadblocks or is likely to fail.

(3) Adopt JCOTS practices that “close the loop”

- Consider asking JCOTS to develop a standard framework (checklist) that staff will use to prepare a policy concept for bill drafting to include key components of agile governance;
- Consider asking JCOTS staff to develop briefing notes for all JCOTS-endorsed bills and for technology bills sponsored by JCOTS members upon request. These briefing notes would provide key information (including an explanation of any agile approaches taken or agile instruments used) to assist patrons with bill presentations on the floor and in committees.

Study Background

At its October 8th, 2025, meeting JCOTS presented a limited study on artificial intelligence (AI) in the healthcare sector in Virginia. The study resulted in two sets of legislative recommendations: the first set encompassed policy recommendations for the adoption and application of enterprise AI in healthcare, and the second set of recommendations proposed a more agile approach to regulating AI, which the report referred to as the “Responsible AI Regulation Roadmap” (see Figure 1).

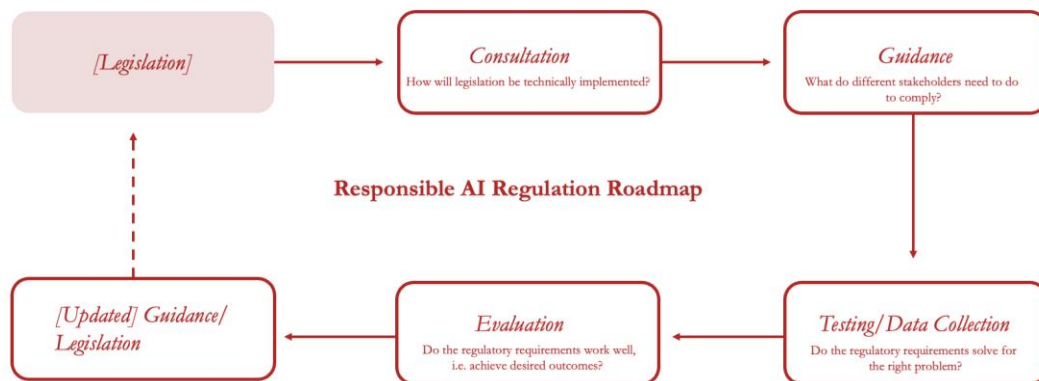


Figure 1: A responsible AI regulation roadmap, reproduced from the 2025 JCOTS Limited Study “AI in Healthcare”

The report presented the roadmap as a feedback loop, in which legislation stipulating specific requirements for AI developers and deployers would serve as a starting point for iterative development of robust guardrails, rather than the end-point of rule-making. The recommendation in the report was for the roadmap to “work hand-in-hand” with the sector-specific recommendations on AI guardrails, embedding “flexibility and learning into the regulatory process itself. This approach could ensure that the impacts [of the recommended requirements for developers and deployers] in Virginia are measured, reviewed, and shared to the benefit of the state AI ecosystem as well as other jurisdictions grappling with similar policy issues.” The roadmap consisted of a series of iterative policy practices that collectively created a regulatory cycle with the aims of:

- Promoting evidence-based regulation;
- Minimizing unnecessarily burdensome and/or ineffective regulation;
- Cultivating new innovations for social benefit;
- And enabling regulatory learning and adaptation.

At its November 5th, 2025, meeting, the Commission voted to adopt all seven legislative recommendations pertaining to AI in healthcare. However, these recommendations were not ultimately put forward in the 2026 legislative session due to concerns about White House Executive Order 14365, issued that December, which articulated an intention to withhold federal BEAD funding for broadband deployment from states that passed AI legislation deemed “onerous.”

At its December 3rd, 2025, meeting, the Commission voted to conduct a further study this year into the regulatory roadmap from the AI in healthcare study. In revisiting the topic and scoping this study, staff determined that it would most valuable if the study examined the legislative process for regulating emerging technologies in two broader senses: (1) exploring a wider range of approaches than just those presented in 2025 as recommendations for the healthcare sector so that the recommendations could be relevant to more policy issues; (2) considering the more general topic of emerging technologies (rather than AI alone) because the literature on agile policymaking encompasses many different domains and because the uncertainty around federal AI policy at the time, making it unclear whether the General Assembly would be reconsidering AI legislation this year.

Study Scope

There are advantages and disadvantages to broadening the scope of this study to encompass the regulatory process in general and a wider range of technologies than just AI. On the one hand, broadening the scope makes the findings relevant to many more contexts and topics that present policy challenges similar to AI. On the other hand, casting a wider net in this way risks providing generic or unfocused insights that leave policymakers without actionable steps they can take as a result of the findings. To address these potential drawbacks, this study should be read with the following scope boundaries in mind:

- **How rather than what:** The study is concerned with the regulatory process—practices, procedures, and mindsets that influence the outcomes of regulation. In other words, it is less about the *what* of regulation and more about the *how* of regulation. The study does not focus on specific technologies, and it also does not evaluate or present recommendations for specific bill provisions pertaining to AI (or any other technology). The findings are therefore applicable to a wide range of technology issues, from AI to quantum computing, and more.
- **How rather than how many:** This study shares the view expressed by the Organisation for Economic Co-operation and Development (OECD) that “while policy ideas will always be contested, the core elements of good regulatory process will not” [67]. In this sense, good

regulation means regulation that achieves its purported policy objectives based on good faith efforts to weigh the inevitable tradeoffs in terms of costs and benefits (e.g. economic, social, environmental, and so on). This study therefore does not examine the question of whether there should be more or less regulation. Such a question assumes that “regulation” is a single, coherent, universal concept, rather than a diverse array of rules, guidance, and approaches. There is a more detailed discussion in the report about the characteristics of “good” regulation.

- **Legislative focus:** As a legislative commission, JCOTS is most actively engaged in the legislative aspects of technology regulation, and the report emphasizes the role of legislatures, recognizing that the legislature is just one venue in which rule-making takes place. The study is not focused on regulatory, executive, or independent agencies engaged in rule-making, nor is it focused on the Administrative Code. The contemporary regulatory process implicates many different agencies. These non-legislative bodies and rules do play an important role in the regulatory process that must be acknowledged in any analysis of regulation, and they will be mentioned in various places throughout this report, but the study is focused on the role of the legislature and legislation in the regulatory process.
- **Limited policy landscape:** The study examines the agile instruments that have been used or proposed in various jurisdictions tackling emerging technology policy and explores how these may be applied in Virginia based on interviews with policy practitioners in the Commonwealth and a few other jurisdictions. Therefore, the study does not examine other states’ attempts at agile regulation in any detail. This is partly because relevant real-world examples are limited, but also because examples that do exist are tailored to their unique context, so a deep understanding of the institutional arrangements of government in each jurisdiction would be required. Such an in-depth mapping of the institutions and processes of other jurisdictions is beyond the scope of this study.

A note on terminology

The Key Concepts section provides some definitions of common terms used in regulatory studies of agile approaches to emerging technology regulation. But there is considerable variation in how sources talk about flexible, adaptive approaches to regulating emerging technologies (e.g. regulatory innovation, agile regulation, adaptive regulation, experimental regulation, regulatory innovation, and anticipatory regulation). Therefore, for the purposes of this report, several terms are used for consistency.

Agile regulation

The terms “agile regulation” or “agile governance” are used throughout the report because these are the terms adopted by the Organisation for Economic Co-operation and Development (OECD) in its 2012

Recommendation [63], and they seem to encompass many of the other adaptive approaches that use experimentation, foresight, and evaluation to improve regulatory outcomes. Agile regulation is conceptually linked to agile software development in that it entails practices to iteratively test and adapt policies to changing real-world conditions and information. However, agile software development is guided by the 2001 Agile Manifesto, authored by technologists with principles tailored to their field of practice. Whereas, the OECD has translated the agile approach to policymaking, with entirely different practices geared toward legal rule-making that only really share a conceptual common heritage with “agile” as it is known to technologists.

Regulation

The report uses the term “regulation” throughout to refer to formal, binding rules about emerging technologies, regardless of where they originate. The focus of the report is on legislation, the role of legislatures, and policy options available to legislators. In some narrower legal definitions, regulation refers to the subset of law promulgated by the executive branch. Legislatures hold the ultimate rule-making authority, but they often delegate this authority to other agencies to develop and implement specialized rules. Using a broader definition of regulation blurs some lines that legal scholars and practitioners might take issue with. But for the purposes of this study, the more colloquial, conceptual definition does some helpful work—both encompassing the crucial role of the legislature in the regulatory process and setting up a starting point from which to examine the relationship between innovation and regulation (writ large). When legislatures discuss, debate, and enact laws that impose requirements on covered entities, commentators commonly refer to these requirements or provisions as “regulations.” So, “regulation” carries many meanings, and arguably all of these are helpful in the discussion that follows.

Emerging technology

Finally, the report addresses regulatory challenges associated with emerging technologies. According to the OECD, “emerging technology” refers to “technologies characterized by rapid development, evolution, novelty and uncertainty in trajectory and impact” [71]. Scholars further define emerging technologies as having a propensity to display unanticipated behaviors in the real-world that cannot be fully tested or known in advance of their market diffusion. They also often lack established methodologies for measuring and mitigating risk, even as they gain adoption and market share. Today’s emerging technologies are largely made possible by advances in digital computing and data processing, and they also often have cross-sector or general-purpose applications.

Research Questions

The defined study scope motivated three research questions for this study:

- (1) What are the key hurdles or challenges in regulating emerging technologies, such as artificial intelligence?
- (2) What regulatory approaches could address these challenges?
 - (a) What is the role of legislatures in these regulatory approaches?
- (3) Which, if any, of the studied approaches could be applied in Virginia?
 - (a) What existing mechanisms exist to facilitate these approaches?
 - (b) What new resources or infrastructure might be needed to facilitate these approaches?

Methodology

This research report is based on a narrative literature review of academic and grey literature in the fields of regulatory studies, regulatory theory, regulation of innovation, and law; interviews with subject matter experts; and interviews with staff of state agencies in Virginia, other U.S. states, and international jurisdictions.

Generative AI was not used for outlining, writing, or editing any part of the report. Several generative AI tools were used in background research for the report to explore key concepts, transcribe some interviews (with interviewee consent), identify potential sources, and synthesize notes from a human-curated list of sources.

Key Concepts

Agile regulation or agile governance: Agile regulation refers to a whole-of-government approach to dealing with the pace and inherent uncertainty of technological innovation by adapting regulatory tools and processes to more proactively and flexibly respond to, manage, and foster innovation. It may encompass or integrate aspects of other regulatory approaches for managing uncertainty, such as anticipatory regulation or resilience. Key aspects of agile governance involve a test-and-evolve mindset, iterative feedback loops that involve gathering real-world data and learning from this evidence to adapt regulation, multidisciplinary collaboration among government, academic, industry, and civil society stakeholder, and flexibility to respond proactively to a changing technological and political environment. It borrows the “agile” concept from the software industry, where agile software development entails practices to iteratively test and adapt software to meet technical, market, and security demands.

Anticipatory regulation: Anticipatory regulation refers to a set of strategies and tools to help rule-makers identify, develop, and test solutions to emerging technological challenges before market disruption and entrenchment occur. It is closely related to the concept of anticipatory governance, which generally refers to forward-looking approaches to gathering evidence on emerging technologies with the goal of continually assessing their technical, social, ethical, and legal dimensions. Anticipatory regulation attempts to get ahead of projected technological risks while they are still manageable.

Collingridge Dilemma: Named for Professor David Collingridge, who introduced the concept in his 1980 book *The Social Control of Technology*, the Collingridge Dilemma refers to a situation in which intervening early in a technology’s trajectory is easier, but there is much less reliable information about the benefits and risks of the technology, whereas intervening later allows for the development of better evidence about the real impacts of a technology, but it may make regulating costlier or more difficult due to widespread adoption or market entrenchment.

Emerging technology: This concept refers to “technologies characterized by rapid development, evolution, novelty and uncertainty in trajectory and impact” [71]. Such technologies are characterized by high levels of uncertainty, unknown risks, and a propensity to display unanticipated behaviors in the real-world that cannot be fully tested or known in advance of their market diffusion. There are often few established methods for measuring the risks of these technologies, leading to a scientific evidence gap. Most of today’s emerging technologies are underpinned by advances in digital computing and data processing.

Experimental regulation: Sometimes called experimental legislation, regulatory experimentation, or experimentalist governance, this term refers to a rule-making instrument of a temporary nature enacted to test a new rule under real-world conditions to gather evidence and evaluate its effectiveness to inform regulatory design and implementation. The characteristics of experimental regulation are generally limited time duration; circumscribed geographic, population, or subject scope to allow for comparison with non-experimental conditions; derogation or exemptions from existing laws; and clearly defined evaluation protocols to test the policy hypothesis.

Information asymmetry: Information asymmetry is a condition where one party in a governance relationship holds more, better, or more complete information than another, and it constitutes a classic form of market failure that regulation is intended to address. In the context of emerging technology, information asymmetry may manifest as a lack of knowledge on the part of consumers or policymakers regarding a technology's safety, quality, real-world performance, or risks.

Pacing problem: In regulatory theory, the pacing problem refers to the gap between the rapid pace of technological innovation and the slower rate at which regulation is developed and implemented. This is a fundamental timing problem related to emerging technologies because these innovations often scale much faster than policymakers can act. The lack of information about technological impacts can lead to initial delays in rule-making, which are compounded by the highly proceduralized, bureaucratic process of developing regulations.

Regulation: In this report, regulation refers to policies made by governments to set rules for or constrain the behavior of private individuals or businesses, usually to correct market failures or mitigate risks. It encompasses legally binding rules promulgated by legislatures, independent regulatory agencies, and executive branch agencies.

Regulatory lag: Closely related to the pacing problem, regulatory lag describes the timing gap between technological innovation and formal rule-making. Innovation often occurs quickly, and regulatory issues only become apparent once a new technology has achieved significant or influential market penetration. By contrast, the traditional (non-agile) regulatory process has evolved to contain many points of friction to intentionally slow the rule-making process down in the interest of transparency and accountability. This mismatch in timing can result in legal uncertainty, accumulating real-world harms, or public panics.

Regulatory capture: Regulatory capture refers to a phenomenon where a rule-making body or process is co-opted by private interests to serve the financial priorities of the regulated industry rather than the public interest. Risks of regulatory capture increase as a result of information asymmetry and the pacing problem because rapid technological advances often mean that knowledge and expertise

about new technology is disproportionately held by private companies rather than the public sector. Public sector rule-making bodies may therefore rely heavily on private sector experts in rule-making.

Resilience: This concept refers to a governance approach that focuses on planning for, managing, absorbing, recovering from, and adapting to risks and harms after they occur rather than attempting to predict all potential risks up front. Although it emphasizes strategies for dealing with technological impacts after they occur, it depends on important preliminary (or *ex ante*) practices to put mechanisms in place in advance to deal with risks as they emerge. Resilience is both procedural and substantive, encompassing strategies such as periodic regulatory reviews and ongoing monitoring of technological harms alongside tools such as financial assurance mandates, product recall protocols, or kill switches.

Introduction: innovation versus regulation?

Regulation refers broadly to the policies made by governments that set rules for or constrain the behavior of private citizens and businesses. Recent developments in emerging technologies, such as artificial intelligence, quantum computing, fintech, synthetic biology, nanotechnology, and more have presented some distinct challenges for regulation. These challenges are not entirely foreign to the regulatory process; they are the product of the technical qualities and market dynamics of new technologies [2, 35]. New technologies often emerge and evolve rapidly, gaining market diffusion and public adoption much faster than governments can develop rules to steer technological developments toward desired social outcomes. In the inevitable gap between technological advances and laws to govern them, real-world harms can surface and accumulate, and speculation about both risks and opportunities runs rampant. In spite of the cyclical pattern of hype that accompanies new technologies, every innovation with transformative societal impacts stokes new hopes and fears. These hopes and fears range from promises to dramatically improve the human condition to moral panics about vulnerable groups, such as children, to existential threats of species or planetary annihilation [74]. They are rooted in well-founded anxieties about unpredictable future effects of unfamiliar technologies, but they are also fueled by commercial incentives, social norms, and the cognitive biases and ideological inclinations of various stakeholders, including technology developers, politicians, interest groups, and members of the public [61]. They spur public debate, concern, and calls for regulation.

Out of the tension between technological optimism and pessimism emerge critical policy questions about how to govern a variety of uncertainties—unknown societal, economic, and security risks and benefits. Is regulation the friend or foe of disruptive technological advances? Can regulation maximize

technological benefits while mitigating the costs? No discussion of emerging technology and regulation can avoid running headlong into the regulation versus innovation debate. In this debate that plays out in the public sphere time and time again, “regulation” colloquially means rules that impact the technology sector, whether they originate in legislatures, executive agencies, or independent regulatory organizations. This general understanding of regulation is used throughout this report, although the focus will remain on the role of legislatures in rule-making.

Depending on the values, politics, incentives, and market position of the stakeholders in this faceoff, either innovation or regulation is cast as inherently good, while the opposing side is presumed less good on the whole. In the context of emerging technologies, this standoff is anchored in a misconception that scholars call “technological determinism,” the idea that technology dictates the trajectory of economies, societies, and cultures and that technological innovations are inevitable—even uncontrollable—developments. This perception of technology’s power also often leads to an assumption that only technical expertise and further technological interventions can mitigate risks. It therefore implicitly precludes societal interventions, like regulation, that seek to shape the trajectory of innovation [16, 77].

