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The Regulation of Inchoate Technologies

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ESSAY

THE REGULATION OF INCHOATE TECHNOLOGIES

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ABSTRACT

In this Essay, I explain why and how certain technologies I refer to as "inchoate" defeat regulatory interventions. I examine the "law" of unintended consequences and the role of regulatory ideologies. I suggest that traditional policymaking models, when applied to inchoate technologies, do not adequately reflect the risk of regulatory failure, which is proportional to the level of inchoateness of the technology. I also consider whether the regulation of inchoate technologies should take into account that, and may in fact be undesirable because, some technologies (or the use thereof) tend to self-regulate. Finally, I suggest lessons that can be drawn from this analysis and present the basic structure of an approach to the regulation of inchoate technologies.

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I. INTRODUCTION

Innovation matters. In global economic competitive terms, each nation wants to maintain or increase its comparative standing.[1] Governments want to get it right.[2] Does this mean

1. In the case of the United States, this means trying to maintain a leading position as China, India, and others accelerate the development innovation potential, leading to a global displacement of innovation to the East and South. *See* Jerome H. Reichman, *Intellectual Property in the Twenty-First Century: Will the Developing Countries Lead or Follow?* 46 HOUS. L. REV. 1115, 1118 (2009) (discussing the development of innovation-oriented intellectual property law and policy in most Asian countries).

2. According to www.whitehouse.gov, the "guiding principles" of the Obama Administration's technology policy are (a) "*Innovation* in the Economy: Drive Economic

that they need to regulate more?[3] This Essay argues that they must regulate certain technologies, which I will refer to as inchoate, differently and probably less.[4] Put differently, when the target of a possible regulatory intervention is an inchoate technology, regulators should restrain their regulatory impulse.[5] Specifically, the two-prong thesis of this Essay is that some technologies cannot be dealt with in the same way as other fields of regulatory intervention and that the level of difficulty in regulating an inchoate technology is proportional to its level of inchoateness. The principal difficulty of regulating those

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Growth and Solve National Problems by Deploying a 21st Century Information Infrastructure"; (b) "*Innovation* in Science: Invest in Science and Science Education"; (c) "*Innovation* in Public Administration: Creating an Open and Secure Government"; and (d) "Restoring a Culture of Accountability through Openness and Transparency of Government Operations and Information." The White House Homepage, Issues: Technology, http://www.whitehouse.gov/issues/technology (emphasis added) (last visited, July 9, 2010). In remarks on the "Educate to Innovate" Campaign and Science Teaching and Mentoring Awards, the President declared that "[w]hether it's improving our health or harnessing clean energy, protecting our security or succeeding in the *global economy*, *our future depends on reaffirming America's role as the world's engine of scientific discovery and technological innovation*." Press Release, The White House: Office of the Press Sec'y, Remarks by the President on the "Educate to Innovate" Campaign and Science Teaching and Mentoring Awards (Jan. 6, 2010), http://www.whitehouse.gov/the-press-office/remarks-president-educate-innovate-campaign-and-science-teaching-and-mentoring-awar (emphasis added). Presenting its Innovation Policy, the European Commission notes along similar lines that "[i]n a remarkably short time, economic globalisation has changed the world's economic order, bringing with it new challenges and opportunities. *Europe cannot compete in this new environment unless it becomes more innovative* and responds more effectively to consumers' needs and preferences." European Commission: Enterprise and Industry Innovation, http://ec.europa.eu/enterprise/policies/innovation/index_en.htm (emphasis added) (last visited July 7, 2010).

3. There are countless studies of the impact of unsuccessful regulation, especially when it reduces competition among stakeholders or prevents the entry of new players into the marketplace: both factors that may lead to decreased innovation. The telecommunications industry is a good example. While a number of countries had national telecommunications operators (functioning as de facto or de jure monopolies), deregulation was seen as a necessary step to promote innovation and competition. *See* Justus Haucap, et al., *Credible Threats as an Instrument of Regulation for Network Industries*, *in* DIGITAL ECONOMIC DYNAMICS: INNOVATIONS, NETWORKS AND REGULATIONS 171, 183–89 (Paul J.J. Welfens & Mathias Weske eds., 2007).

4. *See* David Ewing Duncan, *What DNA*, *Patents and Lady Gaga Have in Common*, FORTUNE (Mar. 17, 2010), http://money.cnn.com/2010/03/17/news/companies/dna_patents.fortune/index.htm (noting that "[a] legal system that does not retain flexibility in incorporating this rapidly moving science will cause confusion down the line . . . it's crucial in this new age of genomics and molecular biology that we are as clever about how we implement new discoveries as the discoveries themselves.").

5. This regulatory impulse by regulators is at all levels—Congress, state legislatures, and also municipal ordinances and (executive) action by regulatory agencies. The city of Cambridge (Massachusetts) attempted to regulate/ban recombinant DNA research. *See* Emily Marden, *Risk and Regulation: U.S. Regulatory Policy on Genetically Modified Food and Agriculture*, 44 B.C. L. REV. 733, 736–37 (2003) (discussing the scientific community's decision to self-regulate in order to prevent future governmental regulation).

technologies essentially stems from their ability to develop and evolve *independently* of both regulation and market forces.

I argue that regulating inchoate technologies will have unintended consequences that may defeat the intervention. In particular, it may interrupt or divert potential chains of events that might have yielded substantial benefits. Complicating the equation further, inchoate technologies destined for mass uses may influence the development of social norms concerning their use and even their development.[6] As social norm research has shown, a gap between social norms and legal norms renders designing an effective regulatory intervention much harder.[7] Enforcing legal norms is a struggle when the disapproval, ostracism, or guilt that results from failure to comply with the legal standard of conduct is absent; in fact, disapproval, guilt, and ostracism "can supplement or even completely replace the threat of punishment as a means of ensuring that these rules are obeyed."[8] In certain cases, that principle is reversed: a technology may empower behaviors encouraged by social norms *in spite of regulation*—technology in the anarchist's sphere—and

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6. Examples include open source code and similar collaborative projects involving hundreds of thousands of people contributing directly to the evolution of the technology. *See* Jonathan M. Barnett, *Property as Process: How Innovation Markets Select Innovation Regimes*, 119 YALE L.J. 384, 402 n.38 (2009) (describing a mix of legal and social barriers to innovation); Charles R. McManis & Eul Soo Seo, *The Interface of Open Source and Proprietary Agricultural Innovation: Facilitated Access and Benefit-Sharing Under the New FAO Treaty*, 30 WASH. U. J.L. & POL'Y 405, 442–43 (2009) ("[M]ost participants in the F/OSS movement use 'copyright ownership and contracts to enforce social norms of sharing and openness.' Unlike proprietary software, in which copyright is used 'to exclude,' however, copyright in F/OSS is used to confer a right 'to distribute.'").

7. Sunstein defined social norms as "social attitudes of approval and disapproval, specifying what ought to be done and what ought not to be done." Cass R. Sunstein, *Social Norms and Social Roles*, 96 COLUM. L. REV. 903, 914 (1996); *see* CRISTINA BICCHIERI, THE GRAMMAR OF SOCIETY: THE NATURE AND DYNAMICS OF SOCIAL NORMS 2 (2006) ("Given the right kind of expectations, people will have conditional preferences for obeying a norm, meaning that preferences will be conditional on having expectations about other people's conformity."). Thus, if the user of a technology perceived that a significant number, or even perhaps a majority of other users, behave a certain way when using the same technology, a law prohibiting that behavior will clash with the social norm. Then again, the equation is often simpler and devoid of a deliberative element: the technology makes something fun or otherwise desirable possible, and the technology will then be used without a conscious and systematic assessment of the situation—whether as a cost–benefit analysis or otherwise. *See id.* at 4–5.

8. Christopher Jensen, *The More Things Change, the More They Stay the Same: Copyright, Digital Technology, and Social Norms*, 56 STAN. L. REV. 531, 535 (2003). On the legitimacy of policy made through a process of democratic discourse, see JÜRGEN HABERMAS, BETWEEN FACTS AND NORMS: CONTRIBUTIONS TO A DISCOURSE THEORY OF LAW AND DEMOCRACY 457–60 (William Rehg trans., MIT Press 1996) (1992), stating that the legitimacy of a legal code is determined by whether those governed by the code have an equal opportunity to participate in its creation.

thus, radically transforms the traditional parameters of policymaking.[9]

Against this backdrop, I suggest that policymaking efforts targeting inchoate technologies must be recalibrated to take account of the difference between the regulation of those technologies, on the one hand, and other forms of regulatory intervention, on the other. I propose an analytical model, not a new regulatory theory.[10] This model can be superimposed on any such theory by suggesting a different approach to decide whether to regulate an inchoate technology.

The dominant feature of inchoate technologies—as this expression is used in this Essay—is their ability to evolve in unpredictable ways and to spawn new chains of technological developments. In his 1996 book *Why Things Bite Back*, Princeton scientist Edward Tenner mentions dozens of examples of technology evolving in unexpected ways—either because of bad design, serendipity, or unintended findings—noting that in the area of electronics for example, "strange things happen . . . for which there is no reason."[11] As to whether that evolution is generally positive, he suggests that technology on its own does not usually produce side effects that outweigh their positive effects (which he terms "revenge effects").[12] He notes that this tends to happen when technology is anchored in laws, regulations, customs, and habits.[13]

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9. *See* HABERMAS, *supra* note 8, at 457–60 (noting that tensions created by differences between laws and social norms can lead to more representative methods of policymaking). Eric Posner has demonstrated that it is important for policymakers to take account of the social norm/legal norm interface in the case of fiscal measures. *See* Eric A. Posner, *Law and Social Norms: The Case of Tax Compliance*, 86 VA. L. REV. 1781, 1791–92 (2000) (discussing how the government may promote compliance with tax laws by manipulating social signals).

10. The four main regulatory theories are the Public Choice Theory, the Neopluralist Theory, the Public Interest Theory, and the Civic Republican Theory. The first three suggest various models of preference aggregation. While they agree on the key role of interest groups, they differ on the role that the citizenry's preferences and the perception of the public interest play in influencing regulatory outcomes. The fourth theory focuses instead on shared values to inform the process. *See* Steven P. Croley, *Theories of Regulation: Incorporating the Administrative Process*, 98 COLUM. L. REV. 1, 31 (1998) (lamenting the fact that economists and political scientists fail to incorporate any well-developed vision of administrative law and practice into their regulatory theories).

11. EDWARD TENNER, WHY THINGS BITE BACK: TECHNOLOGY AND THE REVENGE OF UNINTENDED CONSEQUENCES 4 (1996).

12. *Id.* at 6–7. The French aphorism, "*Les choses sont contre nous*" (things are against us) is another expression of this idea, which also serves as a cornerstone for resistentialism, a tongue-in-cheek movement which postulated a fundamental, rather than an accidental, opposition between man and the inanimate kingdom. *See* PAUL JENNINGS, REPORT ON RESISTENTIALISM (1963), *reprinted in* PAUL JENNINGS, THE JENGUIN PENNINGS 196 (1963). The aphorism is often attributed to French philosopher Pierre-Marie Ventre. *Id.*

13. TENNER, *supra* note 11, at 7.

Having provisionally defined the object of the analysis, namely inchoate technologies, let me situate my analytical field vis-à-vis related areas of inquiry.

There are literally hundreds of books, going back to Plato, about how to govern. A number of those books are about processes to set policy objectives.[14] Sometimes referred to as "policy analysis," this process consists of formulating alternative policy objectives for decisions by the legislature; that is, intervention options that will be shaped by the "political stream."[15] This is the essence of the political process; it is also *not* what this Essay is about. Then there are also studies of the legislative drafting process, and again this is not my focus.[16] There is, however, a key connector that links these two parts of the policymaking and implementation process; namely *how to identify policies that will effectively implement the policy objectives, while taking account of the nature of the regulatory target*.[17] That connector is the focus of this paper when the target is an inchoate technology.

I should add that while the analysis of regulatory failure is not new—it is risky and difficult to regulate any "market," "behavior," or risk generally—this Essay argues that the likelihood of mistakes—which can be made in any regulatory intervention—is significantly higher when one ignores the inchoate nature of certain technologies, or views it rather naively as another facet of the market or user behavior.[18] Inchoate technologies are neither neutral nor a simple part of the "market."[19] They have a life of their own and policymakers must take that factor into account.