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In contrast to technological determinism, this study assumes that the risks of new technologies emerge from the relationship between technology and society, so there are technological and social dimensions to their risks and harms and, likewise, both technical and social solutions to mitigating them. Like regulation, technology is the product of scientific processes, human choices, power dynamics, values and ideologies. Therefore, this study acknowledges but does not seek to resolve the question of whether regulation is holistically good or bad. (This would be akin to asking whether technology is wholly good or bad.) Instead, it assumes that regulation is essential to a functioning modern society and, therefore, this introduction starts with a different question: *what makes a regulation good?* The report then goes on to explore the research questions for the study: *what makes regulating innovation particularly challenging or different from other targets of regulation?* And, bringing these two threads together, asks:

what makes or could make regulation of innovation better? And how could these approaches be applied in Virginia?

This report is motivated by a 2025 JCOTS study of artificial intelligence in healthcare, which recommended developing a “regulatory roadmap” for managing AI in that sector. That report stated: “Since AI is rapidly evolving with unknown future applications, risks, and opportunities, traditional regulatory approaches may prove insufficient or quickly outdated. More foundational work is needed to establish effective technical oversight practices, translate emerging standards into workable compliance frameworks, and ensure alignment with other jurisdictions’ approaches.” That study found that AI risks are real, as are opportunities to improve health outcomes by leveraging AI in the health system. But risk metrics and safety testing procedures for AI products were still contested and in various stages of maturity, leaving open an essential question for regulation: under these uncertain conditions, what rules could lawmakers confidently enact to ensure AI safety? Sources interviewed for that study repeatedly emphasized the importance of regulatory learning alongside establishing oversight standards for AI.

Building on last year’s report, this study picks up where the findings left off and examines the process of rule-making to explore how to regulate technology under conditions of uncertainty without inadvertently stifling innovation. It presents insights from regulatory theory, empirical studies, and interviews with subject matter experts and representatives of state government agencies to surface ways that governments could be more innovative in addressing the unique regulatory demands of innovation.

Defining “good regulation”

Regulation is indispensable in complex and properly functioning societies and markets, and rule-making is one of the fundamental roles of government. Although regulation is often pitted against the market in political discourse, they are actually highly interdependent and have co-evolved over time [32]. Regulation generally balances the public interest against private interests by correcting market failures, mitigating risks, and promoting equity and distributive justice [29, 67]. Regulation commonly addresses issues such as [29]:

- Monopoly power, where a single firm dominates a market and excludes or unfairly disadvantages competitors, leading to price distortions (e.g. electricity transmission);
- Negative externalities, where private actions impose uncompensated harms or risks on third parties (e.g. industrial pollution);

- Asymmetric information, where private entities have crucial information about product safety that other parties lack, leading to unmitigated risks or real world damages (e.g. food and drug quality);
- Public goods, where shared resources may be vulnerable to degradation, overuse, or destruction and it is difficult to exclude users from depleting these resources (e.g. fisheries).

Absent regulation, private interests are incentivized to externalize risks to protect profit margins, meaning that consumers or other third parties bear the burden (harm) when products or practices are unsafe. A great deal of regulation aims to mitigate risks that the private sector otherwise would not prioritize. Along with economic goals, regulation is also increasingly used to achieve desired social outcomes, such as protecting rights, addressing societal challenges like poverty, protecting the environment, or enabling access to essential services like healthcare and education [24, 40].

Regulation is fundamentally a normative endeavor in that it aims to shape how markets and societies *should* be. Norms are the prescriptive, value-based, ethical standards that societies hold. Norms are therefore subjective judgments about what is right, and they influence the ideas that policymakers and the public have about what the best response to a policy issue should be. In spite of the normative aspects of regulating, there is growing global consensus about what constitutes “good” regulation. Good regulation is defined by the processes, procedures, and institutions that produce regulation, rather than the substantive content of regulation. In other words, it is more about the *how* of regulation, rather than the *what* [65, 67]. The principles of good regulation have coalesced around practices that integrate objective evidence and procedural transparency into what can otherwise be a contentious, politically charged debate about societal values and norms. Such principles arguably share a common ancestor in what is often called evidence-based policymaking or evidence-informed regulatory practice: approaches to lawmaking that incorporate aspects of the scientific method and process that have gained legitimacy and popularity in recent decades [9, 41, 78].

Regulatory best practices have been developed globally as what is often called the “Better Regulation” agenda, championed by the Organisation for Economic Co-operation and Development (OECD). The OECD has become a leading multinational resource on Better Regulation, but the roots of Better Regulation were originally planted in the United States (an OECD member state). The U.S. began seriously considering how to improve the quality and effectiveness of regulation in the 1970s and 1980s by reducing compliance burdens for regulated entities, establishing an oversight body for regulators (OIRA), and introducing evidence-based insights early in the policymaking process in the form of cost-benefit analyses (President Ronald Reagan formalized this approach with an Executive Order in 1981) [32, 100]. During this time, the U.S. also undertook several ambitious policy experiments to test

proposed social policies, with varying degrees of effectiveness but a clear interest in leveraging scientific methods to make good policy [43, 44].

On the whole, the better regulation agenda in the U.S. has driven a significant institutional shift at the federal level toward prospective oversight [11, 32, 100]. This oversight generally has taken the form of structured *ex ante* practices and procedures that (usually non-legislative) rule-making bodies must engage in before formalizing regulation. This shift has been enshrined in law through the Administrative Procedures Acts, which stipulates the stages rules must go through from drafting to formalization, including notices for proposed rules and a “notice-and-comment” period for stakeholder engagement. States also have Administrative Procedures Acts that require similar processes at the state level. Various executive orders over the years have introduced requirements for Regulatory Impact Assessments (RIAs), particularly for regulations that are likely to have a significant economic impact, and these assessments often entail extensive cost-benefit analysis. Federal standards on RIAs emphasize the importance of conducting a variety of quantitative analyses to attempt to evaluate potential unintended consequences of regulation, and further congressional legislation has introduced additional *ex ante* steps, such as convening small business review panels to assess the effects of rules on smaller entities [31, 32, 33, 34]. The intent of such efforts has been to increase the accountability and transparency of the rule-making process, compel rule-making bodies to consult widely before finalizing regulations, and exert more legislative control over executive branch agencies. The cumulative impact of these efforts has been to introduce a great deal of friction into the earliest stages of the regulatory process. Although most of these practices occur in rule-making bodies outside the legislature, some aspects of these friction-inducing procedures are also followed by legislatures, such as generally conducting policy studies *before* legislation is proposed. As a result, evidence-based policymaking is disproportionately front-loaded, relying on gathering and analyzing information before laws are enacted or rules are finalized.

The theory and practice of good regulation continues to evolve. As this study will go on to discuss in greater detail, the arrival of many new, socially transformative technologies, like the internet, has engendered renewed interest in how to regulate *well* and instigated further development of the core principles of good regulation to meet new challenges. Throughout their evolution, the premise of such principles has remained the same: that regardless of the value-driven or normative intent of regulation, good faith efforts to gather factual information, test hypotheses, and evaluate impacts will help ensure that rules achieve desired outcomes with fewer unanticipated consequences. In this sense, good regulation shares several features [63]:

- It responds to a clear public problem and maximizes net benefits for society while minimizing unnecessary burdens and costs;
- It focuses on outcomes rather than the means of achieving particular objectives and aims and measures or evaluates outcomes after the fact;
- It is informed by objective evidence about the likely or observed risks, harms, and market failures regulation aims to address *and* evidence about the likely or observed impacts of rules meant to mitigate these failures and risks;
- It is developed transparently, in the open, with opportunities for meaningful stakeholder and public engagement;
- Rule-making entities justify their decisions and make rules as simple and easy to understand as possible.

In the U.S. today, these principles continue to resonate, and federal and state governments periodically grapple with how to realize them. Nearly all modern presidents have endorsed, in one way or another, nonpartisan principles for improving regulation, informed by evidence [32]. The push for greater emphasis on data, facts, and scientific evidence in the rule-making process is a strong theme across policy and research on “good regulation,” but it is important to acknowledge that it is not the only factor in regulating well. As mentioned above, regulation is the product of many different inputs, both normative and factual, both subjective and objective. There are limits to what scientific evidence can contribute to the policymaking process [75]. In many cases, the gap between evidence and policy needs to be bridged by subjective judgement and informed guesswork [92], an exercise prone to cognitive bias and miscalibrated assumptions because conclusive evidence on the efficacy of different solutions is not available. In other cases, the gap between evidence and policy needs to be bridged by normative judgments about which outcome, among many possible outcomes, should be the priority based on societal values and risk tolerances [32, 58].

A selective overview of key federal actions to improve regulatory practice

- In 1993, President Bill Clinton issued an Executive Order that continues to influence regulatory policy, outlining a regulatory philosophy that requires regulation to address a public need, take account of costs and benefits and regulatory alternatives, and maximize net benefits to society.
- Around the same time, Congress passed several laws to bolster legislative oversight of the regulatory process and require regulatory agencies to disclose factual information about the

projected and actual effects of regulation. These included the Congressional Review Act of 1996, the Omnibus Consolidated and Emergency Supplemental Appropriations Act of 1999, the Truth in Regulating Act of 2000, and the Information Quality Act of 2000.

- President George W. Bush issued a 2007 Executive Order requiring regulatory agencies to establish goals and conduct empirical measurement of those goals.
- President Barack Obama issued several Executive Orders between 2011 and 2012 aimed at improving regulation and regulatory review, with an emphasis on conducting retrospective reviews, analysing performance metrics, and increasing transparency and access for public participation in the regulatory process.
- In 2018, Congress passed the U.S. Foundations for Evidence-Based Policymaking Act, which requires regulatory agencies to make plans for data and evidence collection, referred to as “learning agendas,” and established an “open by default” standard for federal data, opening the door further to independent external scrutiny.

Ultimately, good regulation is always the product of both normative (values-based) and scientific (evidence-based) insights. The hallmark of the “better regulation” agenda is not that it eliminates or negates the role of political debate, ideology, or subjective judgment; it is that it prioritizes generating, analysing, and integrating actionable evidence in the regulatory process so that policymakers have an array of robust information to draw from in making decisions *in addition to* the normative considerations that policy must take into account.

If the desired outcomes of regulation are the product of a complex synthesis of norms and evidence, how can the success or effectiveness of regulation be judged? Good regulation can be evaluated based on whether it achieves its intended outcomes effectively, efficiently, and fairly. Scholarship on good regulation therefore also emphasizes the importance of regulatory review. Regulatory review, or evaluating regulation after it is implemented, can help mitigate the pitfalls of “shot in the dark” policy choices [45]. In short, “[r]egulatory design should be about consequences—what works, how much, and with what costs and side effects” [101]. This framework, which incorporates objective evidence before, during, *and* after rules are made, is the foundation of agile governance approaches that are increasingly favored for addressing the unique challenges of regulating emerging technologies (discussed in greater detail later in this report).

Normative factors in regulatory decision-making: a case study

Scientific evidence and science-based approaches on their own do not provide all of the information policymakers need to develop effective regulations. The convergence of normative and scientific information in policymaking is evident in many domains, but emerging technologies shine a bright light on their unavoidable interdependence. An example adapted from a recent article in Nature Computational Science illustrates this point [20].

Consider a situation in which a state wants to use an algorithm to help decrease the number of missed court dates by individuals with upcoming court dates. There is well-established evidence that transportation barriers (cost or lack of access to public transport) is a leading factor in missed court appearances. In this case, the evidence suggests a fairly clear policy option that could reduce the number of missed court appearances: facilitating access to transport for individuals with upcoming court dates. But this will entail a fiscal impact for governments. In budget-constrained contexts (as most governments are), not all individuals who might benefit from transportation assistance will be able to receive it.

It is more costly to provide transport to individuals who live farther from the courthouse than those who live nearer, and in some localities, there are notable demographic differences between geographic locations. For instance, courthouses may be located further from predominantly Black neighborhoods. Under such conditions, policymakers are faced with a normative decision about what kind of statistical fairness approach the algorithm should apply. If the policy priority is to reduce the overall number of missed court dates, the algorithm will maximize the number of trips subsidized by the government within the budget constraints set by policymakers. This may inadvertently privilege White individuals who live closer to the courthouse and whose journeys are less costly.

However, if policymakers instead want to ensure equitable access to transport support for all demographic groups in the locality, the algorithm will prioritize equalizing decision rates for all geographic locations, resulting in fewer overall court appearances because longer journeys are more costly, so the allocated budget will not go as far. In this case, there is substantial evidence to inform policy options, and there are scientific methods available to ensure the algorithm allocates resources “fairly,” but the ultimate policy choice is contingent on a normative decision about what kind of statistical fairness should be used.

The role of legislatures

Legislatures play a central, critical role in regulation, and legislative rule-making is the focus of this study. Although many different agencies are involved in the regulatory process, the legislature holds administrative authority for the government and is the designated rule-making body according to the U.S. Constitution and the Constitution of Virginia. As the administrative responsibilities of governments have expanded and become more complex over time—dealing with more specialized, technical issues from food safety to aviation to cybersecurity—the role of executive agencies in rule-making has grown [17]. Legislatures deal with a huge array of public policy issues. Executive agencies, by contrast, can develop and maintain specialized, domain-specific expertise that is useful in making rules that need to be specific and actionable for a market sector. So, increasingly, legislatures delegate authority to unelected rule-making bodies, such as executive agencies, independent regulatory commissions, or private entities and self-regulatory organizations.

Legislative delegation statutes vary in their level of detail and delegation directives may be more or less open-ended, potentially leaving a great deal of rule-making to the discretion of non-legislative entities. Although delegation is common practice and has been upheld by the U.S. Supreme Court, scholars and some subject matter experts interviewed for this study highlight several critiques of this approach to rule-making. One such critique suggests that when legislatures delegate rule-making, they are effectively exercising “power without responsibility” [32]. In other words, when complex and politically contentious issues are outsourced to other entities, elected members can insulate themselves from the political consequences of unpopular or ineffective rules while having appeared to take decisive action on an issue. This dynamic also incentivizes a lack of regulatory review or evaluation because revisiting such rules after they have been implemented may result in reputational risks for policymakers and regulators alike. Another critique is that delegation can result in a lack of bureaucratic accountability, as legislatures have struggled to exercise effective oversight of the discretionary activities of what has become a diverse array of rule-making authorities within and outside the government [86].

However, sources generally agree that addressing these drawbacks would be difficult because it would entail significant allocations of resources (to bolster legislative staffing, for example) alongside institutional and cultural changes within modern government, which has evolved and entrenched this complex and interdependent ecosystem of rule-making bodies beyond legislatures. That said, legislatures do continue to play important oversight and accountability roles in regulation by setting standards and requirements for regulators, and several Executive Orders and federal laws in the last couple of decades have focused on bolstering the legislative oversight role. One of the key issues facing legislatures in this context is how to remain engaged meaningfully in the regulatory process, even when

key regulatory authority has been delegated elsewhere. This is especially critical in light of the uncertainties that frequently surround emerging technologies. How can information about the process and outcomes of rule-making make their way back to the legislature? And how can legislatures learn from and act on this feedback? These are the questions that the agile regulation approaches discussed later in this report aim to answer.

State-level regulation: states as laboratories

There is another important dimension to the legislative role in regulation that deserves attention, especially when it comes to considering more agile approaches to regulating technology, and that is the role of the state legislatures in regulation in the U.S. The federal system grants states jurisdiction over many policy issues with regulatory elements. Around 20 percent of the U.S. economy is directly governed by states, and around a third of state-level agencies focus primarily on regulation. Today states tend to take the lead regulating domains such as energy and utilities, occupational licensing, and intrastate commerce. States also often adapt broad federal statutes to local contexts in areas such as the environment and labor and undertake important enforcement functions of federal rules at the state level [90].

Variations in state rules across a wide range of domains are common and generally accepted as an integral part of how the federal system works. States sometimes step in to fill regulatory gaps left by federal rules. For example, in the early 2000s, several states passed “do not call” laws to restrict unwanted telemarketing, which prompted the then-FTC chair to call for a national regulation of telemarketing [90]. States also compete with one another for business and tax revenue by adopting different state-level regulations. For example, states often adopt different corporate rules to attract business [85]. In other words, states can experiment with different regulatory approaches to the same issue, adapting rules to unique local conditions, innovating beyond what the federal government has legislated, and testing policy interventions that address an identified public need.

This remit of states is often referred to as “states-as-laboratories” approach to lawmaking, in reference to an expression used by Justice Louis Brandeis in a 1932 Supreme Court decision: “It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country” [37]. This experimental philosophy, which is structurally embedded in the federal system in the U.S., has provided an example and inspiration for more agile approaches to lawmaking worldwide [41].

However, in practice, the states-as-laboratories paradigm often does not work as idealized. When states enact a variety of different rules for the same issue, it can create a confusing array of compliance requirements for affected entities that operate nationally. Rather than “laboratories” for learning, critics call this approach a “patchwork” of rules. In the case of technology, they argue that this legal miscellany and associated regulatory burdens has a chilling effect on innovation and risks deterring competition from smaller developers because only the largest companies can afford to absorb the compliance costs [46, 91]. To a large extent, this critique is linked to the fact that rule-making is procedurally designed to result in a permanent rule that will ultimately resist much significant alteration. The “regulate and forget” approach arguably undermines the idea that states can act as laboratories and gives credence to the concern that rule proliferation is a burden.

Moreover, when rules are permanent and rarely revisited, regulated entities have the greatest incentive to comply with the most stringent regulations set by states (thereby likely also complying with more lenient regulations in other places) and to lobby for national rules that replicate regulation enacted by states with larger economies due to those states’ outsize influence in the market. As a result, states with significant economic sway can wind up shaping policy for the rest of the country as other states copy their models, resulting in homogenization of state laws rather than a variety of laws that differ significantly enough to provide comparative insights.

The “regulate and forget” approach arguably undermines the idea that states can act as laboratories and gives credence to the concern that rule proliferation is a burden.

Another way that states sometimes fall short of living up to the laboratory paradigm is in *how* different states wind up learning from each other. In practice, this learning often takes the form of examining whether legislation stands up to or is struck down through litigation [31, 57]. Understandably, states wishing to avoid drawn-out legal battles about the tenability of a new law will wait to see if similar legislation in other states faces pushback in the courts. This is an important and valid metric against which legislation can be held accountable in a constitutional democracy, where laws must be consistent with constitutional principles, and courts play a crucial interpretive role. However, it is an exceedingly narrow evaluative frame for testing the viability, appropriateness, and effectiveness of a policy.

The “states-as-laboratories” philosophy of rule-making suggests that there could be benefits to assessing other dependent variables beyond the litigation test—variables like whether a policy achieves its intended outcomes, does so in cost-effective ways, does so fairly and equitably, realizes more benefits than burdens, and more. Focusing only on the litigation risk metric may miss some of these important insights that other states could learn from. For instance, the legal tenability of a particular policy may come down to the precise wording of a law and where it is situated in the code more than the substantive elements of the policy (i.e. whether the policy approach would influence behavior in the intended ways). Because states rarely stipulate information-gathering activities that would facilitate learning when legislation is drafted [9, 11, 45], there are few obvious or systematized avenues for other states to learn more from each other’s experiments beyond whether laws face legal scrutiny in the courts.

Meaningful learning is therefore often accidental when, for instance, a state enacts a rule that happens to provide a useful counterfactual for a policy issue being actively debated at the federal level. One subject matter expert gave an example from the 1970s, when the Civil Aeronautics Board set flight routes and designated carriers for domestic flights. Airlines in states like California and Texas, which were not subject to the Board’s regulations, offered more competitive routes and pricing. These two large states happened to have a large enough internal market for flights due to their geographic size that they provided an effective counterfactual for the federal approach, prompting debates in Washington on how to encourage airline competition. In other words, states more often serve as accidental laboratories than intentional experimental environments to test and compare different approaches to the same policy issue. This can nonetheless be an effective way to influence national policy, but it depends on states’ policies gaining the attention of policymakers in other states or in Washington, which may be as equally likely to invite scrutiny as imitation. Although experimentalism is baked into the federalist system, a lack of formal or coordinated processes for learning from different states’ policies limits the potential for state policy variation to lead to policy optimization.

Despite these reality checks against the state-as-laboratories ideal, scholars argue that diverse state regulations offer an underappreciated opportunity for experimentation and learning. In the pursuit of better regulation, “high variance” policies—those that take bolder, riskier approaches to a policy issue, meaning approaches that come with a higher chance of failure and provide more contrast to other states’ approaches—present optimal search conditions for finding the most effective solution to a policy question [55]. There are plenty of practical reasons that states may pursue more conservative policy approaches, from resource constraints to the pressures of the electoral calendar. Laboratories require appropriate infrastructure to be in place to conduct effective experiments in the first place. In practice, when states treat rule-making as finite rather than experimental, regulations do risk becoming a

“patchwork” of rules rather than a “laboratory” testing different policy hypotheses. But as Sabel and Zeitlin put it, “experimentalism transforms diversity from an obstacle to integration into an asset for its advancement” [86]. Emerging technologies present some specific challenges for regulation that warrant reflecting on and, perhaps, evolving existing regulatory practice toward the experimental laboratory ideal.

The challenge of emerging technologies

For the purposes of this study, emerging technology describes technologies that entail unknown or unpredictable risks and opportunities, often made possible by digital computing and data processing (see “[a note on terminology](#)” above), although emerging technologies of the future may take forms that are impossible to anticipate today. It is a broad term that encompasses many different technologies and applications, but they generally share a potential to have transformative effects on societies and economies. Although they are sometimes called “new” technologies, this report uses the term “emerging” in recognition of both the market newness and the evolving, uncertain nature of these technologies when they enter the policy space. They have not just emerged, in the sense that they are an established fact. They are *emerging*, in the sense that conclusive evidence about their opportunities and risks need to be established.

Emerging technologies are moving targets for regulation; they are dynamic, quick to disrupt existing ways of doing things, and liable to have unpredictable effects on economies and societies. They also present a polarizing tug-of-war between intense optimism (about the potential to improve the human condition) on the one hand and profound pessimism (about present and future risks, including existential risks) on the other. In such cases—where there is a great deal of hype, some observable risks or harms, and a large degree of uncertainty—it is especially hard to engage in regulation. As discussed earlier, regulation typically entails developing and implementing rules in highly proceduralized ways that resist ambiguity and the potential for later reversals or amendments due to the large investment of time and resources needed up front to create the rules in the first place.

There is a great deal of grey area on the spectrum between voluntary, non-binding standards and command-and-control regulation that states could leverage to achieve regulatory goals of correcting market failures and mitigating risks.

The rule-making process has evolved to be more front-loaded, more dependent on certain kinds of evidence, and subject to more rigid processes in the interest of achieving many of the better regulation goals of accountability, transparency, and informed decision-making [61, 65]. But emerging technologies present new policy questions that may need to be answered with new rules, which have to be enacted with incomplete information about the real risks and benefits of these technologies for society. In this context, much less may be known up front about emerging technologies, creating serious impediments for a regulatory process that has emphasized investing in the pre-rule-making stage. This can lead to legislatures taking a wait-and-see approach to regulation, the downside of which is that real-world harms can accumulate in the meantime. Moreover, taking a wait-and-see approach may not be a viable option because technological development rapidly outpaces governments' ability to respond, so waiting may result in ever-growing lists of policy issues that exacerbates regulatory lag. And rapid market diffusion, entrenchment, and dominance of emerging technologies presents additional challenges for governments that wait; some regulatory options may be foreclosed because a technology has already become embedded in everyday life [46, 47, 83, 106].

The regulatory impasse that can ensue is evident around AI policy issues. To date, there is no federal legislation governing artificial intelligence (nor associated issues like data privacy), despite growing public concern about the risks of this emerging technology. In a recent Ipsos survey, 60% of Americans reportedly favor government regulation of AI outputs to prevent harm [52]. A Pew survey found that 40% of adults expect AI to have a negative impact on society in the next 20 years [42]. The lack of federal legislation coupled with public opinion has led many states to begin taking steps toward regulating AI. In 2026, 27 states passed 84 AI bills, tackling a range of different policy issues with a variety of approaches [93]. This surge of state legislation has been criticized by the AI industry for creating a patchwork of laws to comply with, and industry groups have advocated for voluntary commitments by companies and pointed to admirable efforts by leading AI developers to implement safeguards. However, the tension between two opposing narratives—a need for regulation to address and even preempt catastrophic risks and harms on the one hand and a need to promote and defend innovation on the other—sets up an unhelpful dichotomy. It suggests that the regulatory options consist of either innovation-preserving flexibility in the form of voluntary, non-binding standards or innovation-stifling command-and-control regulation mandated by governments. As this report goes on to explore, there is actually a great deal of grey area on the spectrum between these options that states could leverage to achieve regulatory goals of correcting market failures and mitigating risks.

AI, like other emerging technologies introduces not just new risks but a high degree of uncertainty. Proposals for addressing this uncertainty—the unknown unknowns of new technologies—center on what the OECD calls “agile regulation” or “agile governance,” borrowing a term popularized in the technology development sector [68]. This collection of alternative approaches are sometimes called smart regulation [41], anticipatory regulation [6, 7], experimental regulation [78, 79, 80, 81], or resilience [6, 58]. Agile regulation assumes that new technologies may require new paradigms of policymaking that are more adaptive, experimental, and flexible to meet the unique challenges of contemporary innovation. This approach recognizes that policies enacted now in response to emergent technological risks and public concern may have unintended consequences or fail to fully anticipate future risks and harms of the technologies themselves. Agile approaches may offer a wider range of policy options than traditional regulatory processes, allowing legislatures to respond to public demand for proactive rule-making while recognizing the need to keep policy options open as technologies inevitably evolve.

Studying alternative approaches to emerging technologies

The next section of this report examines the policy gaps that traditional regulatory approaches consistently fail to address with regard to emerging technologies in greater detail and presents some agile approaches to the policy process and specific legislative policy tools that could be employed at various stages of the process. However, there are some important considerations to keep in mind about the findings in the sections that follow.

First, while there is an expansive literature on regulation at the federal level and through executive agencies, there is comparatively less literature on the role of legislatures in regulation and even less on the specific role of state legislatures. To a large degree, this imbalance in the evidence base reflects the way that the legislative role has changed over time—toward greater delegation of regulatory authority to independent or executive agencies. Several scholars note (in the literature and in interviews) that the reduced role for legislatures mistakenly suggests that evidence-based rule-making and agile regulatory approaches are therefore predominantly the remit of designated regulatory bodies. Instead, the processes of testing, evaluating, and learning from policy options can be considered as much a part of the legislative process as politics and public opinion [41]. While there are some concrete examples of these processes for legislatures from the sources consulted for this study, identifying legislative applications of agile regulatory approaches has also required some extrapolation, bolstered by interviews with subject matter experts and representatives of Virginia state agencies and legislative commissions.

There is a growing perception among academics, policymakers, and technologists that status quo regulation is inadequate for dealing with the policy issues associated with today's emerging technologies.

Another important consideration is that while there is a burgeoning field of research and policy work on agile governance of emerging technologies, there are few real-world cases illustrating, exemplifying, or evaluating these approaches. Most of the work in this field is still largely theoretical, which is not to say that it is entirely unfounded in research, observations, or expert opinion. Much like the ideal of “better regulation” or the ideal of “states-as-laboratories,” agile regulatory approaches have not been *wholly* realized in any government or regulatory system, but aspects of this approach have been successfully employed in various jurisdictions. Frequently cited leaders in this field include Australia, Canada, Finland, France, and Singapore, but as one research article notes, they are in the early stages: “[t]hey may be ‘talking the talk’; however, ‘walking the walk’ and the achievement of tangible outputs takes time” [2].

Nonetheless, there is a growing perception among academics, policymakers, and technologists that *status quo* regulation is inadequate for dealing with the policy issues associated with today's emerging technologies [23, 101]. As the next section will discuss, agile governance would arguably entail a significant overhaul of policy processes in jurisdictions grappling with these policy issues; it is a philosophical and cultural shift as much as a shift in policy tools, procedures, and resources. In practice, adapting the policy process to contemporary technological challenges will necessarily be a gradual, piecemeal process in which states do what they can, within real-world constraints. The findings and recommendations of this study are grounded in this reality. As much as possible, the findings present an aspirational roadmap for agile approaches to legislation that can be adopted practically and pragmatically, by degrees or in parts, according to the real considerations and constraints of policymakers in the Commonwealth of Virginia.

Agile regulation: innovation *in* regulation

Agile regulation is a whole-of-government approach to regulation that adapts regulatory tools and procedures to be more adaptable, flexible, experimental, and collaborative [68]. It moves regulatory practice (whether situated in legislatures, independent agencies, or executive agencies) away from a “one-and-done” or “regulate-and-forget” approach toward a more iterative “adapt-and-learn” approach in which both regulation and technology co-evolve in an iterative feedback loop [2, 6, 7, 70]. As discussed in the Introduction, agile regulatory approaches assume that regulation and innovation are not born adversaries; instead, they are co-dependent, with regulation being one of the primary responsibilities of government in the modern world. Given this co-dependence, the question for policymakers is more nuanced than simply whether to regulate or to allow innovation to flourish unimpeded.

Because regulation encompasses a wide array of instruments that all have different effects on innovation and have different consequences—just as innovation encompasses a huge range of different scientific advances and technologies—the choice of regulatory approach and regulatory instruments matters [101]. Different instruments will have different consequences, and policymakers need information about these subtleties to make effective policy decisions. Agile regulatory approaches embrace this variance among regulatory tools and outcomes; the goal of agile regulation is to provide valuable information to compare and contrast different policy options to improve the quality of regulation [55].

“Regulation is the technology of government” [101], and it is as capable of undergoing development, testing, and evaluation as the emerging technologies it seeks to regulate [67]. In fact, many regulatory scholars acknowledge the inherently experimental nature of policy and regulation. Every new law or rule could be considered an experiment because policymakers can never foresee all of its consequences. Some of these experiments succeed and some fail, and they generate useful information that could be leveraged to improve existing or future policies [56, 78]. However, for the most part, traditional regulatory approaches are not built to accommodate this kind of learning and adaptation. The emphasis on *ex ante* research and consultation, which leverages evidence and consultation *before* a rule is finalized, renders rule-making time consuming and costly up front and creates a variety of disincentives to revisit or evaluate regulation after it has been enacted or finalized. The rigidity, proceduralization, and permanence of traditional rule-making achieve several important goals of “better regulation,” such as accountability and transparency, but they also foreclose some opportunities to mitigate unintended consequences or amend burdensome rules after the fact. For this reason, periodic efforts toward regulatory reform at the state and federal level often focus somewhat narrowly on reducing the number

of rules and requirements rather than on which rules and requirements are most effective in achieving their intended outcomes [24, 67, 87].

The most crucial difference between agile regulatory approaches and traditional regulatory approaches is that in the agile conception, regulation is a waypoint along a feedback loop rather than the final destination of policymaking.

With the arrival of disruptive emerging technologies, like AI, synthetic biology, and fintech, regulatory scholars and practitioners have proposed agile regulation as a response to policy's unavoidably limited capacity of prediction. These rapidly evolving technologies demonstrate a potential to effect widespread societal and economic changes that bring both unprecedented opportunity and risk. Perhaps the greatest policy challenge in addressing these technologies is the high degree of uncertainty about both the way risks will manifest and the underlying causes of the risks that will emerge. Without this information up front, it is hard to develop policy options. Agile regulatory approaches attempt to work *with* this uncertainty rather than attempt to stand up overly precautionary or reactionary rules as bulwarks against it. They leverage specific instruments, such as sandboxes, sunset clauses, policy laboratories and prototyping, and horizon-scanning (many of which are discussed in greater detail below). But the specific tools are less important than the overarching approach, which prioritizes experimentation, iteration, and learning. The most crucial difference between agile regulatory approaches and traditional regulatory approaches is that in the agile conception, regulation is a waypoint along a feedback loop rather than the final destination of policymaking. It constitutes a shift away from regulation as a linear process, with a singular, defined end point, toward regulation as a cyclical process that anticipates the information, collaborations, evaluations, and adaptations needed to keep moving along the loop.

Applying agile approaches to the policy cycle

The regulatory policy process is composed of three stages: before legislation or rule-making, often referred to as the *ex ante* phase and consisting of studies, proposals, and debate about policy options; during rule-making, which encompasses the finalization and implementation of new rules; and after rule-making, often referred to as *ex post* phase and consisting of retrospective activities after a rule has been put into effect, such as enforcement.

The Default: A Linear Approach

Current default approaches to regulation treat the regulatory policy process as a linear pathway from start (*ex ante*) to finish (*ex post*). Figure 2 provides an illustration of this linear approach. This linear pathway generally treats rules as static products once they have been finalized, leading to this approach being described as “set-and-forget,” “solve-and-leave,” “regulate-and-forget,” or “one-and-done” [6, 58, 67]. The linear approach has arguably evolved out of admirable efforts over time and across different political eras to professionalize, streamline, and reform the regulatory process in an ever more complex policy environment to facilitate more accountability, minimize regulatory burden, and develop rules based on objective evidence. However, as discussed in the introduction, because of its progression toward a relatively static end-product, the linear approach has also placed disproportionate emphasis on the “before” or *ex ante* stage of the process. While this emphasis has introduced helpful sources of information and evaluation into the policy process for policymakers, it also focuses on a stage of the process when often *the least is known* about policy impacts and outcomes. In the case of emerging technologies, it can be difficult if not impossible to anticipate emergent risks of new technologies or their likely impact on the economy or society.