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14. *See, e.g.*, CHARLES E. LINDBLOM, THE POLICY-MAKING PROCESS 3–4 (1968) (describing, for example, one approach to implementing policy objectives through a sequence of steps: "(a) preliminary appraisal of or inquiry into the problem; (b) identification of goals or objectives; (c) canvassing of possible policies to achieve the goals; and, (d) choice or design").

15. *See* JOHN W. KINGDON, AGENDAS, ALTERNATIVES, AND PUBLIC POLICIES 145–63 (2d ed. 1995) (stating that policy goals come from many sources, including the national mood, organized interests, election repercussions, and the orientation of elected officials).

16. *See, e.g.*, Victoria F. Nourse & Jane S. Schacter, *The Politics of Legislative Drafting: A Congressional Case Study*, 77 N.Y.U. L. REV. 575 (2002) (discussing the legislative drafting process in the Senate Judiciary Committee).

17. That is the object of the regulation—in our case an inchoate technology or the behavior of users of that technology.

18. *See* MALCOM K. SPARROW, THE REGULATORY CRAFT: CONTROLLING RISKS, SOLVING PROBLEMS, AND MANAGING COMPLIANCE 282–90 (2000).

19. *See* HUMBERTO R. MATURANA & FRANCISCO J. VARELA, AUTOPOIESIS AND COGNITION: THE REALIZATION OF THE LIVING 78–80 (D. Reidel Publ'g Co. 1980) (1972) (discussing the interconnected and variable nature of autopoietic, or "living," machines). Technology's "life of its own," the fact that it creates winners and losers in a Schumpeterian process, is well documented in social science research. Maturana and

My analysis proceeds as follows: I will review, first, the dominant regulatory ideologies, essentially to show that they are poor guides when regulating inchoate technologies. In Part II, I define the notion of inchoate technology. In Part III, I situate the approach to the regulation of inchoate technology vis-à-vis regulatory ideologies. In Part IV, I explicate the ability of inchoate technologies to react and possibly defeat regulation. This reaction is amplified when the legal norm is divorced from the social norm. In Part V, I review a major pitfall of regulation as it applies (or not) to the regulation of inchoate technologies; namely, the "law" of unintended consequences. In Part VI, I discuss the ability of technologies to self-regulate, which may negate the need for outside norms. In Part VII, I discuss the precautionary principle, which I see as the best, and possibly the only, coherent analytical framework to regulate inchoate technologies. Finally, in Part VIII, I present the outcomes of the analysis and the structure of a regulatory model that follows from those conclusions.

II. INCHOATE TECHNOLOGIES

A. *Definitional Indices*

I use the term "inchoate" in this Essay to reflect the fact that certain technologies are far from completely developed and suggest that this differentiates them from more stable ones.[20] The

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Varela suggested that one could apply to certain "machines" properties of living systems and develop in part at least from endogenous factors rather than external constraints or stimuli. *Id.* at 78. Naturally, in the TechnoPolicy model, technology is not part of a closed system. Both endogenous and exogenous factors are considered. *See also* Marylaine Block, *Introduction* to NET EFFECTS: HOW LIBRARIANS CAN MANAGE THE UNINTENDED CONSEQUENCES OF THE INTERNET 1, 1 (Marylaine Block ed. 2003) ("Any technology upsets applecarts, both by intention and through unintended side effects; the more powerful the technology, the more powerful those side effects are.").

20. The term was used by a number of previous authors, though not defined. *See* Gregory D. Foster, *Integrating the U.S. Industrial Base: Strategic Necessity for America's Future*, 19 FLETCHER F. WORLD AFF. 133, 144 (1995) ("One example, from among many that could be cited, of an inchoate technology being developed for commercial markets that could have valuable military uses is the computer-based speech-translation system (or universal translator)."); Thomas R. Mclean, *Cybersurgery: Innovation or a Means to Close Community Hospitals and Displace Physicians?*, 20 J. MARSHALL J. COMPUTER & INFO. L. 495, 497 (2002) ("[C]ybersurgery, as with any inchoate technologic innovation, is associated with a plethora of sociologic, and hence legal, questions."); Brent E. Newton, *The Legal Effect of Government Contractor Teaming Agreements: A Proposal for Determining Liability and Assessing Damages in Event of Breach*, 91 COLUM. L. REV. 1990, 1995 n.21 (1991) (referring to *Air Technology Corp. v. General Electric Corp.*, 199 N.E.2d 538, 546 (Mass. 1964) in which the court noted that a "'largely unspecified, untested nuclear detection system' project was subject to the 'changing ideas of the Air Force'"); Kirk Tarman, Note, *The Internet Dilemma: The Virtual Censors—Governmental Control of*

inchoateness can apply to organic changes to the technology or to its use. To take the dissemination of copyrighted content on the Internet as an example, the technology itself (how people connect to the network and with which device(s)) is still relatively inchoate; the ways in which users access, use, and transform that content is more inchoate still and fast developing.[21]

While an inchoate technology is usually a new one, inchoateness involves several features in addition to novelty. While I do not pretend to offer watertight definitional boundaries, there are a number of indices of inchoateness of a technology that one can look for. As just mentioned, novelty is the first sign of inchoateness and an obvious starting point. There is undoubtedly a temporal component. Yet, it is not just a measure of time that has elapsed since the technology was invented because the rate of transition to "choate" status will vary for each technology. Still, a fledgling technology is typically highly inchoate; as it progresses, it (or some of its applications) should become more stable and the social norms surrounding its use easier to identify.[22] With progressive integration into the social fabric, the predictability of the technology will increase and its level of inchoateness decrease. In terms of regulatory intervention, the target will thus tend to stabilize over time. Conversely during its inchoate phase, the development of the technology will typically be driven as much by user response as by unforeseen applications and evolutions.[23]

Juvenile Access to the Internet, 19 J. JUV. L. 421, 428 (1998) ("With the advent of the Internet and its vast impact upon our society, the courts must carefully tread between regulation and stifling an inchoate technology."); *see also* Deborah A. Lathen, *Broadband Today*: *A Staff Report to William E. Kennard, Chairman, Federal Communications Commission, on Industry Monitoring Sessions Convened by Cable Services Bureau* (Oct. 1999), http://www.fcc.gov/Bureaus/Cable/Reports/broadbandtoday.pdf ("[B]roadband is an awesome, yet largely inchoate, technology that will bring the Internet and advanced services to millions of Americans.").

21. *See* Robert C. Piasentin, *Unlawful? Innovative? Unstoppable? A Comparative Analysis of the Potential Legal Liability Facing P2P End-Users in the United States, United Kingdom and Canada*, 14 INT'L J.L. & INFO. TECH. 195, 212–13 (2006) (discussing the difficulties encountered by owners when they attempted to prevent p2p file sharing).

22. *See* W. BRIAN ARTHUR, THE NATURE OF TECHNOLOGY: WHAT IT IS AND HOW IT EVOLVES 163–65 (2009) ("[I]ndividual technologies and bodies of technology go through predictable phases as they mature. . . . [T]hey do evolve in the sense that each establishes a line of descent, with all the branching into different 'subspecies' or different subdomains . . . ."). Of course the phases are predictable, but in the initial phases of new (inchoate) technology, what is predictable is precisely the unpredictable way in which the technology will branch out. This is referred to below as the "chain(s) of events" that can be altered by regulation, often as an unintended consequence. *Supra* Part V.

23. *See* Tarman, *supra* note 20, at 428–29 (discussing the struggle courts face in regulating the Internet in light of its unforeseen use as a source of pornography).

More importantly, an inchoate technology's future is unpredictable, as is the role of existing (and the emergence of radically new) market players and the reaction of potential users.[24] No one knew in the 1920s whether airplanes would really be commercially viable for passenger travel, but everyone could picture how they would function if they were.[25] On the other hand, when Michael Faraday invented the electromagnet, no one knew what it would be used for.[26]

Third, social norms concerning an inchoate technology are usually in flux and tend to evolve rapidly.[27] As noted above, this means that the difficulty of the moving technological target is compounded by social norms that may try to circumvent the regulation, especially for mass use technologies.[28]

Fourth, another feature of inchoateness is whether the technology is being developed by existing firms as part of an existing product line, or whether it is being developed by a host of small, start-up firms as an independent technology.[29] A constellation of unknown start-ups seems to present a greater regulatory challenge than asking already highly regulated companies to adapt to regulation.

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24. Governments often try, and fail, to push a particular technology to market, possibly impeding the development of better ones and not promoting the development of chains of events that would be more productive. I return to this below. *See* ARTHUR, *supra* note 22, at 163 ("There is always a temptation for governments to pursue science with commercial aims in view. But this rarely works. Had there been a stated purpose to quantum physics in the 1920s, it would have been deemed a failure. And yet quantum physics has given us the transistor, the laser, the basis of nanotechnology, and much else besides. Building a capacity for advanced technology is not like planning production in a socialist economy, but more like growing a rock garden. Planting, watering, and weeding are more appropriate than five-year plans.").

25. *See* Justin T. Barkowski, *Managing Air Traffic Congestion Through the Next Generation Air Transportation System: Satellite-Based Technology, Trajectories, and—Privatization?*, 37 PEPP. L. REV. 247, 253–60 (2010) (describing the origins of the regulated airline market starting in 1916).

26. In a famous exchange, Faraday received British Prime Minister William Gladstone and then, as former Prime Minister Margaret Thatcher explains, "demonstrated his remarkable new invention, the electric generator. Afterwards he waited for the Prime Minister's response, expecting him to be suitably impressed but there was silence. Eventually Gladstone did speak, 'Tell me Mr Faraday' he said, 'will this new discovery of electricity be of any practical use?'. To which the indignant but quick-witted Faraday replied 'Oh yes Prime Minister. One day you will tax it!'" *See* Rt. Hon. Baroness Margaret Thatcher, Speech in Bermuda to a Luncheon Organised by Sir John Swan, (Aug. 7, 2001), *available at* http://www.margaretthatcher.org/speeches/displaydocument.asp?docid=109301.

27. *See* Sunstein, *supra* note 7, at 948 (discussing the difficulties of governmental interference with social norms to effect positive change).

28. *See id.* at 914–24 (discussing how social norms can affect collective action and movements for legal and social change). I discuss the interaction between technology, social norms, and regulation in Part IV.

29. Naturally, those new technologies may have Schumpeterian impacts on existing products.

Fifth and finally, a feature of inchoate technology is precisely the risk of regulating it. This could be either the level of risk or the nature of the risk. To take an example of each: regarding the latter, everyone could guess the risk of imposing safety regulation on passenger airplanes in the 1920s, when the first statutes were passed; it was that passenger air travel wouldn't become commercially viable.[30] On the other hand, banning an inchoate technology such as stem cell research or cold fusion creates a high risk of regulatory failure because no one can say with any degree of certainty where such research might lead—that is, which chains of events may be prevented or diverted by regulation.[31]

B. Discussion

Four observations are in order concerning the notion of inchoate technology. First, the definitional boundaries outlined in the previous paragraphs may apply more readily to consumer (or mass market) technologies because a vast number of users may be more apt to develop behavioral norms concerning its use.[32] Yet, this is true also of technologies that are used within a particular community with its own norms.[33]

Second, while I would grant that a technology that requires expensive labs may be an easier physical *enforcement* target for

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30. Barkowski, *supra* note 25, at 253.

31. This led Professor Abramovicz to argue for *simplified* regulation, using cold fusion as an example:

> A happy consequence of regulatory simplification is a reduced danger that regulations will become obsolete. As long as a predictive mechanism occurs continuously, predictors will have incentives to update their predictions. Insurance companies pricing bank risk, for example, would have an incentive to respond to relevant changes in the economic environment. Similarly, participants in an information market about scientific propositions could profit by trading on news affecting the validity of scientific propositions. So, if cold fusion were suddenly conclusively proven impossible, a government relying on the information market could stop funding such research without any separate analysis of its own.

Michael Abramovicz, *Predictive Decisionmaking*, 92 VA. L. REV. 69, 85 (2006).