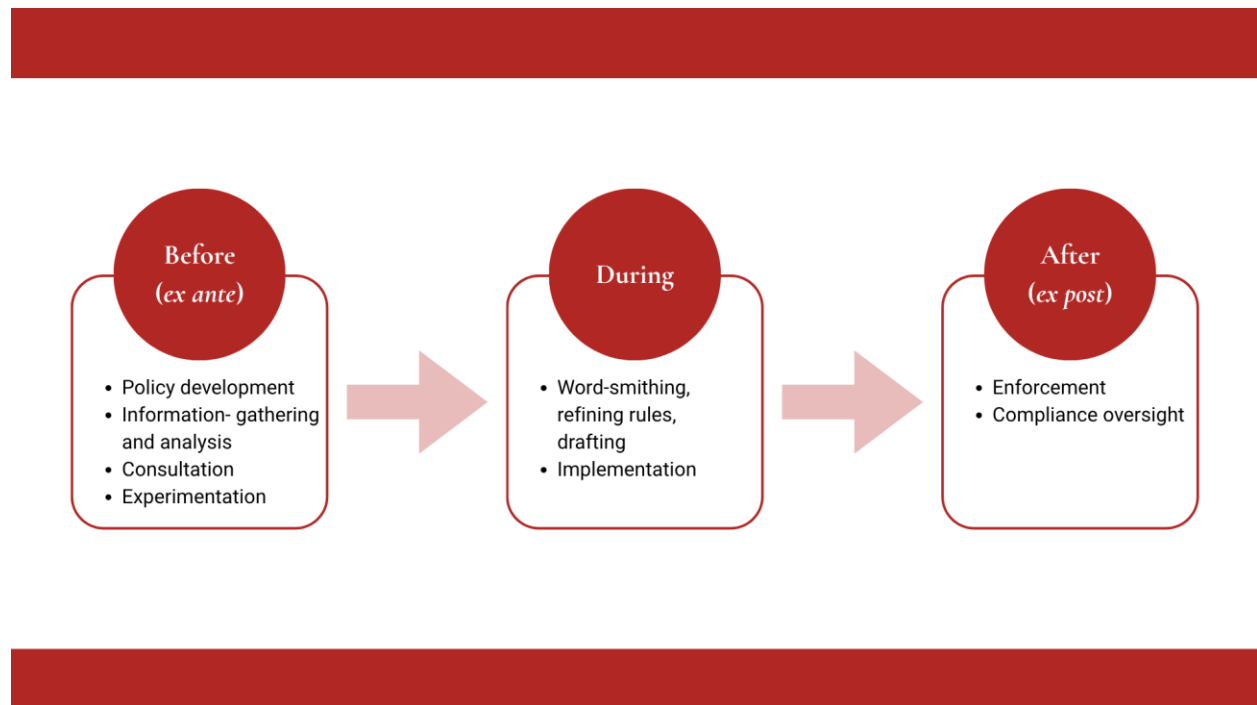


Figure 2: The linear policy process

There are several reasons for the comparative maturity of *ex ante* procedures, tools, and mechanisms. One important reason is the philosophy that “prevention is better than the cure” [41]. Because new rules place new costs and burdens on industry and other affected entities, there is an incentive to introduce

friction in the rule-making process *before* laws are enacted or rules are promulgated by rule-making agencies. Public perception and opinion also play a role in elevating the *ex ante* phase because new laws are attention-grabbing and carry political value, but once a law goes into effect, it often loses urgency and becomes stale news [67]. Moreover, there is little political motivation to engage in follow-through activities, like ongoing monitoring or *ex post* evaluations of policy because learning that things have gone wrong creates reputational risks—both for elected members and rule-making agencies [11, 30, 67]. Finally, compliance with new rules is costly for industry in both time and resources, so even regulated entities may resist revisiting rules once they are in effect [11, 33, 55].

All of these factors contribute to the comparative lack of dynamism in the second and third stages of the policy process—the during and after stages of the policy process. The OECD has called *ex post* reviews the “forgotten child” of regulatory policy [67]. The linearity of the policy process has also constrained periodic efforts toward regulatory reform. Because this process treats finalized rules as static outputs whose stability is one of their primary virtues, reform efforts tend to focus on “cutting red tape” by introducing *ex post* reviews that aim for quantitative reductions in statutes or rules rather than adapting or evolving rules based on evaluating observed policy outcomes [11, 33, 67].

A Missed Agile Opportunity? Hands-Free Calling Laws

It may be hard to believe now, but just two decades ago, cell phones were an emerging technology gaining popularity and disrupting everyday life. Surging adoption raised a number of policy issues, including concerns about how cell phone use while driving could distract drivers and lead to car accidents. As a result, in the early 2000s several states passed so-called hands-free calling laws that banned the use of handheld phones while driving, allowing calls only through hands-free systems or accessories that would allow drivers to keep both hands on the wheel.

However, such laws are cited in regulatory studies as examples of missed opportunities to leverage scientific evidence and agile governance approaches to produce better policy. The laws focused on the new technology rather than the underlying cause of road accidents: cognitive distraction [4, 49]. In fact, scientific studies showed that hands-free calling did not increase road safety because being on the phone is a distraction regardless of whether it is held in the hand. Restrictions on hand-held phones also generally did not regulate the design of hands-free alternatives, many of which still require manual dialing, plugging things in, or pressing buttons. Studies of Connecticut’s hands-free law showed that it did not achieve its intended outcomes, failed standard cost-benefit tests, and showed a dropoff in compliance after the initial implementation [49]. The “regulate-and-forget” outlook on lawmaking locked in the ineffective rules, without the motivation or mechanisms to gather new evidence, learn, and adapt.

Agile regulatory approaches could potentially have pre-empted the adoption of this unsuccessful policy or provided avenues for revising and improving these laws after implementation. For example, small-scale, time-limited policy prototyping or pilots could have generated real-world evidence of the impact of such policies on driver behavior and may have refocused the attention of policymakers on the behavioral factors in driver distraction rather than a specific technology. The policy could have included programmed review and systematic monitoring of key metrics, like traffic tickets and court dismissals, rates of compliance, and other accident data, with required adjustments to the policy at scheduled intervals based on these inputs.

Hands-free calling regulation ultimately fell prey to many of the pitfalls of making policy about new technologies, and because these laws were generally developed through a linear policy process, there were few opportunities to explore alternatives or learn from implementation.

An Agile Alternative: The Policy Loop

In contrast to the default linear approach to the policy process that has become entrenched over time at both state and federal levels, agile regulatory approaches treat the policy process more like a cycle or a loop, facilitating both evidence generation (information) and adaptation based on new evidence (learning) throughout. Agile approaches intentionally shift the policymaking process away from a “regulate-and-forget” mindset, toward a “test-and-evolve” mindset [6]. Such approaches rely on multidirectional feedback channels at every stage of the policy process that go beyond checking for compliance with finalized rules. This feedback instead consists of a variety of monitoring and accountability mechanisms, accompanied by opportunities for different rule-making entities to learn from the information generated through these mechanisms [72]. It requires pre-planned and continuous collaboration and communication between legislatures, regulatory bodies, technology developers, and enforcement agencies. Therefore, a crucial hallmark of the agile approach is programmed or scheduled review of regulations at regular intervals so that rules are not left to ossify as technologies continually evolve [22, 58].

According to agile regulatory theory and practice, treating the policy process as cyclical rather than linear has a number of benefits for dealing with the unique challenges of emerging technologies:

- **Overcoming key timing challenges** in the regulatory process, allowing the policymakers to take proactive steps toward regulation while a technology is developing and emerging, rather than later, when harms have accumulated and rules are much harder to implement [2];

- **Confronting the inherent uncertainty** around technological opportunities and risks by taking a learning-by-doing approach that anticipates and embraces the existence of unknown unknowns through policy experimentation [58];
- **Generating evidence** *through* the policy process to address information roadblocks by leveraging regulatory instruments to compel information-sharing or collaboration between regulators and technology developers, or engaging in policy testing and experimentation to trial policy solutions while learning more about regulated technologies [53, 106];
- **Leveraging and adapting to changes** in technologies themselves, real-world outcomes, scientific understanding, and social norms [11];
- **Overcoming regulatory inertia** by leveraging a range of different experimental, time-limited, information-generating instruments to build consensus for a controversial approach or to keep the policy process moving, even when more information is needed (or may be continuously needed) to finalize effective, formal rules [9, 55, 78];
- **Enabling innovation** by providing structured opportunities for collaboration across government and the private sector, building consensus and clarity and reducing regulatory uncertainty [7, 72].

Figure 3 provides an illustration of the agile policy loop, simplified to focus on the three key stages of policy development discussed above. However, it is worth noting that agile regulatory approaches are really loops within loops, meaning that any stage of the process could provide feedback for the current stage, a future stage, or a previous stage in the cycle. In other words, moving along the loop does not necessarily mean moving always in the same direction (beginning to end). For example, insights from a policy experiment implemented in the “during” phase (as it is described here) might feed back to the “before” stage and require revisiting the hypothesis for the experiment, the premise for a policy intervention, or even the intended outcome of a policy. For legislatures, it may mean revising the policy objectives for a proposed statute based on the findings from a pilot study, for example.

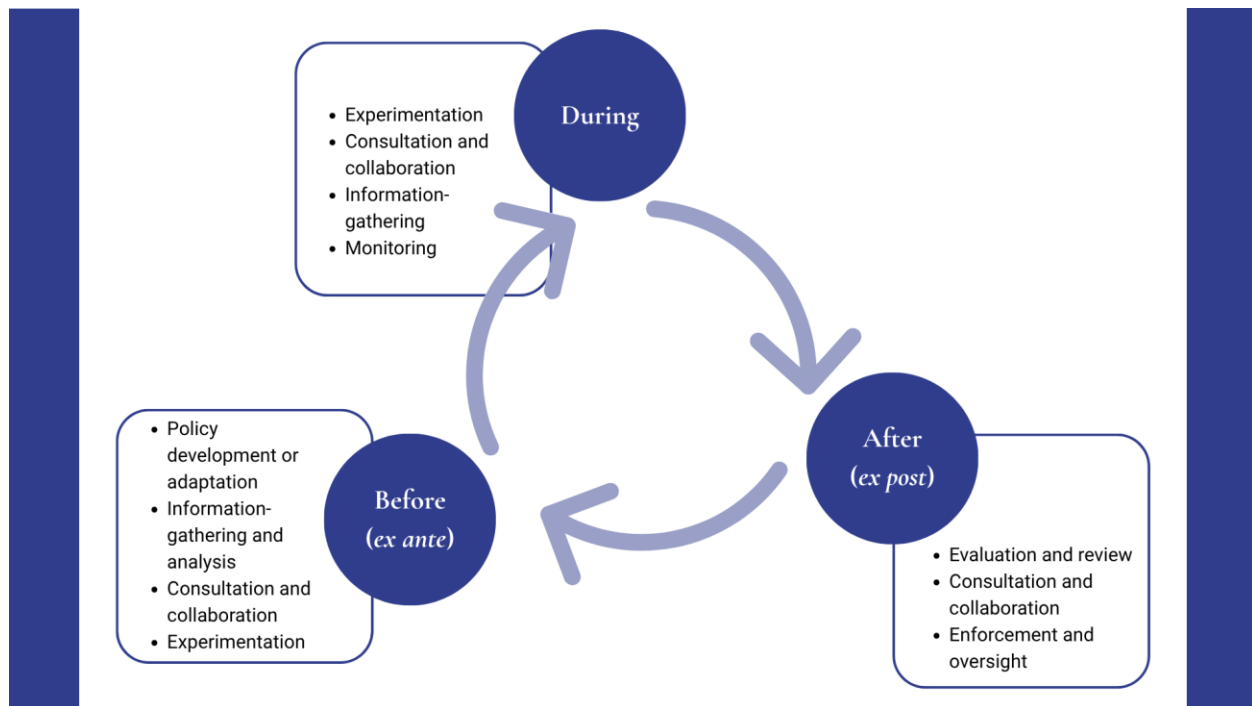


Figure 3: The policy cycle or loop

Table 1 summarizes each phase of the policy loop with a brief description of both the default and agile approaches, highlighting their differences.

Before (ex ante)	This is the anticipatory stage of law-making, in which potential regulations are proposed, debated, and stress-tested using an array of strategic and impact assessment tools, such as exploratory studies (e.g. by Commissions), cost-benefit analysis, regulatory impact analysis, work groups, and stakeholder input/lobbying. Characteristics of traditional (static) rule-making: • Evidence gathering and analysis heavily front-loaded, generally making this the most intensive phase of rule-making • Prescriptive procedures, such as notice-and-comment and Regulatory Impact Assessment • Relies on past historical data to forecast • Policy objectives may or may not be clearly set out • Limited or no planning for evaluation or review • If any testing, prototyping or experimentation occurs, it is most likely to take place in this stage alone
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	Characteristics of agile rule-making: • Continuous strategic foresight activities, such as horizon-scanning to detect important policy issues • Well-established policy objectives, accompanied by clear metrics or strategies to assess whether they have been successfully met after implementation • Testing, experimentation, and policy-prototyping with diverse stakeholders, accompanied by plans to incorporate new information throughout the next stages of the policy process
During (drafting, consultation, implementation)	This is the stage at which a law or rule is refined, finalized, and implemented by regulatory agencies and covered entities. Characteristics of traditional (static) rule-making: • Switches “on” a rule with compliance requirements, without much (if any) mechanisms to adapt based on new information • Compliance often focuses on formally defined procedural steps, which can lead to tick-box compliance • Focuses primarily on word-smithing the legal language of rules to achieve consistency with other rules or to avoid future legal challenges • Consultation is often highly prescribed by either formally established procedures or informally entrenched practices and can become perfunctory or exclusionary for those unfamiliar with the process Characteristics of agile rule-making: • Uses real-world testing instruments to observe policy and technology impacts with regulatory oversight • Leverages feedback loops between rule-makers, regulated entities, and other stakeholders to adjust rules based on information about observed outcomes (for industry, society, and the economy) • Collaborative engagement with diverse stakeholders using transparent policy (and research) design, accessible language, and a variety of engagement mechanisms (e.g. workgroups, advisory panels, citizen assemblies, etc.) • May include phased implementation, temporary implementation (e.g. through sunset clauses), or self-contained pilots

After (<i>ex post</i>)	This is the retrospective state of law-making, in which rules that have been implemented are evaluated, reviewed, and sometimes amended. Characteristics of traditional (static) rule-making: • “Set-and-forget” outlook that treats rules as final and permanent and difficult to amend or update • Rarely involves evaluations or reviews of policy outcomes; when reviews are conducted, they tend to focus narrowly on cost-benefit analyses • Periodic political interest in regulatory reform may result in reviews or lookbacks at regulation, but often with the narrow goal of reducing the quantity of regulation (cutting red tape) rather than evaluating more dimensions of regulatory impact Characteristics of agile rule-making: • A critical part of the policy cycle, featuring evaluation and review of rules and their impacts (including costs and benefits, unintended benefits or harms, and success toward achieving intended policy objectives) • Depends on collecting information (data) about technologies and policies in the real world, as many impacts, benefits, and harms, will not be known beforehand • Usually planned for in the before/<i>ex ante</i> stage of the policy process
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Table 1: Phases of the policy loop

Regulatory roadblocks for emerging technologies

The primary goal of the agile policy loop is to overcome the regulatory roadblocks that policymakers repeatedly face when considering rules for emerging technologies. Encountering any one or any combination of these roadblocks along the roadmap from policy need to legislative rule can lead to either a regulatory impasse, where rules are delayed or never even proposed, or to “symbolic laws” [41, 56], where ineffectual rules are enacted that may give the appearance of having addressed a policy need but fail to achieve the intended outcomes. Emerging technologies present many regulatory challenges that can be grouped into three broad “roadblocks” in the policymaking process: timing, information, and learning. While the specific dimensions of these roadblocks will vary depending on the technology, these three categories effectively encompass most of the challenges, regardless of the technology, sector, or

regulatory institution. Table 2 below provides an overview of the three emerging technology roadblocks to effective regulation—timing, information, and learning—with a description of the challenge and its key characteristics. The subsections that follow provide a more extensive narrative description.

Timing	Information	Learning
• Pacing problem: The process of developing sound, evidence-based policy is often too slow to keep up with emerging technology or to meet the political demands of election cycles. • Collingridge Dilemma: Waiting for better evidence can delay policy interventions until technologies are so entrenched in the market that regulating them becomes more expensive and time-consuming. • Front-loaded procedures for rule-making: Well-intentioned due diligence requirements or practices for rule-making (like regulatory impact assessments) can slow down policy development. • Political pressures: Short electoral cycles or the time constraints faced	• Information asymmetry: Private technology companies often possess a monopoly on expertise, research insights, and proprietary data, and it can take lawmakers a long time to catch up because the mechanisms to access privately held information are slow (e.g. litigation, whistleblowing, independent academic research). • Under-investment in public interest research areas: The concentration of expertise and research activities in the private sector also means that some areas of research that could support policymaking are not prioritized. Research that answers public policy questions about safety, ethics, privacy, and so on may not receive the same	• Over-emphasis on <i>ex ante</i> process: In traditional rule-making, policies are fairly permanent once they are implemented (enacted or finalized). Therefore, the most dynamic phase of rule-making is <i>before</i> the rule is final. But front-loading evidence gathering, experimentation, and/or consultation means that important insights might be missed, and there is no way for policymakers to learn from policy implementation and adapt rules to changing conditions. • Dynamic technologies: When a permanent rule is the end point of the policy process, rules about emerging technologies may not be able to respond to the ways these technologies continuously change, adapt, and develop

by part-time legislatures can force policymakers to adopt unintentionally reactionary policies. ● Pacing fallacies: While technology development often happens much faster than rule-making, catastrophic risk narratives about very new technologies tend to be overblown based on how innovations are known to diffuse and impact society. Therefore, simply speeding up the traditional process of making permanent rules is not the solution. Reactionary rule-making can result in overlooking real policy issues that are more mundane but carry significant societal consequences.	attention as research that establishes commercially competitive performance metrics. ● Informational dependence: The profound information asymmetry between technology developers and the public sector can lead to dependence on industry expertise, voluntary standards or self-regulation. ● Limited infrastructure: Lack of technical or specialized expertise in the public sector may result in relying on industry experts too heavily or delegating rule-making to executive or independent agencies without enough guidance on policy objectives. ● Scientific evidence and social norms: Both scientific evidence and social norms are important inputs into the policy process, but striking the balance between different kinds of valid information can	emergent capabilities and risks in the real world. ● Self-reinforcing negative outcomes: Without considered ways to learn from both policy implementation and technology development over time, the policy process risks producing overly brittle rules that have a chilling effect on innovation. When continuous monitoring and learning are not part of the public sector's policy process, policymakers may overly rely on alarmist messaging or cherry-picked information from industry.
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Table 2: Roadblocks to regulating emerging technologies

Timing

Legislation on emerging technologies faces what is commonly called “the pacing problem,” where regulation usually lags behind the rapid evolution of technology [35, 53]. At the federal level in the U.S., it typically takes six to eight years to develop a new regulation [58], a timeline that seems completely unmatched to the current pace of technological innovation and market dissemination. The pacing problem is well-illustrated by the public release of ChatGPT by OpenAI in 2022. The market dissemination of general purpose generative AI surprised lawmakers worldwide. At the time, the EU had been developing the EU AI Act for around four years, but lawmakers suddenly needed to address new policy issues around foundation models, which did not fit neatly into the risk-based framework as it had been carefully refined at that point [46]. Moreover, technologies like generative AI are known to develop emergent capabilities once they are operating in the real world, after they are deployed, creating further challenges for rule-makers. In just a few short years, numerous risks and harms have surfaced as a result of the market diffusion of foundation models, from scams and hacking to emotional manipulation [5, 46]. What these anecdotes reveal is that the pace of technological change is very fast and there is often a high level of immediate public exposure to technological risks and harms, leading to urgent policy issues that deserve attention. The pacing problem is a longstanding regulatory timing challenge that can result in accumulating risks and harms of unregulated products or practices, but it is amplified in the context of today’s fast-moving technologies.

A regulatory process that has evolved to conduct the bulk of its due diligence (e.g. Regulatory Impact Analysis, cost-benefit analysis, evaluation, and consultation) *before* a rule is finalized is particularly vulnerable to the pacing problem [92]. Requiring extensive inputs into making a rule, including sometimes high evidentiary standards for weighing policy options, has the effect of slowing the process down right at the start. As discussed earlier, there are many good reasons that these points of friction have been introduced as policies are being developed; in traditional law- and rule-making, finalized regulations are hard to change. As one subject matter expert put it, it can be very hard to change the Code, so policymakers have to be cautious and careful about what goes into it. This friction can contribute to better regulation outcomes because new policies are thoroughly considered in advance, and when they are established, they provide clarity and predictability to regulated entities (a principle often “legal certainty”) [53]. However, the unique roadblocks of timing, information, and learning associated with emerging technologies collectively create a perfect storm of regulatory challenges that often cause policy to stall in the early stages when technologies are newest, we know the least about them,

and the window for policy intervention is paradoxically widest.

With many of today's emerging technologies, the policy window can rapidly close, leading to the perception that the "ship has sailed" when a technology has become deeply embedded in the market. This second timing challenge is referred to in the regulatory studies literature as the "Collingridge Dilemma." The dilemma describes a tension between information and timing. When a technology is in an early stage, it is flexible and easier to regulate. At the same time, this is the stage when its future applications, benefits, social and economic consequences, and risks and harms are least understood. So, it is difficult to design effective, long-lasting rules. At later stages, the consequences and harms of a technology will be more apparent, but the technology may have scaled and achieved a high level of market penetration. At this point, there are various behavioral, economic, and structural forces that make regulating more expensive, difficult, and slow, from widespread public adoption of the technology to the economic influence of technology companies [53, 92]. A common example is social media, which has largely evaded regulation through dedicated legislation at the state and federal level in the U.S. until very recently, leaving social media policy to develop through litigation rather than lawmaking [6, 16].

Additionally, structural and political dynamics in particular jurisdictions can create entirely different timing challenges for regulating emerging technologies. The electoral cycle puts pressure on elected legislators to implement policies their constituents want. These pressures shorten the window for elected policymakers to craft new rules and often means that the legislative regulatory process is truncated or rushed [30, 39]. In part-time legislatures, as in Virginia, these pressures can be especially pronounced because legislators have extremely small windows to propose policy options and refine bill language [40, 84]. Short timelines for developing legislative policies combined with an ever-increasing volume of complex policy issues that legislatures must address is one factor that has led to the increasing delegation of rule-making authority to other branches of government and independent agencies [32]. Therefore, legislation typically contains broad principles that regulatory experts in other bodies need to develop, refine, and finalize—a system that requires a mature ecosystem of expert regulatory bodies with sophisticated in-house expertise. Many U.S. states lack this robust ecosystem at the state level for the diverse array of emerging technologies warranting policy attention [90, 70].

Finally, a further complication inherent in the timing roadblock is that the "pacing problem" can be something of a fallacy when it is based on hype and speculation rather than empirical facts about technological capabilities. While technology development often truly does outpace rule-making, catastrophic risk narratives about very new technologies tend to be overblown based on how innovations are known to diffuse and impact society. Technology adoption follows well-established

trajectories, with early adopters often amplifying exceedingly optimistic (or pessimistic) expectations, while widespread adoption and impacts are slower to materialize. Moreover, there is usually considerable uncertainty about how far along the technological development arc a technology really is. Sudden breakthroughs fuel excitement that even greater capabilities are within short reach, but many emerging technologies have experienced much slower progress than their periodic breakthroughs might have suggested, such as self-driving cars and quantum computing [60]. For this reason, along with those discussed above in this section, simply speeding up the traditional process of making permanent rules is not the solution to addressing the timing roadblock. In response to breakthroughs that supercharge concerns about the pacing problem and technology's catastrophic risks, rule-making can become overly reactionary. Policymakers may overlook real policy issues associated with a technology that are more mundane but carry significant societal consequences. Or, well-intentioned policymakers may enact rules for the most prominent risks of the moment with a one-and-done mindset that does not account for the unpredictable trajectory of ongoing technology development.

Information

The second roadblock category is information, and there are several key dimensions to this roadblock. One informational challenge is "information asymmetry," where technology developers often possess more complete and specialized knowledge about an emerging technology than policymakers or independent researchers [32, 106]. Today private technology companies have a disproportionate informational advantage over the public sector, holding a virtual monopoly on technical talent and possessing vast financial resources for internal research [6, 46, 98]. The public sector, by contrast, often lacks comparable technical expertise, visibility on key technological features and performance metrics, and resources to conduct rapid, robust, independent evidence collection or to enforce existing rules that might apply to new technologies [46]. Several sources consulted for this study observed that the current technological era is characterized by perhaps the greatest concentration of knowledge in the private sector than any previous era. By way of example, less than one percent of all graduates with degrees in AI go into the public sector [83]. This informational gap between policymakers and technology developers is not easily bridged without establishing processes and channels—and sometimes mandated requirements—for knowledge-sharing. And it creates specific problems for regulation.

When the public sector lacks information, it can wind up relying heavily on private companies (the intended regulated entities) for factual information it can use to develop policy options [46, 106]. This informational dependence, combined with timing pressures, can result in intellectual capture, where policymakers uncritically defer to industry standards or definitions [98]. It can also mean that crucial insights about how technologies work and whether they are safe may not be considered in the

policymaking process because companies withhold certain details or present cherry-picked data to nudge policy toward their own commercial priorities (and many examples from regulatory history demonstrate this tendency, from tobacco to automobile regulation) [45]. Without important information about how emerging technologies work, lawmakers will struggle to develop optimal rules to govern them, resulting in anything from unenforceably specific technical mandates on the one hand to overly vague principle-based mandates without clear pathways to technical implementation on the other [16, 47, 89]. The result is ineffective regulation that fails to achieve its intended outcomes.

Another informational problem is what some scholars have described as a “pacing problem” in scientific evidence [75]. It takes a long time to develop robust, independently vetted and verified scientific evidence of technological harms. This is especially true when there is information asymmetry between independent experts and private sector technology developers. In developing the evidence base for policy options, policymakers may be interested in understanding the evidence for harms, the evidence for the causes of those harms, and the evidence for specific interventions to mitigate identified harms. In an asymmetric information environment, the scientific community can wind up spending a long time on the first category—proving that harms exist—and comparatively little time on the causes and potential solutions. When the regulatory process disproportionately emphasizes evidence-based decision-making at the *start* of the policymaking process, this informational requirement can severely delay the development of effective policy options.

A related but distinct research problem is that the private sector may under-invest in generating evidence on topics that would be of the most value to policymakers and the public. Research on public interest topics might test the effectiveness of different safeguards or risk mitigation techniques, or study the impacts of technology on privacy, equity, civic life, or the environment. Private sector dominance of technology research and development can result in prioritizing research into commercially competitive performance metrics or about strategies for maximizing adoption. This informational problem is exacerbated by widespread funding of academic research by private companies developing leading emerging technologies [77]. In the case of AI, this dynamic has resulted in an under-investment in studying explainability, for example, as compared with research that tests AI performance against benchmarks, which may not reflect real-world applications of the technology [60].

Finally, another informational challenge is that technical knowledge and independent scientific evidence are not the only valid informational inputs into the policymaking process. Public opinion and societal norms also play important roles in determining policy options for addressing technological risks and harms. Determining viable policy options requires marrying scientific and normative insights to

define a desired outcome and steer technology toward that goal. The essential integration of normative insights and priorities into the regulatory process introduces more space for misalignment of policy and intended outcomes. Normative or political priorities can come into conflict with scientific evidence, leading to regulations that symbolically demonstrate political decisiveness on an issue while ignoring (often inadvertently) important insights about cognitive biases, behavioral realities, or enforcement gaps that render such regulations less effective at achieving their intended outcomes.

Learning

The third roadblock category is learning, meaning the ability to iteratively and continuously take on new information about both emerging technologies and regulations. As discussed elsewhere in this report, in traditional regulatory processes, learning is front-loaded. Efforts in recent decades to systematize and professionalize the regulatory process to produce better regulation have led to prioritizing evidence-gathering before rules are made. Once a new regulation is finalized, it is permanent, and most regulatory systems have comparatively few established review or evaluation procedures after a rule is implemented [27, 56, 70]. Restricting the window for learning mainly to the earliest stages of policy development presents a roadblock because of the challenges of timing and information discussed above: for emerging technologies, this is the stage when the least is known about a technology's benefits and risks, and both waiting to regulate and regulating too quickly can result in potentially irreversible social and economic impacts. When the policy process lacks meaningful feedback loops, where policymakers can take on new information about technologies as they evolve and learn from the real-world impact of policies that have been implemented, the consequences of poorly crafted regulation are greater. This can result in a chilling effect on policy—with legislatures hesitant to make rules if they feel they do not have enough information. Or, conversely, it can have a chilling effect on innovation—when legislatures pass rules without plans to monitor unforeseen consequences on markets and consumers.

Another learning challenge unique to emerging technologies is their dynamic nature. Many of today's technologies are not static products for which establishing a pre-market safety testing standard or protocol will mitigate most risks and harms. The technologies themselves are constantly evolving, often in response to consumer interactions or specific real-world use cases and environments, and this presents new challenges for policymakers. In other words, the technologies themselves are learning. For example, in the case of AI, many of the risks *cannot* be known in advance of deployment in real-world scenarios [60], rendering many traditional approaches to regulation inadequate. This summer, over 1300 technology sector employees, including the CEO of Anthropic and Chief Scientist at OpenAI, signed an open letter calling for government regulation of AI because leading AI companies could be close to “automating AI research,” meaning that AI models could develop themselves without human input,

dramatically accelerating the emergence of new AI capabilities [76]. This letter rang an alarm bell regarding the ability of one of today's most consequential emerging technologies to continuously learn, evolve, change its behaviors and risk profiles.

Of course, the paradox is that the policymaking process lacks well-established instruments to regulate such dynamic technologies, and information asymmetry problems mean that the public sector lacks verifiable information about technological performance, risks, and safeguards to craft policy solutions independent of industry influence. The stage is set for an array of regulatory failures because the most accessible information about technological risks often comes in the form of alarmist messaging from the tech sector, leading to growing public demand for swift policy action. The greatest challenge in this context is to develop policy responses that are not only symbolically decisive but substantively effective.

Agile approaches to regulatory roadblocks

As is likely already apparent, these roadblocks overlap and reinforce one another in some cases. For example, informational hurdles contribute to timing challenges: when scientific evidence takes a long time to develop, policymakers may delay taking action to wait for more conclusive information about technological risks. In another example, learning as technologies evolve and policies go into effect depends on collecting meaningful information and evidence that policy makers can act on. When the policy process is linear, moving from identified risk to permanent rule, encountering any one of these roadblocks can stall progress or cause paralysis. By treating the policy process more like a cycle or a loop, removing roadblocks can be integrated into the process of rule-making. Removing roadblocks can be a substantive policy step that simultaneously takes decisive action toward risk and harm mitigation while building the information base for more stringent or permanent rules.

By treating the policy process more like a cycle or a loop, removing roadblocks can be integrated into the process of rule-making.

To paraphrase regulatory scholar Cary Coglianese, taking an agile approach entails a shift away from regulation as a noun, a fixed destination on the policymaking roadmap, toward regulat^{ing} as a verb, an

ongoing, iterative process that is always striving toward a better realization of the intended policy outcome [24]. A large part of *regulating* is building and bolstering the independent evidence base for different policy options. Many (if not most) of the regulatory instruments that make up the agile regulation toolkit are geared toward this objective: providing policymakers with more information on which to base their policy choices and weaving information collection and analysis into *every* stage of the policy cycle, not just the first stage. This focus on evidence generation, analysis, and integration into the policy cycle serves several important roles in overcoming the regulatory roadblocks that emerging technologies throw up:

- **Mitigating cognitive bias:** Policymaking is a fundamentally human endeavor and is therefore often subject to biases like loss aversion, groupthink, or pre-conceived beliefs. By leveraging experimental design and scientific research methods, agile approaches build a robust evidence base to inform policy options [30, 92].
- **Building consensus or buy-in for a policy option:** Under conditions of uncertainty about a technology's benefits and harms or about the most effective policy intervention to mitigate risks, proposed regulations may be highly contentious and lead to legislative gridlock. Agile approaches that actively generate robust, independent evidence for a policy intervention and/or build in opportunities to adapt rules once they are made offer avenues to build consensus based on shared knowledge and expectations. Experimentation and transparent reporting on findings can also help build public legitimacy [2, 41, 78].
- **Reducing implementation costs:** Agile methods like pilots and prototyping can allow policies to be tested before they are implemented permanently or on a wide scale, avoiding the potential costs of large-scale failure. Extensive collaboration and information-sharing between public sector policymakers and private sector technology developers also means that industry can gradually gain a comprehensive understanding of forthcoming rules that they also helped co-create, reducing compliance costs [41, 70, 82].
- **Working with, rather than against, technological timelines:** By crafting policies that are built to learn, rules can evolve alongside technological developments. Agile approaches also offer a wider array of policy instruments and steps in the proactive policy process beyond simply finalizing a permanent rule, so policymakers can respond more quickly to emergent risks or harms in the knowledge that there are clear pathways to learn from policy implementation and adapt rules accordingly [6, 7].
- **Providing more opportunities for collaboration and input from external stakeholders:** Agile approaches to policymaking depend on triangulating information from multiple sources,

including industry, civil society, and academia. The necessity of feedback means that consultation is integral to every stage of the process rather than just at the beginning [68].

Agile instruments in action: EU Policy Lab

In 2014, the European Union established the EU Policy Lab within the Joint Research Centre (JRC) of the European Commission to serve as a collaborative, experimental space for innovative policymaking. The lab leverages behavioral science, foresight activities, prototyping, and other experimental methods to inform policy design for complex policy topics, including emerging technologies.

For example, between 2017 and 2018, the Policy Lab conducted experimental work on blockchain technologies as part of its #Blockchain4EU research agenda to explore existing, emerging, and potential applications of blockchain for non-financial sectors. The outcomes of that multidisciplinary project, which leveraged several agile policy instruments (including horizon scanning, desk and qualitative research, speculative design, and more) directly influenced EU policy on blockchain, including prompting the European Commission to fund an initiative for the development of blockchain applications for small- to medium-sized enterprises [2].

An agile toolkit for legislation

As discussed earlier in this report, agile regulation is an approach—it is as much about an outlook on regulation as it is about employing certain strategies or regulatory instruments. The approach is a shift from regulation as a linear process toward regulation as a feedback loop, from policy-making to policy learning. To facilitate that loop, there are many different regulatory tools, instruments, and strategies that sources recommend. Importantly, no single instrument or even combination of policy instruments will necessarily result in more agile regulation of emerging technologies. The policy objective, context, and availability of requisite resources will all factor into which instrument may be most appropriate. Therefore, when adopting a policy tool, policymakers must also consider how to *close the loop*: What other policy conditions need to be in place to support the entire policy cycle (before, during, and after rule-making) and address the regulatory challenges discussed above (timing, information, and learning)?

For example, legislatures may mandate an outcome-based framework for regulating a technology that gives industry flexibility in developing technical solutions to achieve the outcome. An example might be requiring age verification in statute for certain digital platforms using reasonable technical methods. The intended outcome is to prevent minors from accessing harmful content online. This could be an effective approach because the private sector possesses more domain-specific, technical expertise than

legislatures. It mitigates a timing and an information issue, allowing governments to take action to mitigate technological risks by leveraging external expertise to fill a public sector knowledge gap. However, it could leave other information and learning gaps unresolved. And it may neglect the “during” and “after” phases of the policy cycle if ongoing monitoring and reporting are not required or there is no mandate to collect evaluative metrics. How will we know if the technical solutions chosen are resulting in the intended outcomes? How will we know if the technical solutions adopted have other unintended consequences? What other methods could have been employed, and would they be more or less effective? What are the penalties if the technical solutions are ineffective or have adverse consequences?

Table 3 below presents a non-exhaustive list of policy tools associated with agile and adaptive approaches to regulating emerging technologies that policymakers may consider using. Each instrument is then described in greater detail after the summary table, including conditions policymakers should take into account for each instrument. These conditions may be limitations to the instrument if they are not mitigated by design. The instruments below each enable different aspects of agile governance, such as anticipation, experimentation, monitoring, flexibility, evaluation, and adaptation. Each instrument is also best suited to particular stages of the policy cycle and to addressing specific regulatory roadblocks. There is considerable overlap among some of these instruments, such as experimental regulation and pilots, for instance. However, depending on their design and application, each instrument could still be considered a unique mechanism and may also have distinct political meanings and connotations that policymakers need to account for.