32. A reference to technological determinism will offer a counterfactual for the argument made here, according to which technology drives the development of social structure and cultural values. *See, e.g.*, THORSTEIN VEBLEN, THE PLACE OF SCIENCE IN MODERN CIVILIZATION 53 (2007) (arguing the traditional attitude is to be submissive towards the laws of natural science). In Part II, I will take a different view; namely that society (and specifically demand for certain technological applications) shapes technology. This may be closer to the notion that technological "artifacts" correlate with particular kinds of social and political relationships. *See, e.g.*, LANGDON WINNER, THE WHALE AND THE REACTOR: A SEARCH FOR LIMITS IN AN AGE OF HIGH TECHNOLOGY 52–55, 99 (1986) (arguing that technology is a powerful force that gives meaning and direction to our lives and shapes conditions of power, authority, freedom, and social justice).

33. Gary Burnett et al., *Small Worlds: Normative Behavior in Virtual Communities and Feminist Bookselling*, 52 J. AM. SOC'Y FOR INFO. SCI. & TECH. 536, 538–39 (2001).

regulators (that is, in terms of finding its developers to enforce a regulation), it may not be easier to *achieve a desired regulatory outcome* because the unpredictability that accompanies its inchoateness remains.[34] That said, a software-based inchoate technology may be more nimble and, in the final analysis, a prime target for the model outlined in this Essay.[35]

Third, a "technology" is more properly understood in the context of my analysis as a particular *technological application*, as opposed to what might more appropriately be called technological "domains."[36]

Fourth and finally, the process by which a technology becomes more choate is precisely that, a process. A technology does not move from one state to the next in a day. The level of inchoateness will tend to decrease over time as the technology becomes more stable and predictable.[37]

Historically, technologies that are now well established were inchoate, even if only briefly. Airplanes were inchoate before World War I, and television was inchoate in the 1930s, as were automobiles and movies in the 1890s.[38] I suggest below that for

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34. Hence the point about technologies developed by several start-ups instead of well-established companies. *See infra* Part III.A (noting that the development of inchoate technologies often outpaces regulatory efforts).

35. Yet, a number of commentators have argued that even technologies such as those in the domain of nanotechnology which cannot be developed by consumers in the same way as, say, source code, must be regulated in a way which reflects societal perceptions. *See, e.g.*, Emilio Mordini, *Nanotechnology, Society and Collective Imaginary: Setting the Research Agenda*, *in* NEW GLOBAL FRONTIERS IN REGULATION: THE AGE OF NANOTECHNOLOGY 29, 30 (Graeme Hodge, Diana Bowman & Karinne Ludlow, eds., 2007) (defining social imaginary as "a filter for new information . . . the lens through which people perceive the world" and a source of collective action, including technological regulation). The notion of social imaginaries was explored in depth by Charles Taylor. CHARLES TAYLOR, MODERN SOCIAL IMAGINARIES 23–24 (2004). I discussed some of the lessons intellectual property policymakers can draw from that notion in Daniel Gervais, *Of Clusters and Assumptions: Innovation as Part of a Full TRIPS Implementation*, 77 FORDHAM L. REV. 2353, 2367–68 (2009).

36. ARTHUR, *supra* note 22, at 163–65 (defining a "domain"—and contrasting that notion with "individual technologies"). Arthur explains that domains crystallize "around a set of phenomena loosely understood or around a novel enabling technology, and build organically upon the components, practices and understandings that support these. And as the new domain arrives, the economy encounters it and alters itself as a result." *Id.* I would argue that the verb could be in straight active form: the technology alters the economic (market).

My point is that, while a new technological domain may at first overlap almost entirely with a single technological application (say, the first nanotechnology ever created in a laboratory was the entire domain of nanotechnology at that point in time), as new applications develop, they become individual regulatory targets—unless of course the regulator tries to ban the entire domain.

37. Marc B. Sokol, *Adaptation to Difficult Designs: Facilitating Use of New Technology*, 8 J. BUS. & PSYCHOL. 277, 279–80 (1994).

38. AN ENCYCLOPAEDIA OF THE HISTORY OF TECHNOLOGY (Ian McNeil ed., 1990).

any such new technology, *market* regulation during the initial, inchoate stage is highly risky, and unintended consequences are extremely likely.[39] If the technology does not need to be regulated under a sound application of the precautionary principle, then any impulse to impose technology-specific regulation is probably best resisted.[40] Conversely, because risks may emerge during the inchoate stage, a nimble regulatory approach effected by courts or regulatory agencies may work best.[41]

The analytical model I propose below does not consider technology regulation as *justified* because costs are likely lower than expected benefits, in part because (a) the value of the prediction when applied to an inchoate technology is dubious; (b) because there are rarely feedback loops to adjust the regulatory framework if the target is missed; and (c) the unintended consequences are rarely factored in.[42] Instead, I suggest that an *optimal* model refrains from shaping the future of an inchoate technology or its market relevance unless the precautionary principle applies.

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39. *See infra* Part V (asserting that the unpredictable nature of inchoate technologies makes the impact of regulation almost impossible to predict).

40. *See infra* Part VII.B (demonstrating a proper application of the precautionary principle to inchoate technologies).

41. This is not the same as cost–benefit analysis. *See infra* Part IV (arguing that because inchoate technologies are constantly evolving, regulation is often outdated before it is put in place). Technologies such as use of asbestos, Thalidomide, etc. might have been regulated much more effectively under such an approach. One author explains:

> [A]sbestos is not a wholly isolated case. The use of dangerous workplace materials and production of some products with latent defects or perceived health risks is inevitable in a vibrant market economy. Examples abound: coal, DDT, Thalidomide, lead, mercury, tobacco, intrauterine devices, and polyvinyl chlorides. . . .
>
> . . . These dangers can create huge classes of claimants, seeking compensation for injuries, lost wages, and diminished quality of life as well as retribution for any corporate wrongdoing that contributed to their losses. These claims, in turn, will raise the issues of whether courts should try to address the underlying issues or defer to other forums.
>
> On this central issue of institutional choice, the rise of asbestos litigation suggests two main lessons. First, contemporary legal process analysis implies that there is a choice of social ordering mechanisms, albeit imperfect ones. In reality, some options will be off the table as a practical matter. Indeed, in a lawmaking process riddled with veto points and supermajority requirements such as the filibuster in the Senate, legislation is often out of reach. As a result, the initial choice facing judges is often not litigation versus other modes of social ordering; it is litigation or nothing at all.

Jeb Barnes, *In Defense of Asbestos Tort Litigation: Rethinking Legal Process Analysis in a World of Uncertainty, Second Bests, and Shared Policy-Making Responsibility*, 34 L. & SOC. INQUIRY 5, 21–22 (2009).

42. *See infra* Part VIII.B (proposing a new regulatory approach for inchoate technologies).

One might counter that inchoate technologies are more malleable and can be shaped by regulation without the significant damage to the economy that might occur once the technology generates significant levels of employment and investment. The point concerning risk to the economy is well taken, but I maintain that the risk of failure (that is, the absence of correlation, let alone a match, between the regulatory objective and the actual outcome once the regulation is implemented) is much higher when dealing with an inchoate technology.

III. REGULATORY IDEOLOGIES

At its most basic level, policymaking is often informed by the perceived desirability, or absence thereof, of a regulatory intervention.[43] Whether to try to direct the market or only fix a failed one is a long-standing debate—one that I do not plan to discuss here.[44] It is fair to say, however, that this traditional political (sometimes dubbed "Left–Right") "axis view" and the major approaches that are derived from it are overrated and, at best, a very rough guide for policymakers when it comes to inchoate technologies.[45]

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43. According to public choice theorists, the market is, in fact, the model for regulatory interventions. Croley, *supra* note 10, at 34, explains that, "The public choice theory of regulation . . . treats legislative, regulatory, and electoral institutions as an economy in which the relevant actors—including ordinary citizens, legislators, agencies, and organized interest groups most affected by regulatory policies—exchange regulatory 'goods,' which are 'demanded' and 'supplied' according to the same basic principles governing the demand and supply of ordinary economic goods."

44. For an example as to how law can affect the economy, see Jim Chen & Daniel J. Gifford, *Law as Industrial Policy: Economic Analysis of Law in a New Key*, 25 U. MEM. L. REV. 1315, 1319–20 (1995), where they note that law can be used to both nurture and restrain national economies.

45. That is, to simplify, one could call the "Left–Right" debate on the place of the public sector in the economy. My attention was drawn to the Wikipedia entry on "Left–right politics," which puts it succinctly as follows: "The contemporary Left usually defines itself as promoting government regulation of business, commerce and industry . . . . The contemporary Right [in the United States] . . . usually defines itself as promoting deregulation of banking, commerce and industry." Wikipedia.com, Left–Right Politics, http://en.wikipedia.org/wiki/Left_right_politics (last visited July 6, 2010). Hilpert notes that the distinction does not necessarily hold when applied to technological innovation even as an ideological matter:

> Having identified the particular logic of the innovation process under capitalism and, apparently determined that it is based upon value-free scientific progress, the conservatives can proclaim themselves as the natural allies of progress and declare that future social welfare necessitates societal adjustments to the needs of innovation. Social-democratic ideas of applying techno-scientific progress and innovation to broader social problems appear to be inappropriate in this depoliticized situation. . . . Conservatives, thus, are able to present themselves as being "progressive," whilst damning their social-democratic opponents as "reactionary." . . . Once the state adopts its new role in

A. Major Approaches to Regulation

A first major approach is generally characterized as neoclassical or "hands-off"—I prefer to call it downstream or *ex post*. It is reactive.[46] The other major approach is to intervene to try to dictate the future direction of the market, a more interventionist approach—I call it upstream or *ex ante*.[47] It is often motivated by distributive concerns.[48] For the same reasons, the regulation of inchoate technologies cannot, and should not, be approached from the perspective of whether the technology itself or technological progress is "good" or "bad."[49] Evaluative judgments of this nature are unlikely to succeed if translated into stark policy choices. Instead, one should look at inchoate technologies as adding a dimension to the traditional policy equation.

I hasten to add that my point is not to recreate a centuries-old debate (which may nonetheless matter on a broader level) on the appropriateness of *ex ante* interventions by the state in the affairs of private citizens and businesses.[50] Rather, my suggestion is that when the target of a possible regulatory intervention is an inchoate technology, the policymaking equation's complexity increases dramatically, which reduces the chances of a successful regulatory impact (measured by whether the objective is achieved).[51]

Even depoliticized policymaking will still lead to such consequences, if only because decisionmakers do not have, and in

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> generating techno-scientific progress by functionalizing scientific research, there are few opportunities to introduce a different logic of economic development . . . .

Ulrich Hilpert, *State-Induced Participation in New World Markets: Some Comparative Conclusions on Trends in Internationalization Through Techno-Industrial Innovation*, *in* STATE POLICIES AND TECHNO-INDUSTRIAL INNOVATION 340 (Ulrich Hilpert ed., 2002) (1991).

46. *See* Samuel Issacharoff, *Regulating After the Fact*, 56 DEPAUL L. REV. 375, 380 (2007) (defining *ex post* and *ex ante* regulation).

47. *Id.*

48. *Id.*

49. As a simple thought experiment, is the Internet or nuclear fusion good or bad? When I use any technology in class to discuss this aspect of technology regulation, students come up with "good" and "bad" columns and often disagree as to which feature fits into which column.

50. Thomas Sowell's work illustrates this classical dilemma that policymakers face:

> Politics [leading to a regulatory intervention] and the market are both ways of getting some people to respond to other people's desires. . . . However, the two processes are profoundly different. . . . In short, political decisions tend to be categorical, while economic decisions tend to be incremental. Incremental decisions can be more fine-tuned.

THOMAS SOWELL, APPLIED ECONOMICS: THINKING BEYOND STAGE ONE 3 (2004).

51. *See infra* Part V (holding that when unintended consequences are considered, the effect of regulation on inchoate technologies becomes impossible to predict accurately).

some cases, *cannot* have the required knowledge.[52] Put differently, the desirability of the goal tends to generate the normative impetus for a regulatory intervention, but it does not make a successful intervention. That success will be measured by whether the goal was reached.[53] Yet, the political process, arguably by its very nature, focuses on the desirability of the goal of the intervention much more than on how, and to what extent, the stated goal will be implemented.