Policy Instruments	<i>Agile principle</i>	<i>Stage of the policy cycle</i>	<i>Regulatory roadblocks</i>
Adverse incident reporting Sometimes called post-market surveillance, an instrument that requires or encourages the developers or users of technology to notify regulatory authorities when the technology has caused or nearly caused real-world harm, injury, damage, or breaches of rights.	Monitoring	After	Information Learning
Experimental clauses A statutory provision that grants designated authorities (such as a regulator or oversight agency) the power to exercise regulatory	Experimentation	During	Information

flexibility to waive or derogate from existing legal requirements to test innovative products or regulatory approaches at their discretion as long as these practices adhere to the law.			
Financial assurance mandates A resilience instrument that obligates developers or operators of technologies to make financial contributions to a specified fund, purchase liability insurance, or take financial responsibility in some other way for potential harms associated with an unpredictable technology.	Anticipation	Before	Timing
Horizon scanning A continuous process of scanning diverse sources and expert opinions to identify “weak signals” of emerging technology and science trends that have not yet entered the mainstream.	Anticipation	Before	Timing
Kill switches Mandated operational controls that allow regulators, deployers, or developers to rapidly deactivate, terminate, or recall technology that is causing harm, sometimes also called emergency stop mechanisms or safety brakes.	Flexibility	During / After	Timing
Management-based regulation A collection of instruments that involve shared regulatory responsibilities between governments and private entities and generally include an enforceable regulatory backstop for industry self-regulation.	Flexibility	During	Information
Pilots A temporary, scaled-down testing mechanism to evaluate new policy approaches in real-world environments before enacting them permanently in law, sometimes also called experimental legislation.	Experimentation	Before / During	Information

Policy labs A neutral forum for participants from government, academia, the public sector, industry, and the public to come together to explore a policy issue and reach a common policy goal.	Experimentation	Before	Information
Policy prototyping A low-fidelity test of policy solutions before they are formally implemented to evaluate feasibility, likely outcomes, and unintended consequences.	Experimentation	Before	Information
Principle-based provisions A broad category that encompasses any regulatory instrument that sets non-prescriptive goals such as outcomes to be achieved or harms to be mitigated, rather than specifying the technical means to achieve these goals, sometimes also referred to as outcome-based provisions.	Flexibility	During	Information Learning
Programmed or scheduled review An <i>ex post</i> instrument that sets requirements, timelines, and criteria for evaluating an existing regulation in advance or at the drafting of the regulation.	Learning	After	Learning
Regulatory impact analysis A “systematic process of identification and quantification of benefits and costs likely to flow from regulatory or non-regulatory options for a policy under consideration” [66], usually using quantitative methods such as cost-benefit analysis, cost-effectiveness analysis, or business impact analysis.	Anticipation	Before	Information
Safe harbors Statutory, administrative, or contractual provisions that protect regulated entities from legal liability, sanctions, or civil claims if they adhere to specified compliance requirements.	Flexibility	During	Timing

Sandboxes Controlled environments or provisional legal regimes that allow firms or technology developers to test innovative technologies under regulatory supervision for a limited amount of time.	Experimentation	During	Information Learning
Strategic foresight analysis A “structured and systematic way of using ideas about the future to anticipate and better prepare for change” [2]. It involves engaging in a structured process to examine different plausible future scenarios that might diverge dramatically from the status quo.	Anticipation	Before	Information
Studies/exploratory research An evidence-generation instrument based in social and behavioral science methods that encompasses several different approaches to scoping and investigating policy issues, including policy reports, briefs, and basic research on policy-relevant topics.	Anticipation	Before	Information
Sunrise clauses or conditional enactments A temporal regulatory instrument that makes the enactment or implementation of a rule contingent on future conditions, evidence, or other statutory rules going into effect.	Adaptation	During	Timing Learning
Sunset clauses A temporal regulatory instrument sets an expiration for a regulation based on certain conditions.	Adaptation	Before / After	Timing Learning
Transparency/reporting requirements Disclosure regimes that mandate technology providers, developers, or deployers provide specific information about their technologies to designated parties (e.g. regulatory agencies).	Monitoring	After	Information Learning
Voluntary standards or self-regulation A non-binding or soft law approach that relies	Flexibility	Before / During	Timing

on private firms, industry coalitions, or standards bodies to develop guidelines for self-regulation that are not enforceable by government authorities.			
Workgroups Sometimes called expert panels, advisory committees, or “tiger teams,” this is an instrument for collaborative multi-stakeholder consultative instruments for agile regulation.	Experimentation	Before	Information

Table 3: Agile policy instruments

The Agile Toolkit Explained

Adverse event reporting, or post-market surveillance [29, 36, 46, 58, 77, 89]

This tool requires or encourages the developers or users of technology to notify regulatory authorities when the technology has caused or nearly caused real-world harm, injury, damage, or breaches of rights. This tool provides valuable information about how a technology is working in the real world, and several well-established regulatory processes use some version of this kind of surveillance (e.g. the FAA, FDA, and CISA). One of the primary aims is to address information asymmetry between the public and private sectors.

Pros/cons to account for:

- May incentivize technology developers to withhold information on failures if penalties are too harsh;
- Can be hard to determine what the threshold should be for a reportable incident;
- Can be hard to pinpoint causal factors for mitigation, even when incidents are reliably reported;
- Can potentially add to the compliance burden for developers if reporting is required to multiple agencies, for instance;
- May be strengthened by additional whistleblower protections and safe harbors to support independent reporting of incidents (by researchers and employees).

Experimental clauses [2, 9, 78, 79, 80, 82]

This instrument is a statutory provision that grants designated authorities (such as a regulator or oversight agency) the power to exercise regulatory flexibility to waive or derogate from existing legal requirements to test innovative products or regulatory approaches at their discretion as long as these practices adhere to the law.

Pros/cons to account for:

- Although experimental clauses are intended to give designated authorities flexibility in testing new rules or technologies, they should still be narrowly defined enough to avoid introducing legal uncertainty (e.g. by delineating the operational scenario and the specific rules that are open to derogation);
- Risk mitigation procedures should be considered, such as requiring certain preconditions to participate in an experimental environment or requiring independent expert evaluations;
- To avoid derogations becoming permanent loopholes, experimental clauses may need to include a maximum timeframe;
- The ability to experiment without clear requirements for evaluation may lead to a lack of tangible policy insights.

Financial assurance mandates [15, 58, 29]

This is a resilience tool that obligates developers or operators of technologies to make financial contributions to a specified fund, purchase liability insurance, or take financial responsibility in some other way for potential harms associated with an unpredictable technology. This mechanism is planned for ex ante but is operationalized ex post. The dual goals of this mechanism are to enable rapid response when harms occur (with dedicated financial resources to do clean-up, repairs, compensate injured parties, etc.) and to incentivize companies to proactively prioritize safety because they have to internalize economic risks.

Pros/cons to account for:

- Can wind up effectively working like a “tax” on new technology, privileging older, existing technologies that are less uncertain;
- May be hard for smaller companies to comply with financial assurance, creating a barrier to market entry;
- When the mechanism is insurance, insurers may charge huge, prohibitively expensive premiums because it is so hard to predict uncertain risks;
- Because of the drawbacks, this mechanism may be best suited to very dangerous or risky technologies.

Horizon scanning [71, 72, 73, 92]

This instrument is often considered the first step in strategic foresight analysis. It refers to a continuous process of scanning diverse sources and expert opinions to identify “weak signals” of emerging

technology and science trends that have not yet entered the mainstream. Methods are similar to strategic foresight analysis and include desk research tracking an array of sources, expert consultation (e.g. Delphi studies), workshops or work groups, and even automated (AI) analytics.

Pros/cons to account for:

- May require considerable ex ante resources (staff, time) to do scanning well, without guarantee of tangible results to act on;
- Can be highly subjective because it is difficult to objectively anticipate future scenarios, and experts may fall back on existing biases and expectations;
- When horizon scanning is conducted by or with the assistance of AI, reliance on historical data may result in a bias toward existing trends or patterns.

Kill switches, emergency stop mechanisms, or safety brakes [46, 58]

These instruments encompass mandated operational controls that allow regulators, deployers, or developers to rapidly deactivate, terminate, or recall technology that is causing harm. This instrument is best planned for early in the policymaking process, but it is deployed ex post when a hazard appears in the real world. It serves as a technical and regulatory backstop against unanticipated catastrophic risk arising from technology performance in the field.

Pros/cons to account for:

- For certain technologies, including open source technologies, a true “kill switch” may not be feasible, so it is important to engage in extensive stakeholder engagement before requiring this instrument;
- Can influence public perception and anxiety by implying that a commercial technology is very risky;
- Rule-makers may rely too heavily on this instrument, rather than investing in more robust ex ante testing or experimentation.

Management-based regulation and meta-regulation [24, 26]

These instruments involve shared regulatory responsibilities between governments and private entities and generally include an enforceable regulatory backstop for industry self-regulation. Although there are many different possible manifestations of these instruments, they generally entail a regulatory authority mandating that a regulated entity engages in specific self-regulatory practices (such as risk assessment/management, internal planning processes, or incident/harm monitoring). These instruments allow for significant industry input and flexibility in terms of the technical implementation

of regulatory objectives while establishing a legally enforceable standard and penalties for non-compliance.

Pros/cons to account for:

- Flexibility in implementing regulatory objectives may result in regulated entities adopting most minimal protections or standards;
- Can result in checkbox compliance without real effect;
- Requires active, well-resourced government oversight to ensure compliance and effectiveness of adopted self-regulatory standards.

Pilots, or experimental legislation [2, 70]

These instruments offer temporary, scaled-down testing mechanisms to evaluate new policy approaches in real-world environments before enacting them permanently in law. They may test new regulations or proposed modifications to existing regulations, but the unifying goal is to generate evidence from the field to support a policy proposal. Unlike some other mechanisms that rely on voluntary participation (e.g. sandboxes), pilots are a proactive, top-down mechanism used by rule-makers who have identified a policy issue and are pursuing specific evidence on which to base a policy decision. Broadly, there are two kinds of pilots: impact pilots (which test the likely outcomes of a policy) and process pilots (which test the delivery mechanisms or cost-effectiveness of a policy). While the terms “pilot” and “experimental legislation” are often used interchangeably in the literature, pilots tend to encompass a wide range of experimental approaches to test policies in the real world, while experimental legislation is more often used to refer to temporarily modifying, suspending, or waiving existing statutory rights or duties.

Pros/cons to account for:

- Successful pilots require good research design, including developing clear research objectives, data collection protocols, plans for systematic monitoring, and evaluation procedures;
- Pilots can suffer from limited external validity because they occur within small, often geographically confined environments that may not be generalizable to other localities;
- In order to have a tangible impact on policy, pilots need to be well-integrated into the policy process, with clear expectations about data collection, evaluation, timelines, and feedback to decision-makers;
- Temporary legal mechanisms introduce uncertainty into the legal regime, so they must have a clear statutory basis, explicit duration limits, and well-defined evaluation criteria;
- Experimental rules typically apply to a specific population or geographic area, while others remain subject to existing law. This temporary legal differentiation could violate principles of

equal treatment or non-discrimination if it is not temporary, objectively justified, and non-arbitrary;

- While pilots and experimental legislation can help build political consensus for controversial issues by testing policies before they are formalized, they may also be used to delay difficult policy decisions.

Policy labs [2, 64]

This instrument is a neutral forum for participants from government, academia, the public sector, industry, and the public to come together to explore a policy issue and reach a common policy goal. Policy labs are contingent on a network of diverse experts who can bring a robust evidence base to the discussion of a policy, incorporating scientific evidence, normative considerations, and lived experience.

Pros/cons to account for:

- Requires significant staff resources (skilled participants and facilitators) and preparation, which cost time and money and may require establishing new entities or introducing budget amendments;
- There is often no guarantee of formal implementation of policy recommendations from labs, so this instrument may be resource-intensive with little tangible reward;
- Like workgroups, policy labs risk generating limited actionable recommendations if they are not clearly linked to decision-making bodies or lack defined reporting requirements.

Policy prototyping [72]

This instrument is a low-fidelity test of policy solutions before they are formally implemented to evaluate feasibility, likely outcomes, and unintended consequences. There are many methods for conducting policy prototyping, such as tabletop simulations, visual mock-ups, stakeholder consultations, workshops, and more. The goal is to stress-test proposed policy solutions before they become law.

Pros/cons to account for:

- Although policy prototyping can be low cost (compared to instruments like real-world sandboxes or pilots), testing occurs in simulated environments, so there may be little external validity;
- If participation in the prototyping activities is too narrow or non-representative, this instrument may represent stakeholder biases and miss critical information;

- Additional steps or instruments are often needed to translate the findings from a prototyping activity into policy.

Principle-, performance-, or outcome-based provisions [26, 29, 70]

This broad category refers to any regulatory instrument that sets non-prescriptive goals such as outcomes to be achieved or harms to be mitigated, rather than specifying the technical means to achieve these goals. These instruments place obligations on regulated entities to achieve desired outcomes—they enumerate the ends but not the means. Outcome-based rules can help overcome some of the regulatory roadblocks of emerging technologies because they do not require deep technical knowledge up front, and they do not risk becoming outdated as soon as technology evolves. While overly prescriptive lists of technical standards or rules may result in superficial tickbox compliance, this approach is intended to place emphasis on the intent or spirit of a regulation.

Pros/cons to account for:

- Requires regulators to be able to effectively measure the desired outcome to evaluate compliance, and this can be challenging when real-world outcomes have technical, behavioral, environmental, economic, and other manifestations;
- Can be overly abstract or confusing because of principle-based regulations are more open-ended;
- Can result in risks and bad practices going unnoticed until a serious incident occurs because desired outcomes are being observed, but the means of achieving those outcomes introduces new (and unregulated) risks.

Programmed or scheduled review [67]

This ex post instrument sets requirements, timelines, and criteria for evaluating an existing regulation in advance or at the drafting of the regulation. Programmed reviews can take a variety of forms and sometimes overlap with or leverage other agile regulatory instruments (like sunset clauses). They may be statutory or non-statutory, short-term or long-term, one-off or ongoing periodic reviews at regular intervals. They may be used primarily for informational purposes or form part of a clear action sequence, such as contributing evidence for the reauthorization of a law due to expire.

Pros/cons to account for:

- Can be hard to determine the optimal review period and frequency of review;
- Are often resource-intensive to be done well, requiring dedicated funding, expertise (talent), and robust data collection and analysis protocols;

- Requires sound scoping to ensure that reviews account for a wide range of outcomes and intended and unintended consequences, so that reviews are not too narrow to be informative;
- Rule-makers may be reluctant to support scheduled reviews because the findings may find that a favored policy is not working.

Regulatory Impact Assessment (RIA) [31, 33, 65, 66, 67]

This tool is the “systematic process of identification and quantification of benefits and costs likely to flow from regulatory or non-regulatory options for a policy under consideration” [66]. Methods include cost-benefit analysis, cost-effectiveness analysis, or business impact analysis. The main goal of RIAs is to present relevant information about trade-offs to policymakers to enable them to ensure that regulations do more good than harm. RIAs have been widely adopted in jurisdictions across the world, including the U.S., as evidence-based policymaking has grown in popularity. It is predominantly an *ex ante* tool, but proponents of agile governance suggest that RIAs should be revisited and updated with new information throughout the policymaking process.

Pros/cons to account for:

- Can be hard to predict future impacts, leading to highly subjective or biased projections;
- Can wind up being used to justify decisions that have already been made, and are often conducted in a very dense/opaque way;
- May be difficult to measure some benefits; it is generally easier to estimate costs than benefits, leading to findings skewed more in one direction than the other.

Safe harbors [38, 46]

These are statutory, administrative, or contractual provisions that protect regulated entities from legal liability, sanctions, or civil claims if they adhere to specified compliance requirements. This instrument can incentivize regulated entities to disclose vulnerabilities and incidents and to monitor, identify, and remedy risks and harms. It may also ease some compliance burdens on regulated entities.

Pros/cons to account for:

- Can result in superficial checkbox compliance to claim legal immunity while still engaging in risky development;
- Can be leveraged by dominant market actors to exclude smaller rivals;
- When based on voluntary standards or commitments, safe harbors may wind up permitting risky development and deployment of technology.

Sandboxes [2, 62, 69, 81, 106]

Sandboxes are controlled environments or provisional legal regimes that allow firms or technology developers to test innovative technologies under regulatory supervision for a limited amount of time. This instrument is meant to allow technology developers and regulators to learn at the same time about how a technology works, its risks, and appropriate regulatory approaches for mitigating risks. Sandboxes typically provide regulatory “relief” (derogations or waivers) from existing rules. The test environment allows rule-makers to consider how legal frameworks should be adapted for the technology in question.

Pros/cons to account for:

- May have limited usefulness if there are not clear pathways for rule makers (legislatures and regulators) to learn from findings
- Can inadvertently become deregulation in the guise of agile regulatory learning without clear protocols, adequate resources to support sandboxing, and pathways for feedback to decision-makers
- Requires carefully crafted participation rules, so as not to disproportionately privilege sandbox participants over non-participants and exert influence over the market as a result

Strategic foresight analysis [2, 71, 72, 73, 92]

This tool is a “structured and systematic way of using ideas about the future to anticipate and better prepare for change” [2]. It involves engaging in a structured process to examine different plausible future scenarios that might diverge dramatically from the status quo. Methods include Delphi expert surveys, systematic literature reviews, and consistent tracking of journalism, patents, and other sources that cover emerging technologies. It can be used both early in the policy process and after policies are implemented. Early in the process, it can help policymakers identify future risks and attempt to anticipate when policy intervention may be necessary. After policies are in effect, it can be used to stress-test regulations against hypothetical future conditions or technological developments.

Pros/cons to account for:

- Because it is highly speculative, can be hard to effectively link foresight activities with policy;
- Regulatory processes are often not prepared to incorporate these insights into policy decisions because rule-making often takes place after-the-fact, when observable risks have materialized;
- Can be resource-intensive in the ex ante phase of rule-making, without the promise of a clear return on investment in the form of actionable policy.