B. Regulation Pitfalls

1. Legacy Regulation. A number of potential pitfalls must also be considered independent of ideology and politics. The first is the enormous impact of legacy regulation. No regulation, even when dealing with an inchoate technology, exists in a void.[54] There is no clean slate, in other words, and the "zero state" of regulation is not the absence of regulation but rather the existing regulatory framework.[55] As Robert Pepper of the U.S. Federal Communications Commission (FCC) put it when discussing Internet telephony: "Every incumbent sees regulation as a shield against new entrants; every new entrant sees regulation as a sword to slice into the new market."[56] Therefore, the question that FCC policymakers addressed was whether and to what extent competition was a value to be protected by regulation, i.e., how much protection did incumbents need from new entrants. Conversely, they had to consider whether the existing framework was flexible enough to allow new entrants to compete with incumbents.

Applied more broadly, the notion of legacy regulation implies that policymakers must consider the consequences of their choices

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52. Essentially, knowledge of what the future holds is not possible because of an inchoate technology's ability to react to the regulation. *See* SANFORD IKEDA, DYNAMICS OF THE MIXED ECONOMY: TOWARD A THEORY OF INTERVENTIONISM 9 (1997) (noting "the centrality of unintended consequences in the development and implementation of public policy, owing to a lack of relevant knowledge on the part of public choosers"); *see also infra* Part III.B (explaining that new regulation will have to interact with the existing regulatory framework).

53. *See* IKEDA, *supra* note 52, at 55–56 (asserting that although governments seek to center their operations around a "hierarchy of objectives," the complexity of modern government often leads to the pursuit of "contradictory or incompatible policies"); *infra* Part III.B (discussing the pitfalls of government intervention).

54. *See* Janice A. Beecher, *The Prudent Regulator: Politics, Independence, Ethics, and the Public Interest*, 29 ENERGY L.J. 577, 599 (2008) (discussing the effect of global interaction on both regulation and policymakers).

55. *Id.*

56. Robert Pepper, *Policy Changes Necessary to Meet Internet Development*, 2001 MICH. ST. L. REV. 255, 258.

on existing regulatory frameworks. For example, in the copyright area existing legal regulations apply to new technologies such as the Internet.[57] The copyright regulatory matrix is also connected to other matrices, such as telecommunications, and those interfaces must be factored in to minimize negative consequences.[58]

Legacy regulation is not in itself a reason to intervene or not to refrain from doing so. It is, however, part of the extant framework that policymakers must take into account, in part because changes to one policy lever impact others. For example, should nanotechnology used for medical purposes be regulated as a pharmaceutical product (legacy FDA regulation) or treated separately, as an inchoate technology?[59] The former approach of adding may impact how those general rules will be interpreted and applied.

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57. Previous arguments that cyberspace was so different from the "physical world" that an entirely new form of regulation was needed do not seem to be convincing courts. Courts have now applied existing contract, tort (e.g., libel), copyright, trademark, and patent laws to the Internet. *See, e.g.*, Gov't Employees Ins. Co. v. Google, Inc., 330 F. Supp. 2d 700, 702–04 (E.D. Va. 2004) (finding trademark infringement in the use of particular "pop-up" advertising); Compuserve Inc. v. Cyber Promotions, Inc., 962 F. Supp. 1015, 1022–23, 1027 (S.D. Ohio 1997) (using traditional notions of tort law to determine if unwanted e-mails constituted trespass to chattel); Adsit Co. v. Gustin, 874 N.E.2d 1018, 1023 (Ind. Ct. App. 2007) (applying traditional legal principles of contract law to internet "clickwrap" agreements); *see also* Jovan Kurbalija, *Internet Governance and International Law*, *in* REFORMING INTERNET GOVERNANCE: PERSPECTIVES FROM THE WORKING GROUP ON INTERNET GOVERNANCE (WGIG) 105, 106 (William J. Drake ed., 2005) (emphasizing the appropriateness of using existing legal mechanisms for regulating the Internet).

58. Legacy regulation may also fill the regulatory void. "Perri 6" (David Ashworth) noted that:

> By 'regulation of the internet and other internationally publicly accessible electronic networks' . . . we actually mean the *application to a new field of the [existing] regulation* of personal information, intellectual property rights, rationing of scarce resources such as certain kinds of carrying capacity, restrictive practices and abuse of monopoly power, freedom of expression or censorship on such grounds as obscenity, libel, advertising, tax law, privacy, police powers in respect of surveillance, technical standards and so on.

Perri 6, *Global Digital Communications and the Prospects for Transnational Regulation*, *in* GOVERNING GLOBALIZATION: POWER, AUTHORITY AND GLOBAL GOVERNANCE 145–46 (David Held & Anthony McGrew eds., 2002) (emphasis added). I realize that this would require its own analysis, but I will posit that if an inchoate technology was able to emerge in the extant regulatory framework, then it had the ability to develop. Of necessity, its development will be influenced by such framework, but the issue strikes me as mostly theoretical, because there a no-zero state (complete *un*regulation) seems unrealistic.

59. Otherwise known as nanomedicine, a label, which in itself seems to suggest that it should be regulated as a medicine. *See* Shanna Harris, *The Regulation of Nanomedicine: Will the Existing Regulatory Scheme of the FDA Suffice?*, 16 RICH. J.L. & TECH. 4, 34, 41 (2009), http://jolt.richmond.edu/v16i2/article4.pdf (explaining that the "FDA Office of Combination Products also created a Nanotechnology Interest Group (NTIG), which is composed of representatives from all of the centers"). The author further explains that, "the goal of its creation was to facilitate the regulation of nanotechnology products," but adds that "there are likely to be *sui generis* problems only addressable through the creation of entirely new laws." *Id.*

2. *Asymmetry of Regulation.* The asymmetry of regulation, which may be defined as either treating two comparable situations differently or treating two noncomparable situations in the same fashion, emerges as a relevant concern.[60] Asymmetric regulation is not always a bad thing per se. Asymmetry may be the desired outcome of a policy orientation designed to favor one industry over another.[61] If a new technology has only new entrants and starts from a blank page, the risk is minimal; but this rarely happens. For example, Internet-based TV retransmitters may be relatively new (where they are allowed to operate), but they are competing against existing cable companies that are already extensively regulated and who can use existing regulation to preserve their market.[62] To take another example: is multimedia or e-book publishing so different from traditional paper-based publishing that it requires entirely new regulations? Or should it be brought under general publishing?[63] Are rules regulating the distribution of music on the Internet used to protect incumbents (CD makers and distributors) against new entrants or to ameliorate market functioning?[64]

Asymmetric regulation leads to distortions by providing protection to incumbents against the competition with new entrants. In those cases, the question is whether the government should intervene. Should the government decide whether old business models (used by the incumbents) and the technologies that support them must survive? The answer should be self-evident.

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60. Pepper, *supra* note 56, at 257.

61. International trade regulation is another. While several governments trumpet the virtues of free trade, in fact, their real policy objective is to export in areas where their companies are competitive and protect industries that are not competitive from foreign imports. In other words, policymakers usually try to adjust the regulatory framework to obtain the maximum degree of asymmetry favoring their national industry.

62. When Internet TV retransmitter iCraveTV (and later JumpTV) started up in Canada, the Copyright Act (R.S.C. c C-42) was quickly amended to exclude Internet retransmitters from the definition of retransmitters to prevent them from taking advantage of the compulsory license for cable retransmitters. *See* Matt Jackson, *The Technological Revolution Will Not Be Televised: Canadian Copyright and Internet Transmissions*, 2006 MICH. ST. L. REV. 133, 144 (discussing the Canadian Legislature's response to the development of Internet retransmission).

63. To continue along the lines of footnote 61 above with a simple example, the government of a country where traditional publishing flourishes and is highly competitive, but not competitive in e-publishing, might not be willing to extend the same benefits to the e-publishing industry.

64. *See* Jared S. Welsh, *Pay What You Like—No, Really: Why Copyright Law Should Make Digital Music Free for Noncommercial Uses*, 58 EMORY L.J. 1495, 1509–11 (2009) (discussing recording agreements and whether digital distribution models are supported by legislation and existing contracts).

C. Breyer's Six Reasons

A better model in my view is the one proposed by Stephen Breyer (now a U.S. Supreme Court Justice). In a seminal article on regulatory reform, he argued that there are six reasons to regulate: the need to control monopoly power; the need to control windfall profits; the need to correct for spillover costs (externalities); the need to compensate for inadequate information; the need to eliminate 'excessive' competition; and the need to alleviate scarcity.[65]

An inchoate technology exhibiting all or most of the characteristics described in Part II (novelty, unpredictability, instability, and development by several small start-ups) could hardly be the basis for a monopoly or windfall profits; and information about the technology will, like the technology itself, be a constantly moving target.[66]

In fact, I suggest that, of the six reasons mentioned by Justice Breyer, it seems that only the *elimination or prevention of significant harm* is likely to apply to an inchoate technology. His six-reason approach is thus commensurate with the model outlined in Part VIII. I return to this issue below.[67]

IV. THE TECHNOPOLICY TRIANGLE

One of the pillars of the analytical model I propose is the fact that inchoate technologies are a moving target. The following

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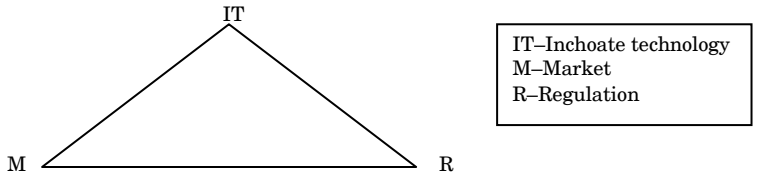
65. Stephen Breyer, *Regulation and Deregulation in the United States: Airlines, Telecommunications and Antitrust*, *in* DEREGULATION OR RE-REGULATION? REGULATORY REFORM IN EUROPE AND THE UNITED STATES, 7, 9–11 (Giandomenico Majone ed., 1990). Prior to his elevation to the U.S. Supreme Court, Justice Breyer had been an "architect" of airline deregulation. *See* Paul Stephen Dempsey, *The Financial Performance of the Airline Industry Post-Deregulation*, 45 HOUS. L. REV. 421, 476 (2008) (discussing Supreme Court Justice Stephen Breyer's involvement in airline deregulation while he served as an aide to Senator Ted Kennedy in the 1970s).

66. *See supra* note 52 and accompanying text.

67. Breyer's approach is of course a much broader net cast over all regulation. In the same vein, Ludwig von Mises noted in his classic text that "[a]s soon as something happens in the economy that any of the various bureaucratic institutions does not like or that arouses the anger of a pressure group, people clamor for new interventions." LUDWIG VON MISES, HUMAN ACTION: A TREATISE ON ECONOMICS 859 (3d ed. Henry Regnery Co. 1966) (1949); *see* IKEDA, *supra* note 52, at 11 (suggesting that deadweight losses and other unintended consequences tend to play only a marginal role in public choice and that "redistributional activities produce deadweight losses and other unintended effects [that are] often completely irrelevant from the viewpoint of the decision-making agents in public-choice models, in which *incentives* are nearly always the central focus").

To be clear, while a Misesian critique might support a model arguing for limited regulation of inchoate technologies, I do not take the view that regulatory impulses *in general* should be avoided for the reasons that von Mises, Ikeda, and others have mentioned.

triangle may be useful to explicate how the nature of inchoate technologies affects the policy equation:



This triangular model is intended to reflect the complexity of inchoate technologies compared to the traditional analytical grid (intervention/no-intervention) axis described above.[68] It is not a matter of deciding whether to intervene or not. Even if a regulatory intervention is deemed desirable, it may not achieve its objective and may in fact be counterproductive. The added layer of complexity stems from the fact that each *element of the triangle reacts to actions by the other two.* An inchoate technology reacts to both market changes and regulation, and the market reacts to technological and regulatory changes. It seems logical that regulatory changes should similarly take account of both technology and the market, and that policymakers should expect this dual reaction to any change.[69] Technology, especially during its inchoate phase(s), is a constantly moving target.

Timing is thus a crucial element because it is axiomatic that technological change happens faster than social change.[70] Thus,

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68. *Supra* Part III.

69. In fact, some organization theorists might add a fourth dimension; namely, how organizations react to market and other forces. As noted in 1992:

> [T]he preferences of designers, makers and users do not lead in any unmediated way to particular outcomes for the position and power of current users mediates between design and outcome and is channeled in part by the unintended consequences of social life. What is crucial, then, is to retain the ambiguity of technology in the sense that organizations and social relations are neither determined by technology nor are they determined by social agency; organizations are the contingent result of a permanently unstable network of human and non-human actors. Technology and its properties, then, are not fixed or determinate but contingent.

Keith Grint, *Sniffers*, *Lurkers, Actor Networkers: Computer Mediated Communications as a Technical Fix*, *in* TECHNOLOGICAL LITERACY AND THE CURRICULUM 148, 154–55 (John Beynon & Hughie Mackay eds., 1992).

For our purposes, however, this is less of an issue because as legal entities, organizations tend to be relatively stable regulatory targets, and regulation is generally not designed to modify the behavior of a single organization.

70. Examples abound. To take just one, in vitro fertilization techniques have evolved faster than acceptance of a lesbian couple's decision to have a child together. *See generally* John G. New, *"Aren't You Lucky You Have Two Mamas?": Redefining Parenthood in Light of Evolving Reproductive Technologies and Social Change*, 81 CHI.-KENT L. REV. 773, 774 (2006) (discussing how the legal field has addressed the changing concept of parentage). In his classic book, Lewis Mumford argued that social change requires more than technological progress:

by the time a regulation is in place, the regulated technological target may already be outdated or have changed to defeat the regulation, especially for a fast-developing inchoate technology.[71]

My suggestions are that:

(a) An inchoate technology is an element that exists in part independently from the market and regulation; it has life of its own. For example, there will always be some technology that will be invented *not* because market forces demand it; and

(b) Mass-market inchoate technologies may counter regulation to empower market demand, most notably user behavior encouraged by social norms.

With this in mind, the next step in devising a productive approach to the regulation of inchoate technologies is to identify pitfalls to avoid.

V. THE "LAW" OF UNINTENDED CONSEQUENCES

Unintended consequences are to policymaking what gravity is to Newtonian physics: inescapable. This is perhaps why, in both cases, we colloquially refer to the "laws" of unintended consequences and gravity.[72] In fact, probably the single most

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> All the critical instruments of modern technology—the clock, the printing press, the water-mill, the magnetic compass, the loom, the lathe, gunpowder, paper, to say nothing of mathematics and chemistry and mechanics—existed in other cultures. The Chinese, the Arabs, the Greeks, long before the Northern European, had taken most of the first steps toward the machine. . . . It remained for the peoples of Western Europe to carry the physical sciences and the exact arts to a point no other culture had reached, and to adapt the whole mode of life to the pace and capabilities of the machine.

LEWIS MUMFORD, TECHNICS AND CIVILIZATION 4 (1934).

71. Contrast the regulation of a technology where the "arms race" has mostly ended (radar detectors), after detectors of radar detectors and detectors of detectors of radar detectors were marketed, and the regulation of music file sharing on the Internet, where in spite of ever tougher potential sanctions and the deployment of new antipiracy technologies, the phenomenon is far from contained. On the former, consider:

> [T]he absence of empirical data supporting the proposition that radar detectors decrease highway safety, numerous proposals to ban the devices have been introduced by state legislators. Although these efforts "have not been fruitful in the past 10 years," Virginia, Connecticut, and the District of Columbia have succeeded in prohibiting these devices.

Nikolaus F. Schandlbauer, *Busting the "Fuzzbuster": Rethinking Bans on Radar Detectors*, 94 DICK. L. REV. 783, 784–85 (1990) (footnotes omitted).

72. Weber presents an approach that serves a useful purpose if only as heuristics. *See* GLOBALIZATION AND THE EUROPEAN POLITICAL ECONOMY 287 (Steven Weber ed., 2001) ("[T]he so-called 'logic' of unintended consequences is not really logic at all, but is exactly what needs to be explained in most accounts of institutional change."). The usefulness follows from the ability of the notion to call attention to key elements of the equation.

important source of the discrepancy between a stated policy objective and the outcome—after an attempt to implement such objective—comes under the rubric of unintended consequences.

Thomas Sowell asserts that many of the unintended consequences of policies and programs would have been foreseeable if "processes had been analyzed in terms of the incentives and constraints they created, instead of in terms of the desirability of the goals they proclaimed. *Once we start thinking in terms of the chain of events set in motion by particular policies . . . the world begins to look very different*."[73]

As noted in the Introduction, my thesis is that the chain(s) of events concerning the future of inchoate technologies that may be diverted or interrupted are mostly unknown and that the optimal course of action is to resist a regulatory impulse not based on safety concerns, as embodied in the precautionary principle.[74]

Even though unintended consequences are well known, they are a strangely ignored facet of policy implementation. Yet, they emerge in almost all possible contexts: from a war in Iraq that may have strengthened the enemy to tax policies that either "force" companies towards shelters that may make the income previously taxed at a lower rate completely disappear from the tax collector radar and subsidies that incentivize behaviors at the expense of another similarly desirable one.[75]

It is well documented that redistributional policies tend to produce deadweight losses, but the policymakers tend to ignore them because policymakers focus on the behavior they have incentivized, not behaviors that were negatively affected.[76] For example, when the U.S. government launched a Biomass Crop Assistance Program in the 2008 Farm Bill, its laudable aim was to convert wood shavings into renewable energy.[77] The major

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73. SOWELL, *supra* note 50, at 3 (emphasis added).

74. *See infra* Part VI (showing that when legal regulation strays too far from social norms, technology will adapt to circumvent the regulation).

75. Mary Shelley's Frankenstein (the "Modern Prometheus" as she referred to it) comes to mind. MARY SHELLEY, FRANKENSTEIN (Heritage Press, 1934) (1818); *see* PETER W. GALBRAITH, UNINTENDED CONSEQUENCES: HOW WAR IN IRAQ STRENGTHENED AMERICA'S ENEMIES 66 (2009) (contending that the war in Iraq led to the very consequence that it was supposed to prevent: a takeover of a large part of the country by Iranian-backed militia).

76. *See* IKEDA, *supra* note 52, at 11 (noting that deadweight losses and other unintended consequences tend to play only a marginal role in public choice and that "redistributional activities produce deadweight losses and other unintended effects [that are] often completely irrelevant from the viewpoint of the decision-making agents in public-choice models, in which *incentives* are nearly always the central focus").

77. Food, Conservation, and Energy Act of 2008, Pub. L. 110-246, 122 Stat. 1651 (codified as amended at 7 U.S.C. § 8701 (Supp. II 2008)); Juliet Eilperin, *Biomass Subsidy Has Hidden Cost*, WASH. POST, Jan. 10, 2010, at A3.

impact it had was to make sawdust unavailable to makers of low-end cabinetry, while costing U.S. taxpayers $500 million.[78] This example is related to a new area of technology; namely, biofuels and other non-fossil sources of energy.[79] It is a good example of a technology that, for valid normative reasons, a government considers worth supporting but without appropriately weighing the impact on other areas and thereby perhaps preventing or slowing down the development of technologies that could achieve the stated aim of biofuels such as reduction in greenhouse gases and greater energy independence. Indeed it gets worse: new studies question whether biofuels contribute to a reduction in greenhouse gases and suggest they may actually increase total emissions.[80] Obviously, this was unintended; it resulted from a defective analysis of the impact on other uses of the biomass. As the authors of a report published in *Science* noted:

> Most prior studies have found that substituting biofuels for gasoline will reduce greenhouse gases because biofuels sequester carbon through the growth of the feedstock. *These analyses have failed to count the carbon emissions that occur as farmers worldwide respond to higher prices and convert forest and grassland to new cropland* to replace the grain (or cropland) diverted to biofuels. By using a worldwide agricultural model to estimate emissions from land-use change, we found that corn-based ethanol, instead of producing a 20% savings, nearly doubles greenhouse emissions over 30 years and increases greenhouse gases for 167 years.[81]

Tenner mentions literally hundreds of other examples.[82] To pick just two, he notes that legislatures and insurance companies promote the use of alarm systems.[83] However, in a Philadelphia study, only 3,000 of 157,000 calls from automated systems were real.[84] False alarms diverted the equivalent of 58 full-time police officers from other duties and may have led to a net increase in

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78. Eilperin, *supra* note 77.

79. *See* Nathan K. Shrewsbury, *Patentability of Living Matter Related to Biofuel Production in the U.S.*, 5 OKLA. J.L. & TECH. 46, 46 (2009), *available at* http://www.okjolt.org/images/pdf/2009okjoltrev46.pdf (discussing the differences between biofuels and fossil fuels).

80. Timothy Searchinger et al., *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change*, 319 SCIENCE 1238, 1238–40 (2008).

81. *Id.* at 1238 (emphasis added).

82. *See* TENNER, *supra* note 11, at 7 (asserting that the benefits of technology are often accompanied by unintended consequences that appear to cancel out the very reason for using the technology).

83. *Id.*

84. *Id.*

crime.[85] In another set of examples on the technology-regulation interface, Leonard Evans's work has shown that many technologies mandated by traffic laws, such as seat belts, failed to decrease the number of injuries, probably because drivers feel that they can take more risks, thereby actually increasing the risks to other road users.[86]

Jennifer Light[87] also studied several other interesting examples, such as the (a) regulations that forced companies to offer telecommuting options to employees with disabilities that eventually led to workplaces less adapted to the needs of these employees;[88] (b) regulations that put calculators in the hands of underachieving students that led to lower scores in math;[89] and (c) two-second delay between a red light in one direction and the switch to a green light in the other which was quickly internalized by drivers who then started routinely "jumping" the red light.[90]

The "law" of unintended consequences, when applied to an inchoate technology, supports the claim that because of the high degree of unpredictability of the evolution of the technology, the impact of future chains of events is almost impossible to predict, and whether more harm than good will be prevented by even well-intended regulation is educated guesswork at best. This also means that a model such as cost–benefit

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85. *Id.*

86. LEONARD EVANS, TRAFFIC SAFETY 295–96 (2004). His conclusion applied to the U.K. Another article presents a discussion of the U.S. situation. *See* Michael Sivak et. al., *Traffic Safety in the U.S.: Re-examining Major Opportunities*, 38 J. SAFETY RES. 337, 351 (2007) ("[D]rivers who do not wear seat belts are also the drivers who are more likely to be involved in crashes and have more severe crashes."). That study points to advantages of imposing the use of seat belts but notes that beyond any regulatory effort, the only way to truly reduce road fatalities is to convince drivers to drive more slowly and never while intoxicated. *See id*. ("[W]e have an uphill battle to motivate *all* drivers to do everything they can to improve their own safety and the safety of other traffic participants (e.g., by wearing seat belts, not exceeding speed limits, and not driving while intoxicated)."). It should be noted that those technologies have a comparative low level of inchoateness. My point here is to emphasize that even regulating those technologies may create unintended consequences.

87. Jennifer S. Light, *New Technologies and Regulation: Why the Future Needs Historians*, 2001 MICH. ST. L. REV. 241.

88. *Id.* at 244 ("We need to put in place a set of public policies attentive to the predictably complex and even contradictory consequences of technological innovations.").

89. Electronic Frontier Foundation's report on unintended (negative) consequences of the DMCA is interesting. ELECTRONIC FRONTIER FOUNDATION, UNINTENDED CONSEQUENCES: TWELVE YEARS UNDER THE DMCA (Feb. 2010), https://www.eff.org/files/eff-unintended-consequences-12-years.pdf.

90. *See* JAMES BONNESON & KARL ZIMMERMAN, TEXAS TRANSPORTATION INSTITUTE: DEVELOPMENT OF GUIDELINES FOR IDENTIFYING AND TREATING LOCATIONS WITH A RED-LIGHT-RUNNING PROBLEM 6-2 (2004), http://tti.tamu.edu/documents/0-4196-2.pdf (finding traffic accident rates decrease by forty percent when the delay between red and green lights is increased from 2.5 to 3.5 seconds).

analysis, which is used by the U.S. government, almost amounts to fiction because both the costs and the benefits are impossible to assess with any degree of accuracy.[91] The same may be said of related notions taken as normative in this context, such as "efficiency."[92]

Even if one acknowledges that occasionally unintended consequences may be positive (however this is measured), this is hardly a valid reason to ignore them in the hope that unintended consequences will somehow "even out."[93] This would be policy poker, not policymaking.