Studies/exploratory research [94]

This tool encompasses several different approaches to scoping and investigating policy issues, including policy reports, briefs, and original/basic research on policy-relevant topics. They can use a range of methods, including observational studies (e.g. longitudinal studies or qualitative studies), experimental or quasi-experimental studies (e.g. A/B testing or randomized controlled trials), laboratory simulations, and desk research (e.g. literature reviews). Legislatures regularly request studies from various agencies, such as legislative commissions and executive agencies.

Pros/cons to account for:

- Requires careful consideration of methods for the policy questions (e.g. lab experiments have high internal validity, but field experiments have high external validity)
- Requires establishing key baseline information, including explicit methodology, so that studies can be informative for other jurisdictions
- Can take some time to do robust research, and the short timelines of many policy processes (e.g. legislative sessions) may limit the range of possible studies/methods that can be used
- Often requires access to useable data from other entities—contingent on strong data sharing protocols and planning for data collection that could answer policy questions (rather than data for data's sake)

Sunrise provisions/conditional enactments [79, 80]

This temporal instrument makes the enactment or implementation of a rule contingent on future conditions, evidence, or other statutes going into effect. This approach can avoid over-regulating with limited information, allowing time to generate more evidence. Such provisions also give industry advance notice of impending regulations, so they can prepare. They also set clear conditions for triggering a new rule, rather than setting arbitrary effective dates.

Pros/cons to account for:

- Setting the trigger conditions for enactment can be challenging and technically complex, requiring expertise and extensive consultation;
- Can result in accumulating technological harms while the provision is dormant;
- Requires designated oversight body to monitor when trigger conditions have been met.

Sunset clauses [41, 79, 80]

This temporal regulatory instrument sets an expiration for a regulation based on certain conditions. Such provisions effectively require lawmakers to revisit and review rules to consider whether they meet

their intended purpose and should be re-authorized or re-enacted. The aim of sunset provisions is to overcome the tendency to regulate-and-forget by providing an incentive for regulatory learning.

Pros/cons to account for:

- Can make long-term planning difficult for regulated entities if it is not clear whether a rule will be re-authorized;
- Can wind up in a cycle of routine extensions as lawmakers attempt to provide some regulatory certainty and defer a decision on whether to fully expire a rule;
- Can be poorly suited to some technology issues because the expiry disincentivizes participation in any test or experiment;
- May simply delay a difficult political debate on a policy rather than address concerns and build buy-in;
- Can wind up rushing evaluations and evidence collection if the timeline is not paired with a plan for policy review or evaluation.

Transparency and reporting requirements [47]

These instruments are disclosure regimes that mandate technology providers, developers, or deployers provide specific information about their technologies to designated parties (e.g. regulatory agencies). They can encompass many different kinds of disclosures, including other instruments like adverse incident reporting, with the goal of generating useful information for policymakers, independent researchers, and the public to inform policy options.

Pros/cons to account for:

- Can place disproportionate compliance burdens on smaller entities if disclosure requirements are extensive;
- Can result in sharing commercially sensitive proprietary information if requirements do not account for the sensitivity of certain technical details;
- Can result in disclosure fatigue, where regulators, enforcement agencies, or consumers are inundated with large quantities of information or overly technical information that results in inaction.

Voluntary industry commitments and standards [21, 26, 38, 46, 48]

This agile regulatory instrument is a non-binding or soft law approach that relies on private firms, industry coalitions, or standards bodies to develop guidelines for self-regulation that are not enforceable by government authorities. Voluntary commitments may take the form of high-level public pledges

adopted by leading industry firms, technical standards created by independent organizations (like ISO or IEEE), codes of conduct or practice developed by professional bodies, or best practices developed and promoted by dedicated private organizations or non-profits. There are several advantages of voluntary commitments for agile regulation; they leverage technical expertise that is often disproportionately concentrated within the private sector to develop standards that can be adopted immediately and adapted over time.

Pros/cons to account for:

- These commitments are not legally enforceable, so there is no way to penalize non-compliance;
- Voluntary standards may privilege commercial priorities over safety;
- Responsible, well-resourced actors may voluntarily comply, while smaller, high-risk, or bad faith actors opt to operate outside the standards;
- When voluntary commitments inform formal regulation, it may offer the private sector disproportionate influence over the regulatory agenda, resulting in regulatory capture.

Workgroups [30, 70]

Workgroups, expert panels, advisory committees, and “tiger teams” are all collaborative multi-stakeholder consultative instruments for agile regulation. The goal of these groups is to incorporate diverse academic, technical, commercial, and policy perspectives into the policymaking process. Workgroups can serve many different purposes, from horizon scanning for emerging trends to developing policy solutions, and they are often best leveraged in the ex ante stage of policymaking.

Pros/cons to account for:

- Diverse membership that includes independent experts (outside of government and industry) is key to generating robust evidence to inform policymaking;
- To facilitate effective group decision-making and collaboration, established procedures for participation and engagement may help create an environment conducive to both disagreement and consensus-building;
- Overly relying on industry expertise may skew workgroups toward industry biases and lead to regulatory capture;
- The advisory nature of workgroups means that their recommendations may not be adopted, in spite of time and resources committed to convening the group;
- Requires clear pathways to feed back into the policymaking process to ensure workgroup conclusions have policy impact.

Applying Agile Policy Tools in Virginia

Some of these agile instruments have been or continue to be used in Virginia, including sunset and sunrise provisions, workgroups, pilots, and various studies. The legislature has utilized pilots to test policy proposals in domains such as housing and foster care. The legislature has explored the possibility of using sandboxes for electric utilities regulation, healthcare, and artificial intelligence, although no legislation has been enacted, and there has been some confusion around the proposals as to scope, oversight authority, and pathways for regulatory learning. And policymakers have regularly used sunset and sunrise clauses, delayed enactments, and conditional enactments. Sunset clauses have been used in tax policy to prompt reviews of temporary measures, as in the case of the Earned Income Tax Credit, and sunrise provisions have been used to gradually phase in policies with complex compliance requirements, as in the case of the Virginia Consumer Data Protection Act. Workgroups are frequently used to develop policy options, as in the case of the Autonomous Driving Work Group. Legislative Commissions regularly conduct studies to examine a policy issue, develop policy options, or evaluate policy implementation or outcomes. And other state agencies are sometimes required to produce informational reports *ad hoc* or at regular intervals for legislative committees or Commissions.

Agile Challenges

However, sources interviewed for this study indicated that there have been notable drawbacks and shortcomings to many of these approaches in practice. For example, researchers within state agencies often encounter major issues with data access, data quality, and data relevance when they are asked to complete studies. A common problem is that the available data does not provide insight into the specific policy questions researchers are tasked with answering. A few sources noted that because data collection is not considered at the outset when a new policy is put in place, it is often not available years later when an agency is asked to review or study that policy. Another issue is that there are many impediments to data-sharing between different entities, ranging from onerous data transfer processes to messy data that needs extensive cleaning to be usable.

Such informational challenges also come to bear on pilots. Sources familiar with legislative pilots highlighted that pilots are most effective if there are clear plans for data collection up front, such that participating entities gather the most relevant data for analysis later. When expectations about data collection are not established at the outset, when the pilot is enacted, participating entities may make assumptions about what data to collect that does not wind up yielding the most useful information for evaluating the policy later on. Another potential drawback is that pilots may be repeatedly renewed or extended, negating the benefits of a time-limited study and effectively turning pilots into long-term programs for specific constituencies. The result is that the beneficial outcomes of a pilot may not be

measured, reviewed, or expanded to other Virginia constituencies. Whether studies or pilots, another issue is that it is not always clear what the receiving entity is supposed to do with such information. Several sources noted that all too often reports wind up in a pile on a committee's desk and do not always lead to policy impact or learning. Resource-constrained agencies across the state ecosystem may therefore be reluctant to support additional information-gathering mandates without observable outcomes from these efforts.

Legislative instruments like sunrise and sunset clauses also present some challenges. Sources indicated that drafting legislation with sunset or sunrise provisions can be substantially more complicated, and the success of such instruments often depends on the willingness and expertise of both the bill patron and the members of the Division of Legislative Services (DLS) who are drafting the legislation. Time constraints (due to the short legislative sessions in Virginia) and staffing constraints (due to limited capacity within DLS) sometimes combine to preclude the consideration of such instruments in the drafting process.

Collectively, the challenges that sources identified align with the regulatory roadblocks that scholarship on emerging technology regulation has surfaced (discussed above in the section on "[Regulatory Roadblocks](#)"). These are summarized in Table 4 below.

Agile challenges in Virginia		
Timing	Information	Learning
• Temporary instruments like pilots are often renewed or extended, undermining their informational potential • Short legislative sessions mean that policy development predominantly takes place in the brief interim between sessions, and frequent electoral cycles incentivize rapid policy adoption, leaving little room for robust	• For agile and traditional legislative instruments alike, data collection and analysis is often not planned for at the outset (when the policy is implemented), so available data may not be suited to the questions that arise when the policy is being reviewed later on • The availability, quality, and accessibility of data needed to do policy evaluation is often limited	• Information-gathering practices (such as pilots, studies, and other mandated reports from state agencies) can sometimes wind up being perfunctory because there are not clear pathways to directly influence decision-making • The absence of non-legislative bodies at the state level to assist with oversight, monitoring, experimentation, and

experimental design, data collection, and analysis • Temporal instruments like sunrise and sunset clauses can be effective for phasing complex policies, but they rely on drafting expertise (of both patrons and DLS staff)	• Expertise on substantive issues may be limited by staffing constraints (staff numbers, turnover, generalist rather than specialist knowledge, or years of experience)	rule/guidance development in many domains and sectors contributes to: ○ Pressure on the legislature to develop more detailed rules in code language, which may impede flexibility and adaptability down the line ○ Limited options for feeding actionable information back into the policy cycle
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Table 4: Agile challenges in Virginia mapped to regulatory roadblock categories

Limited Applications to Emerging Technologies

In addition, although some of these instruments have been used in various policy domains, few have been proposed in recent emerging technology legislation, such as legislation pertaining to AI. There are a few exceptions. For example, the General Assembly instigated a work group (HB 2627 in 2025) for autonomous vehicles, led by the Department of Motor Vehicles, VDOT and the Virginia Transportation Research Council (VTRC). The work group is reported to be considering recommending a pilot program to gather more information, but other agile instruments have not been employed in this policy domain so far. Even beyond emerging technology issues, Virginia pilots tend to occur in policy domains with clear regulatory oversight by a designated executive agency, such as the Department of Motor Vehicles. Sunset clauses have also been used, as in the case of facial recognition technology for law enforcement (HB 1339 in 2022). Some proposed legislation on emerging technologies has attempted to assign new regulatory roles to existing agencies (e.g. HB 797/SB 384 in 2026) or to establish new oversight and enforcement initiatives for technology (e.g. HB 1250 in 2026), but these have not been successful so far. Existing oversight and enforcement capacity is primarily situated in the Virginia Information Technology Agency (VITA) and the Office of the Attorney General (OAG).

VITA is responsible for state agency IT policy in the domains of governance, cybersecurity, procurement, and infrastructure. It has published AI standards for executive branch agencies, such as the AI Utilization Policy. However, VITA has not traditionally engaged in oversight of private technology companies, nor does VITA perform a formal regulatory role for state agencies. Such responsibilities would entail a significant expansion and reformulation of VITA's scope. The OAG is responsible for enforcing and defending the Code of Virginia, including provisions relevant to emerging technologies, such as the Consumer Protection Act and the Consumer Data Protection Act. The OAG also reviews every proposed bill and provides legal analysis to patrons, and legislators may proactively request advice on proposed legislation. However, the OAG does not typically engage in other regulatory oversight functions, such as receiving safety reports or technical documentation, unless these are requested as part of an investigative demand or subpoena. In addition, because the OAG serves as the enforcement arm of the state, some regulatory functions may not be appropriately administered by that office, especially if certain reporting requirements or experimental instruments (such as sandboxes) are intended to allow for the co-evolution of the technology and the regulatory framework, with structured incentives for compliance rather than direct penalties.

Some state agencies with regulatory authority, such as the State Corporation Commission (SCC) or the Department of Education, may deal with emerging technology issues as they pertain to their regulated domains. For example, the SCC can issue guidance on whether existing regulations cover an emerging technology, like AI. It may also be directed to develop regulations pertaining to emerging technologies in the financial or energy sectors. This approach has many advantages because it leverages existing regulatory authorities to address new technological challenges, and the sector-specific expertise in these agencies also means the rules may be tailored to the real-world use cases for the technology. However, there are also drawbacks to relying solely on this existing regulatory infrastructure. First, the emerging technologies in sectors with well-established regulatory oversight agencies may be heavily regulated while many applications of similar technologies in other sectors are entirely unregulated. This risk is particularly acute for general purpose technologies, such as generative AI. Second, sector-specific rules may result in a fragmented landscape of regulation for broadly similar or related families of technologies, especially if regulatory agencies develop their rules without proactive interagency consultation. Third, developing effective rules for dynamic, unpredictable emerging technologies requires expertise in technology and policy that individual agencies may lack.

Scholarship on agile regulation also emphasizes the importance of building the infrastructure (in terms of human talent and institutional resources) to engage in a more cyclical policy process oriented toward continuous learning and adaptation. Sources advocate taking a whole-of-government approach, which requires proactively considering what institutions and processes are needed across government to

comprehensively address emerging technology policy challenges. Such an approach would arguably require a fundamental reorganization of the public sector, including restructuring institutional architectures, financing, and human talent. Few (if any) governments are well-positioned to undertake such an overhaul all at once, and the following section contains some insights into how to develop the capacity for agile regulation under real-world constraints.

Agile regulation is as much about a regulatory outlook as it is about specific tools, practices, or infrastructures, so existing regulatory instruments could contribute to a more agile approach to emerging technology regulation when they are deployed intentionally with the feedback loop in mind. Although the Commonwealth has undertaken various policy experiments and leveraged agile instruments to set timelines and implement regulatory review in various policy domains, these efforts have not been part of an overarching agile governance agenda and to date, they have not been employed widely in emerging technology policy domains. However, the agile challenges suggest potential avenues to bolster the Commonwealth's capacity for agile policymaking.

Paths forward: overcoming agile challenges

- Leveraging research expertise in existing state agencies to assist with agile instrument design (e.g. pilot design, including data collection and analysis plans) at the start of policy development
- Bolstering staffing in key information-generating departments and roles, such as Commissions and DLS, which support evidence-based policymaking
- Coordinating across legislative and executive branches to develop the infrastructure to address emerging technology issues (e.g. through regulatory/oversight departments and agencies that can provide additional expertise and monitor ongoing developments and compliance)
- Reviewing reporting requirements for various agencies to evaluate whether the information generated is necessary and actionable within the policy process
- Reviewing reporting requirements for various agencies to evaluate whether the entities receiving reported information are positioned to act meaningfully on findings
- Regularly engaging in and report on strategic foresight activities (such as horizon scanning) as a core legislative research activity, alongside more traditional reports, audits, and reviews

Building the infrastructure for iteration

One of the key agile challenges identified by sources interviewed in Virginia was capacity to implement and follow through on agile instruments that the legislature already has the means to leverage. Most real-

world examples of agile regulatory practices are fragmented, scattered and embedded piecemeal within otherwise traditional regulatory environments. There may be one agency running policy experiments on a handful of policy questions in specific sectors, without much influence on the policy process as a whole. Or, there may be a single agile regulatory instrument, like a sandbox, employed in an isolated domain, without additional instruments, like mandatory reporting requirements back to legislatures or regulatory bodies, in place to close the policy loop. However, even these limited steps toward agile regulation can achieve desired outcomes. Since agile approaches pivot on experimentation, even small-scale experiments in adopting agile practices have the potential to spur additional changes that collectively make governments more resilient and responsive to emerging technology challenges.

However, governments that aim to adopt more agile regulatory approaches should anticipate that some new, reconfigured, or reconceptualized public infrastructure will be needed to support these efforts. Across the sources consulted for this study, several themes emerged around the technical, institutional, and human infrastructure needed for successful adoption of agile regulatory approaches [40, 83, 84, 90]:

- **Human talent:** Agile regulatory approaches require significant staff expertise within rule-making bodies, whether legislatures, executive agencies, or other independent entities [23]. One of the key information roadblocks for regulating emerging technologies is rooted in the imbalance between the private and public sectors when it comes to technical expertise. The public sector would benefit from hiring more technical experts with deep understanding of emerging technologies. But to tackle the multidimensional (economic, social, legal, political, and technological) impacts of emerging technologies, the public sector needs multidisciplinary talent, including social scientists, behavioral scientists, and legal experts, working collaboratively to tackle policy questions [88].

In particular, sources highlighted the importance of bolstering legislative staffing to provide objective, expert advice to legislators, who often have limited time to cultivate deep knowledge of complex technological issues. The regulatory process could be strengthened by distributing knowledge about emerging technologies throughout the entire regulatory ecosystem (legislative, executive, independent, and industry bodies), rather than relying on one sector or body to provide most of the knowledge on a topic, which can lead to inadvertent biases or distorted incentives. In-sourcing more legislative staff expertise may be especially important in part-time legislatures, like Virginia's, where policymakers have exceedingly limited time horizons to engage with complex issues [90]. Full-time staff can provide continuity and dedicate more time and energy to complicated policy questions. Sources also highlight the need for ongoing skill

development and training for existing staff, both in agile methods and also in the policy issues associated with emerging technologies [6].