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91. For a discussion of cost–benefit analysis, see Richard A. Posner, *Cost-Benefit Analysis: Definition, Justification, and Comment on Conference Papers*, 29 J. LEGAL STUD. 1153, 1160 (2000), where he argues that cost–benefit analysis is inexact because of the difficulty in placing a value on human life. Cost–benefit analysis is routinely invoked in congressional action in the United States and informs many Executive Branch decisions, one of which was upheld in 2009 by the Supreme Court (Entergy Corp. v. Riverkeeper Inc., 129 S. Ct. 1498 (2009)). The Court found that the Environmental Protection Agency (EPA) acted reasonably in weighing the costs and benefits of various technologies when it promulgated regulations under section 316(b) of the Clean Water Act (33 U.S.C. § 1326(b); 69 Fed. Reg. 41,576 (2004)), which requires that power plants employ "the best technology available for minimizing [their] adverse environmental impact." The Court concluded that while cost–benefit analysis is not the only and may not be the best policy analysis tool, it was "within the bounds of reasonable interpretation." *Entergy*, 129 S. Ct. at 1508. For a comment, see *The Supreme Court: 2008 Term—Leading Cases*, 123 HARV. L. REV. 342, 343 (2009), which argues that the Supreme Court granted the EPA deference to follow its own interpretation of the Clean Water Act.

92. Even if one can probably safely posit that a policymaking effort should strive to be "efficient," efficiency may be defined not as achieving the original objective but much more loosely as whether the welfare impacts (intended or not) of a regulatory intervention were positive. Efficiency measurements would have to include a time factor because implementation will vary over time (that is, measuring regulatory performance is not an event; it is best viewed as a process). Both the market and technology respond to the change in the regulatory environment in the more complex systemic way illustrated by the TechnoPolicy triangle; the distance between empirically verifiable outcomes and the objectives may well increase.

And then of course, one may apply *Pareto optimal efficiency*, according to which, given a set of alternative allocations of, say, goods or income for a set of individuals, a Pareto improvement is a change from one allocation to another that makes at least one individual better off without making any other individual worse off; that is, an allocation is *Pareto optimal* when no further Pareto improvements can be made without making someone worse off. Or one could apply *Kaldor-Hicks efficiency* according to which Pareto optimal outcomes can be reached by arranging some *compensation* from those that are made better off to those that are made worse off. In fact, the compensation principle was apparently developed by Pareto himself, another Italian economist Enrico Barone, and British economist Alfred Marshall as early as 1890. *See* John S. Chipman, *Hicksian Welfare Economics*, *in* THE LEGACY OF HICKS: HIS CONTRIBUTIONS TO ECONOMIC ANALYSIS 96 (Harald Hagemann & O.F. Hamouda eds., 1995) (providing a "critical examination" of Hicks' compensation principle); Dinh The Luc, *Pareto Optimality*, *in* PARETO OPTIMALITY, GAME THEORY AND EQUILIBRIA 481–82 (Altannar Chinchuluun et. al. eds., 2008) ("The concept of Pareto optimality originated in the economic equilibrium and welfare theories at the beginning of the past century.").

93. To quote Tenner again, "[M]ost unintended consequences are unpleasantly rather than pleasantly surprising. We usually discover even the positive effects only after negative experience." TENNER, *supra* note 11, at 6.

VI. TECHNOLOGY AS REGULATION

Lawrence Lessig, in his seminal book *Code and Other Laws of Cyberspace*, made the point that (computer) code may be stronger than legal code (regulation).[94] In the case of software-based technologies, the reaction to legal regulation may thus be a different form of "code." Once computer code becomes standard, it is (as it were) the de facto rule. Specific legal regulation is therefore unnecessary because technology replaces regulation or leads to the development of standards that regulation can only confirm, but not easily change.[95] There are several examples of code (or, more generally, technology) coming to the rescue of policymakers. I use copyright as an example watermarked throughout this Essay, but other areas such as privacy[96] and taxation[97] could also be mentioned here.

Lessig's principal insight, in my view, was the interaction between the two sets of rules that govern the Internet; namely, legal and software code ("East Coast" and "West Coast" code, respectively[98]). If the legal code is too far removed from the social norm, then West Coast code will give Internet users the tools to "fight" the legal norm. Music "sharing" is an excellent example.[99] The development of peer-to-peer file-sharing (p2p) technology was viewed by the recording industry as a potential lethal threat, and

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94. LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE 4 (1999).

95. As Charles Clark, a former publishing industry lawyer once said, "The answer to the machine is in the machine." *See* CHARLES CLARK, *The Answer to the Machine Is in the Machine*, *in* "THE ANSWER TO THE MACHINE IS IN THE MACHINE" AND OTHER COLLECTED WRITINGS 11 (Jon Bing & Thomas Dreier eds., 2005). As a specific example, it would hardly be economically efficient, if at all possible, to mandate a change of the protocols that "regulate" data flows on the Internet backbone. *See* Michael Gilden, *Jurisdiction and the Internet: The "Real World" Meets Cyberspace*, 7 ILSA J. INT'L & COMP. L. 149, 151 (2000) (arguing there is no way to monitor Internet transmissions, so countries have no way to block Internet transmissions); *see also* Marcus Maher, *An Analysis of Internet Standardization*, 3 VA. J.L. & TECH. 5, ¶95 (1998), http://www.vjolt.net/ vol3/issue/vol3_art5.pdf ("[T]he Internet has become a vast network of diverse interests competing to control its future.").

96. This includes technologies such as PGP/P3P and encryption. Platform for Privacy Preferences (P3P) Project, http://www.w3.org/P3P/ (last visited July 7, 2010).

97. *See* Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1665 (1996) (stating the government grants tax breaks for research and development that promotes overall commercial development).

98. *See* LESSIG, *supra* note 94, at 53 (defining "East Coast Code" as enacted by Congress and "West Coast Code" as code embedded in hardware and software).

99. *See* Daniel J. Gervais, *The Price of Social Norms: Towards a Liability Regime for File-sharing*, 12 J. INTELL. PROP. L. 39, 52 (2004) ("If policy makers insist on making illegal socially-acceptable conduct, technology will adapt to the legal environment either by circumventing the legal norm or by making enforcement either impossible or too costly.").

it used a complete legal arsenal to try to stop it dead in its tracks.[100] This was fairly successful in the case of Napster, a file-sharing service with a centralized directory.[101] Attempts to shut down decentralized p2p services, e.g., using software such as Freenet, KaZaa and Scour, have been somewhat less successful, and new services have emerged (BitTorrent, LimeWire, and many others since).[102] On the other side of the technological battlefield, a number of companies are offering technologies to wrap copyright material in digital containers that prevent unauthorized use or spiders and content detectives that track unauthorized content on the Internet.[103] Another example would be the technological handshake used by Internet music-streaming services[104] or the country-coding of DVDs.[105] The United States has had legislation to reinforce technological protection measures (TPMs) since 1998: the Digital Millennium Copyright Act (DMCA).[106] Yet, countries where no such legislation exists (e.g., Canada) have only marginally higher rates of p2p.[107]

The TechnoPolicy analysis presented in Part IV shows that the industry's efforts are bound to fail. If music "sharing" is supported by social norms (given that it is used by a majority of

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100. The threat is so severe that the industry apparently needs not just to prevent technological circumvention but any fair use of music. *See* William Henslee, *You Can't Always Get What You Want, But If You Try Sometimes You Can Steal It and Call It Fair Use: A Proposal to Abolish the Fair Use Defense for Music*, 58 CATH. U. L. REV. 663, 665 (2009) (arguing courts have interpreted the fair use doctrine so broadly it may render an author's rights meaningless).

101. *See* A&M Records, Inc. v. Napster, Inc., 284 F.3d 1091, 1098–99 (9th Cir. 2002) (holding Napster could be shutdown because its software failed to prevent infringement of copyrighted materials).

102. *See* Welsh, *supra* note 64, at 1518–19 (reviewing recent technological changes and the recording industry's response).

103. *See id*. at 1520 (explaining the system of digital rights management, or "DRM").

104. *See* Jane C. Ginsburg, *Copyright Use and Excuse on the Internet*, 24 COLUM.-VLA J.L. & ARTS 1, 2 (2000) (explaining the "secret handshake" employed by RealAudio to control access to copyright works); *see also* RealNetworks, Inc. v. Streambox, Inc., No. 2:99CV02070, 2000 WL 127311, at *2 (W.D. Wash. 2000) (same).

105. *See* Robert Silva, *DVD Region Codes—What You Need to Know*, http://hometheater.about.com/cs/dvdlaserdisc/a/aaregioncodesa.htm (last visited July 6, 2010) (arguing DVDs have region codes to prevent pirating and to protect movie studio profits).

106. Digital Millennium Copyright Act (DMCA), Pub. L. No. 105-304, 112 Stat. 2860 (1998) (codified as amended at 17 U.S.C. §§ 1201–1205); Lexmark Int'l, Inc. v. Static Control Components, Inc., 387 F.3d 522, 545 (6th Cir. 2004).

107. This is accurate as of 2003, at least. *See* ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), WORKING PARTY ON THE INFORMATION ECONOMY—DIGITAL BROADBAND CONTENT: MUSIC 75 (2005), http://www.oecd.org/dataoecd/13/2/34995041.pdf (arguing the proportion of Canada's population that shares files is "closely followed by the United States"). Due to its failure to enact anticircumvention legislation, Canada is a prime U.S.T.R. target. OFFICE OF THE U.S. TRADE REPRESENTATIVE, 2009 SPECIAL 301 REPORT 17 (2009), http://www.ustr.gov/about-us/press-office/reports-and-publications/2009/2009-special-301-report.

Internet users, at least those in the younger age brackets which constitute the bulk of music buyers), then legal efforts to block p2p are out of step with user demand.[108] According to the TechnoPolicy triangle, technology will respond either by circumventing the legal norm or making its enforcement next to impossible.

Empirical data supports this proposition. When Napster was shut down, the demand and the underlying "sharing"-based social norm were simply too strong, and p2p was born in the form of LimeWire and other "clients," i.e., computer programs that, once downloaded on a user's PC, allow her to share some of her computer's contents (files) with other users of the same (or compatible) software.[109] Because p2p software is meant to empower sharing—some of which is perfectly legal because it does not involve copyrighted material—the software makers have, up to now, been essentially immune.[110] As to users of the software, first the music industry had to find who they were and thus, had to use subpoenas (issued under the DMCA) to force Internet service providers (ISP) to disclose the identity of their subscribers. One ISP was successful in challenging such subpoenas.[111] More importantly, technology has "responded" by making anonymous file sharing possible, using anonymizing clients and repurposing the "old" USENET.[112]

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108. *See* HOWARD RHEINGOLD, SMART MOBS: THE NEXT SOCIAL REVOLUTION 72 (2002) (explaining how legal efforts to stop Napster were successful but ultimately failed to stop file sharing in general).

109. *See* Seagrumn Smith, *From Napster to Kazaa: The Battle over Peer-to-Peer Filesharing Goes International*, 2003 DUKE L. & TECH. REV., no. 0008, at 1, http://www.law.duke.edu/journals/dltr/articles/pdf/2003DLTR0008.pdf (stating international p2p sharing sites are flourishing after the shutdown of Napster).

110. Grokster and Aimster were found liable, but on a theory of inducement, not simply as makers of a p2p technology. *See* Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd., 545 U.S. 913, 941 (2005) (remanding to determine if statements made by Groskter had the "patently illegal objective" of inducing infringement).

111. *See* Recording Indus. Ass'n of Am., Inc. v. Verizon Internet Serv., Inc., 351 F.3d 1229, 1236 (D.C. Cir. 2003) (holding an Internet service provider must be adequately notified before it can be subpoenaed).

112. Stacey L. Dogan explains this evolution:

> [G]iven the collective creativity and tenacity of those with an interest in such technologies, the legal arms of the content industries will arguably never keep pace with their development. Just as Grokster and Kazaa cropped up in the immediate wake of Napster, so will existing sharing and distribution tools give way to new generations of technologies that copyright holders will likely stand powerless to avert.

Stacey L. Dogan, *Code Versus the Common Law*, 2 J. TELECOMM. & HIGH TECH. L. 73, 76 (2003) (footnotes omitted). *See* Lior Jacob Strahilevitz, *Charismatic Code, Social Norms, and the Emergence of Cooperation on the File-Swapping Networks*, 89 VA. L. REV. 505, 508 (2003) (explaining why users of file-sharing sites are willing to make copyrighted materials available for perfect strangers to use without any obvious incentive for doing so); *see also* Bobbie Johnson, *Internet Pirates Find 'Bulletproof' Havens for Illegal File Sharing*, GUARDIAN, Jan. 5, 2010, http://www.guardian.co.uk/technology/2010/jan/05/internet-

Is music file sharing truly supported by relevant social norm or is it just "theft"?[113] Howard Rheingold argues that sharing was/is more than just a socially acceptable behavior; it is part of a broad and developing form of social interaction which he termed "adhocracies" or, more eloquently perhaps, "smart mobs."[114] Internet users can use the Internet to share the various facets of their lives with other people with similar tastes, political views, etc. Social networking sites such as Facebook or MySpace facilitate and, in fact, may reinforce these phenomena. These can lead to informal, yet powerful, networks of influence and new forms of lobbying.[115] While these developments are arguably still inchoate and in their early stages in terms of replacing or complementing existing channels, the same cannot be said of music sharing, which has become the main form of access to music for a great number of Internet users.[116]

In short, legal efforts to stem the tide of file sharing will not work because that "sharing" is empowered by social norms, and technology is able to adapt and morph to defeat regulation.[117] Some download transactions are paid for; others are experimental or social in nature.[118] This is evolving of course, and the industry may legitimately try to move more users to pay more often. The best way to do this is (a) to make it easy and

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piracy-bulletproof (describing the experience of a particular Internet pirate). Johnson details:

> 'Before going completely dark in October 2009, Demonoid physically moved their servers to Ukraine, and remotely controlled them,' said John Robinson, of BigChampagne, a media tracking service based in Los Angeles. 'Ukrainian communications law, as they paraphrase it, says that providers are not responsible for what their customers do. Therefore, they feel no need to speak about or defend what they do.'

Id.

113. *See* Henslee, *supra* note 100, at 668 (arguing copyright laws need to be updated to protect music copyright owners from unauthorized use or misuse of their intellectual property).

114. RHEINGOLD, *supra* note 108, at 169 (defining a smart mob as a "[m]obile ad hoc social network").

115. *See* ROBERT WRIGHT, NONZERO: THE LOGIC OF HUMAN DESTINY 177 (2000) (explaining how lobbyists use recent technological advances, like computerized mass mailings, to target narrow interest groups).

116. *See* Victoria Shannon, *Record Labels Contemplate Unrestricted Digital Music*, N.Y. TIMES, Jan. 23, 2007, at C5 (stating the MP3 format of music has "destroyed" the record industry's control over the world distribution of music).

117. *See* Dogan, *supra* note 112, at 76 (arguing record industries will "never keep pace" with those attempting to download pirated music).

118. *See* Jessica Litman, *Sharing and Stealing*, 27 HASTINGS COMM. & ENT. L.J. 1, 6 (2004) (saying the internet's value as a source of information continues to grow exponentially, while its value as a source of commerce ebbs and flows).

(b) to develop initiatives that will allow users progressively to internalize the need to "do the right thing."[119]

This brief tour of p2p regulation illustrates the difficulty of regulating a technology that can change to respond to demand and social norms, especially when, as with software, the technology is highly nimble.

VII. THE PRECAUTIONARY PRINCIPLE

Whether a technology ultimately generates more positive or negative outcomes depends on its use.[120] From that perspective, few, if any, technologies are risk free, and hence regulation is perhaps best viewed here as risk management.[121] I suggest that, to proceed coherently, policymakers need an appropriate framework to decide on bans and limits on the use of an inchoate technology. In my view, this framework should be based on the precautionary principle, both because of its convincing normative underpinnings, which, as I argue below, are consistent with the model I am proposing, and because it fits squarely within accepted principles of international law.[122]

I should state at the outset that one must distinguish the analytical framework of the precautionary principle, which I suggest should apply to determine whether to attempt to regulate an inchoate technology, from the simple exercise of caution by a government.[123] At its core, the application of the precautionary principle justifies taking action in the absence of

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119. Arguably at least, paid sites should be as "good" as free ones, although the exact value proposition of each service may be rated differently by each user. The suggestion here is to use social norms, not fight them. *See* Jensen, *supra* note 8, at 535 (arguing the guilt that comes from violating social norms is so strong it can completely replace the threat of conventional punishment).

Experience supports the claim that not all free activity is nefarious in nature. Some of it may allow Internet users to share discoveries of new artists with friends, a form of viral marketing. If users paid for the songs "they know they want," the industry would have scored a major victory and could then leverage the Internet instead of trying to shut it down.

120. As Arthur Koestler noted, "Like any other human science, biochemistry can serve the powers of light or of darkness. Its dangers are terrifying; but we are now concerned with its beneficial possibilities." ARTHUR KOESTLER, THE GHOST IN THE MACHINE 334 (Danube ed. 1976). Should biochemistry be banned because a terrorist might build a biological device using the knowledge developed by those researchers?

121. *See* DAN GARDNER, RISK: THE SCIENCE AND POLITICS OF FEAR 282 (2008) (citing situations where terrorists could abuse technology for nefarious purposes).

122. *See infra* note 131 and accompanying text (referencing three situations where courts nearly embraced the precautionary principle).

123. Arie Trouwborst, *The Precautionary Principle in General International Law: Combating Babylonian Confusion*, 16 REV. EUR. COMMUNITY & INT'L ENVTL. L. 185, 189 (2007).

complete scientific information (and, *a fortiori*, agreement) of a causal relationship between an activity and a threat of harm to human health or the environment.[124] Going back to examples used previously, the first commercial airplanes were risky by contemporary standards, sometimes for technological reasons (several crashed before people realized that they had to be de-iced), but everyone knew the nature of risk; namely that everyone in the plane would die, but essentially nothing else would happen.[125] Genetically engineered food, nanotechnology, or cold fusion, on the other hand, creates potential risks that we cannot fully envision.

A. History

The precautionary principle arose due to a heightened awareness of the environment's vulnerability to human interference and of science's ineffectiveness to predict the effects of such interference.[126] In part, the precautionary principle also has its origins in technological skepticism.[127] The first legislative implementation seems to have been the Swedish Environmental Protection Act of 1969.[128] Internationally, the first expression of the

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124. *See* CASS R. SUNSTEIN, LAWS OF FEAR: BEYOND THE PRECAUTIONARY PRINCIPLE 4 (2005) ("[R]egulators should take steps to protect against potential harms, even if causal chains are unclear and even if we do not know that those harms will come to fruition."); James Cameron et al., *Precautionary Principle and Future Generations*, *in* FUTURE GENERATIONS & INTERNATIONAL LAW 93, 98 (Emmanuel Agius & Salvino Busuttil eds., 1998) (arguing scientific data for the precautionary principle is elusive and hard to find). While it is often invoked in environmental matters, it is also routinely used more broadly in toxicological controls and workplace safety (which may of course have environmental impacts). *See* A. Wallace Hayes, *The Precautionary Principle*, 56 ARCHIVES INDUS. HYGIENE & TOXICOLOGY 161, 162 (2005) (discussing how the precautionary principle has been used to regulate benzene levels in the workplace).

125. Interestingly, the environmental risks of using massive amounts of deicing fluid have raised concerns. *See* Matthew J. Griesemer, *Welcome Aboard: Aircraft Deicing Fluid and the Environmental Epidemic It Is Causing*, 72 J. AIR L. & COMM. 727, 744 (2007) ("The time has come for the FAA to take more responsibility and regulate *exactly* which types of deicing systems are acceptable and which are not.").

126. *See* ARIE TROUWBORST, PRECAUTIONARY RIGHTS AND DUTIES OF STATES 117 (2006) (stating that the precautionary principle was designed to answer the problem of science's limited capacity to predict environmental effects coupled with a vulnerable environment).

127. INDUR M. GOKLANY, THE PRECAUTIONARY PRINCIPLE: A CRITICAL APPRAISAL OF ENVIRONMENTAL RISK ASSESSMENT 6 (2001); *see also* David Kriebel et al., *The Precautionary Principle in Environmental Science*, 109 ENVTL. HEALTH PERSP. 871, 871–73 (2001) (discussing how the precautionary principle allows for taking action in the face of uncertainty and stimulates the search for safer technologies); *supra* p. 669 and note 12 (observing the ability of technology to evolve in unpredictable ways).

128. *See* Peter H. Sand, *The Precautionary Principle: A European Perspective*, 6 HUM. & ECOLOGICAL RISK ASSESSMENT: AN INT'L J. 445, 448 (2000) (observing that the precautionary principle was first translated into law in Scandinavia with the passing of the Swedish Environment Protection Act). However, it is generally recognized that the principle developed from German environmental policy founded on the *Vorsorgeprinzip*. *See* SUNSTEIN, *supra* note 124, at 16 (noting that although the first use of a precautionary

precautionary principle appeared in the 1982 *United Nations World Charter for Nature*, which stated that when "potential adverse effects are not fully understood, the activities should not proceed."[129]

The principle was multilateralized in two specific sectors; namely, the *Treaty on the Non-Proliferation of Nuclear Weapons* (NPT) and the *Wassenaar Arrangement*.[130] Despite those adoptions into various treaties, however, it is still unsettled whether the principle has crystallized into a principle of customary international law. This uncertainty may be because formulations of the precautionary principle in international law lack uniformity.[131] In the context of the World Trade Organization (WTO) dispute-settlement system, where the compatibility of a measure based on the precautionary principle with any of the WTO Agreements may be challenged, a measure should normally reflect the majority view of the scientific community, although some leeway was granted to base the measure on the minority view in certain cases.[132]

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principle in law was the Swedish Environmental Protection Act of 1969, at the same time the *Vorsorgeprinzip*, a precursor of the precautionary principle, was forming the basis of German environmental policy).

129. World Charter for Nature, G.A. Res. 37/7, Annex, ¶ 11(b), U.N. Doc. A/RES/37/7 (Oct. 28, 1982), *available at* http://www.un.org/documents/ga/res/37/a37r007.htm. *See also* GOKLANY, *supra* note 127, at 4 (revealing that although versions of the precautionary principle started to appear in various declarations and agreements in the 1980s, its "international debut" was in the 1982 United Nations World Charter).

130. Treaty on the Non-Proliferation of Nuclear Weapons, July 1, 1968, 21 U.S.T. 483, 729 U.N.T.S. 169; *see* N. Jansen Calamita, *Sanctions, Countermeasures, and the Iranian Nuclear Issue*, 42 VAND. J. TRANSNAT'L L. 1393, 1418–33 (2009) (discussing the Nuclear Non-Proliferation Treaty and the availability of unilateral countermeasures for violations of the NPT); Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (2010), http://www.wassenaar.org/publicdocuments/index_BD.html (last visited July 27, 2010). For a discussion, see generally Jamil Jaffer, *Strengthening The Wassenaar Export Control Regime*, 3 CHI. J. INT'L L. 519, 521–25 (2002), which reviews the Wassenaar Agreement and suggests that attempts to strengthen the regime must protect national sovereignty in export decisions while still addressing the concerns of nations who choose to deny certain exports.

131. *See* David VanderZwaag, *The Precautionary Principle in Environmental Law and Policy: Elusive Rhetoric and First Embraces*, 8 J. ENVTL. L. & PRAC. 355, 368 (1998) ("Three recent cases before the International Court of Justice demonstrate the potential of the precautionary principle to affect international dispute resolution, although the cases involved 'friendly waves' at the principle, rather than wholehearted embraces of it."); *see also* Trouwborst, *supra* note 123, at 187 (recognizing the precautionary principle is contained in over sixty multilateral treaties, covering everything from fisheries to climate change, and also in a wide variety of intergovernmental declarations, resolutions, and the like).