- **Central oversight or coordination body (or bodies):** The OECD advocates for governments to consider establishing a central oversight body for agile regulatory approaches. Such an entity would possess deep methodological expertise in experimental policy approaches, advise on agile approaches and instruments for dealing with emerging technology policy issues, collaborate with other regulatory bodies, lead or conduct regulatory experiments, and audit the experiments conducted by other bodies [70]. The goal is to provide quality control for regulatory experimentation in an effort to mitigate some of the possible shortcomings of agile approaches (such as poor experimental design, inadequate data collection or a lack of feedback mechanisms to influence policymaking).

Canada, for example, has a Centre for Regulatory Innovation, which is an executive agency that works across government to help regulators keep pace with emerging technologies. It advises other parts of government on how to design experimental instruments, such as sandboxes, to answer policy questions [62, 69]. Other examples include Denmark's One-Stop-Shop for New Technologies, managed by the Danish Business Authority [70], or the EU Policy Lab, managed by the Joint Research Centre [2].

- **Technical protocols:** Agile regulatory approaches are meant to address emerging technologies, but they are also dependent on technology. Sources highlight the importance of improving the technology of government and governance to meet the scale, speed, and sophistication of the current technological moment [2]. Many technical systems in the public sector require upgrades and improvements to both technical infrastructures and processes and protocols. Just as data is the raw material of today's digitally-driven emerging technologies, data is also the raw material of evidence-based policymaking. Data collection, management, and sharing processes underpin many aspects of agile regulation, so policymakers may also need to address public sector practices around data as they also incrementally work toward greater regulatory flexibility, adaptability, and resilience [65, 66].

Additionally, as public policy increasingly takes the form of technical requirements and standards, policymakers and regulatory agencies may need to consider strategies for publishing "rules-as-code" to make adoption and implementation by regulated entities smoother [92]. Rules-as-code refers to machine-readable versions of rules in the format of software code that

allows legal provisions to be understood and executed by computer systems. Such an approach would inherently integrate many agile principles because rather than treating regulations as static legal language in the code or in rulebooks, rules-as-code could be continuously tested and updated using traditional software practices, like version control, bug fixes, and iterative updates. This technical manifestation of regulations could also facilitate automated monitoring for compliance [12, 23]. Some sources have pointed out that translating abstract legal rules into executable technical practices can be difficult and involve a process of translation that risks distorting the intent of the rule. Developing rules-as-code from the outset may support better regulation of emerging technologies in some specific cases, but this technical protocol would also require the public sector to in-source multidisciplinary teams with technical, policy, and legal expertise.

Trade-offs and considerations

In addition to the infrastructural requirements discussed above, agile regulation entails a shift in regulatory culture and practices that inevitably introduces some trade-offs that policymakers must consider when undertaking more experimental approaches to rule-making. Like traditional rule-making, agile approaches have drawbacks. Well-designed and well-implemented, agile approaches may be well-suited to deal with many of the challenges of timing, information, and learning that emerging technologies present, but they invariably introduce challenges of their own.

- **Cost and fiscal impact:** Shifting regulatory practices from one regime to another takes time and resources, even when such a shift is incremental and issue-driven. Perhaps the biggest consideration for policymakers in proactively adopting more agile approaches to regulation is the fiscal impact of different agile strategies or instruments. Additional staff, new technical architectures or protocols, or entirely new regulatory bodies or oversight agencies may require substantial financial resources that governments may not be able or willing to allocate. This is especially true in the current emerging technology landscape, where the resources of private sector technology developers vastly outstrip those of the public sector. In this environment, governments may struggle to compete with private sector infrastructure and salaries, all contributing to the information roadblock that regulators face.

Moreover, investments of time, talent, and finances into agile regulatory approaches do not always yield familiar, tangible, or actionable policy results. Foresight and horizon scanning activities, for instance, require significant time and expertise, but they may only result in a few useful insights worth pursuing. One scholar equates these kinds of exercises to “panning for

gold” [2]. Aligning political timelines with experimental or research timelines can also be difficult, so the hard-earned results of even the best-designed experiments, studies, or workgroups may not find a favorable policy environment by the time they surface due to changing public or political priorities [41, 70].

- **Legal uncertainty:** The “better regulation” agenda, discussed earlier in this report, is focused on improving the quality of regulation through transparency, accountability, predictability, and evidence. Many of the practices that underpin good regulation therefore introduce friction into the regulatory process so that a rule has to prove its validity before it is finalized; in the default linear policy process, a finalized rule is a permanent one, providing legal certainty for regulated entities. Once a rule is set, regulated entities need to adjust their practices to comply, and they know their investments in compliance will ultimately be worthwhile because the rule is unlikely to change anytime soon. However, agile regulation upends this longstanding principle in some ways. In striving to be more responsive to social norms and technological realities, agile approaches erode some of the predictability and permanence of the traditional, linear policy process [78].

Therefore, a key consideration for policymakers is how to ensure that experimentation, iteration, and adaptation in the lawmaking process does not create confusion and uncertainty. Such legal uncertainty can lead to unintended chilling effects on innovation as developers try to wait out the regulatory indecision. Sources on agile regulation note that well-designed agile instruments should provide clear boundaries and terms that help protect legal certainty by ensuring that policies adapt *predictably* based on clearly defined evidence, timelines, or conditions. Setting the policy objective, defining the purpose of any experimental or evidence-generating instruments in relation to that objective, and establishing how to evaluate whether the objective is being achieved are all essential aspects of the agile policy process.

- **Ethical experimentation:** Another consideration is the risk of unequal or discriminatory treatment as a result of policy experimentation. Policy experiments usually entail treating some population of participants differently than another in order to observe the effects. A sandbox that allows certain firms to test their innovations in a specialized regulatory environment gives participating firms different treatment from other non-participating firms. Experimentation, therefore, may run counter to legal principles of equal treatment under the law and non-discrimination. Policymakers engaging in real-world experiments to test policy options must

consider the ethical implications of such experimentation and ensure that experiments are fair, proportional, and voluntary [41].

The ethical requirements of policy experiments often mean that such experimental approaches cannot ever achieve the external validity of well-crafted scientific experiments, such as randomized controlled trials. However, this does not necessarily detract from their usefulness for evidence generation. The real world is complex, and as long as the methodological limitations of a pilot, experiment, or study are explicitly acknowledged, they can still provide policymakers with actionable insights.

- **Political realities:** Unlike experimentation conducted in pure research or academic environments, experimental policy instruments must contend with the pressures of the political world, from electoral cycles to changeable societal norms. There is a risk that agile regulatory approaches can become a political tool, leveraged by special interests to achieve their own political objectives. Although agile approaches are intended to provide avenues for proactive regulatory engagement with emerging technologies, even when there is a high degree of uncertainty, they can also be employed to delay conclusive regulatory action (e.g. by continuously renewing pilots rather than adopting a new rule). For this reason, it is important to consider what conditions need to be met for a specific agile regulatory instrument to be effective at producing good regulation, meaning regulation that achieves its desired social outcomes. Table 3 above provides several examples of such regulatory instruments accompanied by the unique considerations for each.

Another consideration regarding the politics of agile regulation is that the information generated through agile instruments may produce evidence or facts that contradict political interests or individual policymakers' priorities. Rather than proving the validity of a favored policy option, agile approaches may generate insights that prove the opposite, and policymakers need to consider how to weigh and act on evidence that undermines their political interests [78]. Relatedly, the policy options most favored by the public may not be the options best suited to the policy issue, based on evidence generated in the agile process. The most effective policy option may not be the most politically desirable, and policymakers may need to consider this tradeoff [39]. Finally, public outrage or hype cycles can often be key motivators for emerging technology regulation [17], but agile regulatory approaches are often geared toward identifying policy issues and options independent of public perception. Policymakers need to balance public opinion (and other normative factors), empirical evidence, market dynamics, and

political realities to determine which policies to pursue, so no single agile instrument can ever provide *all* of the relevant information for good regulation.

- **Pacing problems:** Just as there are pacing problems associated with the default policymaking process, with emerging technologies often outpacing regulation, there are also pacing problems associated with adopting agile approaches. It can take a long time for a regulatory system accustomed to the “one-and-done” linear model of policymaking to incorporate agile approaches effectively. Doing so requires building the infrastructure, talent, and experience in the public sector to leverage agile regulatory instruments and convert the policy process into a meaningful feedback loop, characterized by regulatory learning.

In the face of rapid technological developments today, this shift in regulatory practice may come too late if policymakers focus on getting all the essential pieces in place before even beginning to engage in agile rule-making. But jurisdictions across the world have experienced some success adopting agile approaches piecemeal, building their capacity gradually. Some have established dedicated agile regulatory agencies. Others have invested in a particular agile instrument, like policy labs or sandboxes, and have worked to refine how these instruments can contribute to regulatory learning. There are many routes to more resilient, responsive, and adaptable rule-making, but sources seem to agree that success hinges on buy-in from multiple sectors and branches of government and clear, well-publicized ways to share learning from agile methods.

- **Free riders in the laboratory:** A final consideration for policymakers is the inevitable free rider problem of policy experimentation. As discussed above with regard to the “states-as-laboratories” paradigm, when a state tries something new, the outcomes of that policy provide a learning opportunity for other states. But that may mean that one state bears most of the risk while other states stand to benefit (they get a free ride) [37, 55]. As a result, states may tend toward policy alignment rather than policy variation to avoid bearing all of the risks of pursuing a new policy—risks like litigation, unintended market or societal consequences, or financial cost. In practice, this might mean that more resource-rich states tend toward policy experimentation while other states wait to see how those experiments pan out [40, 90].

The downside of this pattern is that policy experiments undertaken in one context may not translate well to another context (i.e. what works in California might not work in Virginia, or vice versa), pointing to the value of policy experimentation at different scales and in different contexts to provide the best opportunity for learning. Agile approaches to regulation can

provide critical feedback for the policy process *within* an individual state, but they can also provide useful insights to other states. Policymakers may consider how to collaborate and coordinate with other states to maximize the learning potential from different policy experiments around emerging technologies.

- **New law is not always needed for new technologies:** Although emerging technologies present unique challenges and new policy issues for governments to address, existing law may cover some of their risks and harms. In other words, the perception that emerging technologies are unregulated and unaccountable may be due to the absence of any applicable law to address emergent policy issues *or* uncertainty about how existing law applies to new technologies and their use cases. Statutory provisions such as discrimination law, unfair trade practices, copyright, data protection, product liability, defamation, and more may already apply to emerging technologies. Most states bringing investigative demands and lawsuits about social media and AI, for example, are leveraging existing consumer protection law and tort liability rather than dedicated technology-specific laws, which often do not include the requisite investigative powers to compel companies to disclose key information to governments.

Furthermore, some of the downstream risks of emerging technologies may be covered by other domains of law that may need to be strengthened or clarified in light of new innovations. For example, widespread access to generative AI introduces risks around access to information about creating chemical or biological weapons, but the materials needed to produce these weapons are already regulated in various ways. Major updates to existing cybersecurity standards may be needed to defend against the risk of breaches facilitated by AI and quantum computing. Additionally, societal resilience to disruptive innovation hinges on investments in scientific literacy, workforce skills, and safety nets for communities most likely to be disadvantaged by new technologies, and these are all policy domains that governments are better positioned to anticipate and address than the private sector. In short, there are additional policy options for addressing the uncertainties of emerging technologies that center on updating existing law, binding rules, and standards across a range of domains affected by innovation. Determining which policy questions are truly new and deserving of resource-intensive experimentation among technical and policy experts, and which policy questions demand legal clarification of existing rules, is a critical step in the agile legislative process. However, even where existing law may apply, updates are often needed to accommodate new information about emerging technologies, so it is still important for lawmakers to treat the policy process as an iterative loop [3, 21, 46, 47, 61].

Agile approaches to regulating emerging technologies are not a silver bullet. They entail tradeoffs that need to be considered in the design and implementation of specific policy instruments applied to emerging technology issues. Since all the outcomes of a policy cannot possibly be anticipated in advance, policymaking is inherently experimental. Agile regulation is arguably about embracing and leveraging this intrinsically experimental quality of policy to respond more quickly, effectively, and proactively to the challenges of emerging technologies.

Closing the Loop: Recommendations for Agile Legislation

Emerging technologies present a unique set of challenges for regulation because of the pace of technological development, the uneven distribution of crucial information about how technologies work and what their risks are, and the lack of meaningful ways for policy to adapt over time based on learning new information. To overcome these challenges, the policymaking process may need to evolve to be more proactive, adaptable, collaborative, and evidence-driven. This evolution requires a shift in outlook as well as the adoption of practices and policy instruments that enable experimentation, evidence generation, and learning. This shift can be succinctly described as a transition from treating the policymaking process as linear (with a distinct end point) toward treating the policymaking process as a feedback loop (that is continually learning and adapting). Policies that close the loop have a greater chance of accommodating a rapidly developing and changing technology landscape because iteration was built into the policy from the start.

Different agile practices and instruments will be best suited to different policy issues; there is no one-size-fits-all menu of policy instruments that will ensure good regulatory outcomes. The goal in all cases is to produce policies that achieve their intended outcomes—usually mitigating risks or influencing behavior—while reasonably balancing costs and benefits.

Agile questions to inform the policy process

- What is the policy objective?
- What information is available to inform the policy? What information is not available but would be helpful to inform the policy?
 - Is additional information necessary to determine policy options?
 - Could legislation incentivize, facilitate, or mandate the collection of this information?
 - What entity/entities should oversee the collection of information?
 - Which decision-makers should receive this information to inform policy, and on what timeline?
- If policy options seem clear, what would constitute success for the policy (i.e. what outcomes are expected)?
 - How could this be measured?
 - What entity can/should collect metrics on real-world outcomes?
 - What decision-making authority can/should receive collected metrics?

- What infrastructures or resources exist to ensure the policy loop can be closed? What infrastructures are missing?

Therefore, the overarching recommendation from this study is to approach emerging technology policy with the objective of “closing the loop”: developing every emerging technology policy with a view toward generating actionable information that can feed back into the policy process, allowing the policy to adapt to changing conditions. Closing the loop means defining at the outset: what new information is needed and how to get it; any responsibilities for ongoing oversight, clear plans for policy evaluation, and meaningful reporting requirements that ensure information makes its way back to decisionmakers with the authority to act on new evidence. Closing the loop offers an array of better policy strategies than wait-and-see or regulate-and-forget approaches. Rather than getting tripped up on whether tech policy is moving too fast, too slow, or not at all, policymakers can simply focus on staying in motion, being agile—and closing the loop.

Recommendation 1: Build the Commonwealth’s **capacity** for agile regulation

One of the main impediments to implementing agile regulatory processes is a lack of resources, infrastructure, and expertise within public sector rule-making bodies. Legislators may consider bolstering human capacity in the legislative and executive branches and in the independent research ecosystem to position Virginia to better close the policy loop on emerging technology topics.

- Consider introducing a budget amendment to build out the oversight, investigation, and enforcement capacity of the Office of the Attorney General for technology policies (e.g. through establishing a new department or increasing staff in existing departments) because this is the office most commonly tasked with *ex post* responsibilities in technology legislation.
- Consider asking JCOTS to convene a workgroup in 2027 to study what additional regulatory oversight is needed for emerging technology and where this oversight responsibility should be situated within the state government. In addition to several members of JCOTS, workgroup members should include: the Chief Transformation Officer, representatives from VITA, the Department of Commerce, the Office of the Attorney General, and additional representatives of other state agencies as recommended by the Commission.

Recommendation 2: Provide resources on **best practices and agile options** for policymakers

Adopting an agile regulatory approach to emerging technologies is as much about shifting an outlook as it is about leveraging specific legislative or regulatory instruments. It is about the process more than a prescriptive set of tools or practices. Policymakers may consider providing resources throughout the lawmaking process to encourage developing emerging technology policy with a feedback loop in mind.

- Consider asking JCOTS to produce a one-page brief for DLS, Committee chairs, and caucuses with JCOTS-endorsed best practices for emerging technology legislation. JCOTS may also consider developing supporting materials, such as video tutorials, bootcamps, or other training on both agile approaches to rule-making and policy-relevant emerging tech issues.
- When a bill is facing considerable roadblocks or is likely to fail, consider consulting JCOTS staff on strategies for answering key policy questions and continuing progress along the policy loop. Staff can provide expert advice in real time on different agile instruments to address regulatory roadblocks as well as research design and data collection plans for experimental tools, like pilots and policy experiments.

Recommendation 3: Adopt **JCOTS practices** that “close the loop”

Although many policy areas that face regulatory roadblocks associated with timing, information, and learning could benefit from agile approaches to policymaking, emerging technologies like AI have generated a sense of urgency around adapting regulatory practices to meet the current technological moment. As a permanent legislative Commission tasked with developing sound public policies pertaining to technology and science topics, JCOTS is well-positioned to take some initial steps toward agile regulatory practices.

- Consider asking JCOTS to develop a standard framework that staff will use to prepare a policy concept for bill drafting in collaboration with bill patrons. The framework would include key components of agile and better regulation approaches, such as clearly establishing the policy objective, defining what success would look like for the policy, considering how to measure the policy’s performance against these objectives, and creating a plan to monitor the implementation, effects, and outcomes of the policy.
- Consider asking JCOTS staff to develop briefing notes for all JCOTS-endorsed technology bills and for technology bills patroned by JCOTS members by request that provide key information to assist patrons with presenting their bills in the General Assembly. Briefing notes would include key information that addresses and closes the policy loop: including a clear policy

objective, intended outcomes, evidence supporting the choices of policy instruments in the bill, and an explanation of how the bill anticipates the rest of the policy loop (e.g. enforcement, evaluation, etc.). Briefing notes may also contain suggestions for areas that may need further development to close the loop.

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