132. *See* Appellate Body Report, *EC Measures Concerning Meat and Meat Products (Hormones)*, ¶ 16, WT/DS26/AB/R, (Jan. 16, 1998) [hereinafter Appellate Body Report] (suggesting that the precautionary principle is already a general principle of European law applying both to the management of risk as well as to the assessment of these risks). In this case, a ban on beef containing hormones was successfully challenged by the United States. *Id.* ¶¶ 1–2, 253. The Appellate Body noted that a version of the precautionary principle was part of the WTO Agreement on the Application of Sanitary and

B. Application

In determining a proper justification for regulatory interventions on inchoate technologies, the precautionary principle should be front and center because it is invoked precisely in that context: often to ban or severely restrict the use of such a technology.[133]

It is worth noting at the outset that negating the possibility of developing an inchoate technology is an extreme step and not the only possible outcome.[134] A decision to ban may result from ethical concerns, but it may lead to rogue research or simply a displacement to other jurisdictions—possibly resulting in a competitive loss measured in trade terms.[135]

Turning to the principle itself, the starting point is the recognition that inchoate technologies are unpredictable.[136] Consequently, it is often impossible to predict accurately whether such a technology (or the evolution of an existing one) will lead to net positive or negative consequences. This begs two questions: one normative and the other more operational in nature. The normative question is whether governments should try to evaluate the potential of an inchoate technology *ex ante* and ban or limit the use of technological developments they view as "mostly negative." Or should a utilitarian matrix be used and potential welfare impacts assessed? Or perhaps ethical concerns should trump trade or economic concerns? There is a (related) operational question: How can governments predict the evolution and impact of the technology independently of the analytical mask they will then superimpose on their guesswork? What

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Phytosanitary Measures (SPS Agreement), which requires that the measure be based on "available scientific evidence." *Id.* ¶¶ 121–124; Agreement on the Application of Sanitary and Phytosanitary Measures arts. 5.2 & 5.7, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1A, 1867 U.N.T.S. 493. Specifically, the Appellate Body noted that Article 5.7 [of the SPS Agreement] does not exhaust the relevance of the precautionary principle and that a panel should "bear in mind that responsible, representative governments commonly act from perspectives of prudence and precaution where risks of irreversible . . . damage . . . [is] concerned." Appellate Body Report ¶ 124.

133. "Trying to" because it may not be possible to enforce a complete ban on "clandestine" operations. And, that ban would normally apply only within the territory of the legislature adopting it.

134. Other, more common outcomes are restrictions on use and transparency (reporting).

135. One example is the now lifted U.S. ban on stem cell research. *See* Ching Pin Ang et al., *Recent Developments in Health Law*, 37 J.L. MED. & ETHICS 149, 157–58 (2009) (discussing how lifting the ban was seen as a necessary step in Michigan's bid to advance its life sciences industry).

136. *See supra* note 20 and accompanying text (summarizing various previous uses of the term "inchoate" and offering up a definition that inchoate technologies are far from completely developed).

dataset or working hypothesis will inform a ban? Because technological developments are best viewed as parts of chains of events, a ban might trigger circumventing developments with possibly worse impacts.[137] A ban might also prevent the development of highly positive technologies that may have emerged down an interrupted chain of events.

The precautionary principle consists of three elements: (1) a threat of harm; (2) uncertainty; and (3) action.[138] It is self-evident that the hardest part of this equation to solve, both theoretically and empirically, is the definition of the required degree of certainty. However, the components of this equation are also interrelated. The resulting action, which typically will be in the form of control imposed by regulation (up to a complete ban), should be proportional both to the harm and to the level of uncertainty.[139] Traditional application of the principle requires a threshold of (un)certainty to trigger the application of the principle.[140]

Precautionary-principle theorists posit that states of risk knowledge can be categorized in one of three ways: ignorance, as understood to mean uncertainty that is too great to reasonably trigger the precautionary principle; uncertainty; and certainty.[141] The precautionary principle applies only during periods of uncertainty. There is no basis or reasonable grounds to justify its use during periods of ignorance. In cases in which no substantial

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137. As the wars on music file sharing have evolved, they have prompted users to "go underground" with ever more sophisticated anonymizing technologies that, if one were to make an extreme case, terrorists might find useful. *See supra* notes 99, 112 (identifying music sharing as an example where legal codes are far removed from the social norm, thus giving individuals a reason to fight the law).

138. *See* Hayes, *supra* note 124, at 162 (simplifying the principle into a simple equation that says a call for precautionary action arises when there is scientific uncertainty plus suspected harm); Trouwborst, *supra* note 123, at 187 (breaking down the precautionary principle into three elementary components that are present in any currently existing definition of the principle).

139. *See* ALEXANDRE KISS & DINAH SHELTON, INTERNATIONAL ENVIRONMENTAL LAW 212 (3d ed. 2004) (stating that precaution requires preparation for potential, uncertain threats even if it is uncertain that the threat will occur); SUNSTEIN, *supra* note 124, at 24 (concluding that there is a presumption in favor of regulation when there is a certain threshold risk to health, safety, or the environment); Paolo F. Ricci et al., *Precaution, Uncertainty and Causation in Environmental Decisions*, 29 ENV'T INT'L 1, 5 (2003) (indicating that the absence of information forces precautionary decisions under uncertainty principles and not risk principles).

140. *See* Ricci, *supra* note 139, at 5 (suggesting that when this threshold of scientific knowledge is crossed, a public institution should provide protection despite remaining uncertainty).

141. *See* Shawn Kolitch, Comment, *The Environmental and Public Health Impacts of U.S. Patent Law: Making the Case for Incorporating a Precautionary Principle*, 36 ENVTL. L. 221, 224 (2006) (noting that the state of scientific knowledge regarding the impact of an invention generally begins with ignorance, progresses to uncertainty, and ends with certainty).

uncertainty exists—which would be rare given the unpredictable nature of technological evolution—the indeterminacy of technological impacts or future developments can probably be factored out of the equation.[142]

Once the precautionary principle is held to apply, its implementation may take many forms. Some commentators have referred to the *EU Guidelines for Application of the Precautionary Principle* as indicative of proper precautionary measures: they must be (1) proportional; (2) nondiscriminatory, such that similar situations are treated in the same manner; (3) consistent, such that they are similar to those already taken in equivalent areas; (4) comprise an examination of benefits or costs for action or lack of action, including a cost–benefit analysis when appropriate and feasible; and (5) comprise an examination of scientific developments, making it provisional and requiring continued scientific research.[143]

C. Discussion

The precautionary principle is not a perfect analytical framework for a number of reasons. First, precautionary actions themselves create risks that must also be assessed, contrary to current precautionary principle implementations.[144] Second, the precautionary principle may be paralyzing and incoherent: in its strongest forms, the precautionary principle "forbids action, inaction, and everything in between" due to the "risks on all sides of social situations."[145] Third, precautionary decisions sometimes hide trade protectionist measures.[146] Yet, the precautionary

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142. *See* Indur M. Goklany, *From Precautionary Principle to Risk-Risk Analysis*, 20 NATURE BIOTECHNOLOGY 1075, 1075 (2002) (suggesting that the objective of the precautionary principle is to ensure the outcome is "risk-neutral" and that this objective is easy to meet in certain situations). If a policy only reduces risks it should clearly be adopted, but if a policy only increases risks it should clearly be avoided. *Id.*

143. *See* Communication from the Commission of 2 February 2000 on the Precautionary Principle, http://europa.eu/legislation_summaries/consumers/consumer_safety/l32042_en.htm (last updated Feb. 11, 2005) (listing five principles of good risk management that should be applied even in the presence of the precautionary principle); Hayes, *supra* note 124, at 164 (referring to the European Commission's communication discussed above).

144. *See* SUNSTEIN, *supra* note 124, at 14 (observing that the precautionary principle has its own risks that threaten to lead to inaction); Jonathan H. Adler, *More Sorry than Safe: Assessing the Precautionary Principle and the Proposed International Biosafety Protocol*, 35 TEX. INT'L L.J. 173, 195 (2000) ("The unfortunate reality is that efforts to regulate one risk can create other, often more dangerous risks.").

145. *See* SUNSTEIN, *supra* note 124, at 4 (indicating that the precautionary principle may condone what it preaches); Adler, *supra* note 144, at 195 (suggesting that attempts to regulate inchoate technologies can themselves create risks).

146. *See* Adler, *supra* note 144, at 203–04 (discussing the European Community's 1989 ban forbidding the importation of U.S. beef produced with growth hormones as an

principle, correctly applied, is the most (and perhaps the only) coherent extant framework to justify a regulatory intervention concerning an inchoate technology.[147]

The precautionary principle is a sound basis to regulate (or not) an inchoate technology. Its focus is on safety, not on market organization. Because of its limited focus, it is also less likely to interrupt positive chains of events. Because the precautionary principle's undergirding rests on *risk*, often to human safety, it should also mesh with social norms—unlike regulation of an inchoate technology unsupported by such norms or even in direct conflict with them.[148]

VIII. PROPOSED APPROACH

A. *Principles*

The preceding analysis allows us to outline a few principles that may guide the regulatory hand trying to grasp an inchoate technology. While the principles are relatively simple, their application is not necessarily obvious.

First, changes to the techno-regulation framework must be situated within the existing regulatory continuum; notably, legacy regulation.[149] Past is, if not prologue, at least a foundation for future action, and a good historical perspective is therefore essential to adequately modify the present regulatory framework. This is needed to understand, as fully as possible, the depth and scope of any policy changes under consideration.

Second, a sound factual basis to justify a regulatory intervention is essential. Eschatological and ideological arguments must be avoided as a basis to justify any regulatory

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example of trade protectionist measures being disguised as environmental protection); Kenneth R. Foster et al., *Science and the Precautionary Principle*, 288 SCI. 979, 979 (2000) (presenting the ban on imported beef as a possible example of trade protectionism).

147. Ideology and other possible basis were discussed above. *See supra* Part III (presenting various basis for the precautionary principle and concluding with six reasons to regulate). My research has not pointed in any other convincing direction to find such a framework.

148. *See* Jennifer Kuzma et al., *Evaluating Oversight Systems for Emerging Technologies: A Case Study of Genetically Engineered Organisms*, 37 J.L. MED. & ETHICS 546, 576 (2009) (noting that when it comes to environmental health and safety, "unknowns and uncertainty are not well understood" and "[o]versight favors most conservative social norm"); *see also supra* notes 8, 112 and accompanying text (pointing out that it is a struggle to enforce legal norms when society's disapproval is absent, illustrated by attempts to curb music file sharing).

149. *See supra* Part IV (explaining the TechnoPolicy Triangle and the complexity of regulating inchoate technologies).

change in this area.[150] Industries that claim they will suffer immensely absent a change to the regulation should support their view with credible factual data, not pure speculation.[151] In the same vein, one should also avoid the risk of capture or structural conflict because of the inconsistencies in regulatory mandates.[152] Moreover, because few entirely new regulatory wheels are invented, whenever possible, comparative law techniques may be used if another country has in fact put in place a measure similar to the one under consideration.[153]

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150. For example, in the wake of the U.S. Supreme Court decision in *Feist Publications, Inc. v. Rural Telephone Service, Co.*, 499 U.S. 340, 357–60 (1991), which confirmed the rejection of the mere "sweat of the brow" test and required (on the basis of a constitutional argument) that originality in the form of minimal creativity be present to protect an actual compilation under copyright, a number of scholars and industry observers thought that the sky had fallen for database makers. *See* S. Leigh Fulwood, Feist v. Rural*: Did the Supreme Court Give License to Reap Where One Has Not Sown*? 9 COMM. LAW. 15, 19 (1991) ("[V]ast amounts of information have been ejected into the public domain, with resulting implications to all businesses for which the amassing or distribution of information is essential."); *see also* Daniel J. Gervais, *The Protection of Databases*, 82 CHI.-KENT L. REV. 1109, 1133–42 (2007) (recounting the *Feist v. Rural* decision to require creativity for copyright protection and the impact of the "*Feist* test" on factual compilations); Jessica Litman, *After* Feist, 17 U. DAYTON L. REV. 607, 607–09 (1992) (suggesting that the implications of *Feist*'s holding are indirect and sui generis protection may restore what the *Feist* decision took away). A number of bills were introduced in the 106th Congress containing such sui generis rights, including the Collections of Information Antipiracy Act, H.R. 354, 106th Cong. § 1402 (1st Sess. 1999), and the Consumer and Investor Access to Information Act of 1999, H.R. 1858, 106th Cong. (1st Sess. 1999). No bill passed, and yet the database industry seems to have survived.

151. George J. Annas elaborates:

> [Although scientists seldom like to predict the future without overwhelming data to support them, many believe that human cloning or inheritable genetic alternations at the embryo level will never be safe because they will always be inherently unpredictable in their effects on the children and their offspring. As Stewart Newman has noted, for example, it is unlikely that a human created from the union of "two damaged cells" (an enucleated egg and a nucleus removed from a somatic cell) could ever be healthy. Of course, adding genetic modification to the somatic cell's nucleus just adds another series of events that could go wrong, because genes seldom have a single function, but will usually interact in complex and unpredictable ways with other genes.

George J. Annas et al., *Protecting the Endangered Human: Toward an International Treaty Prohibiting Cloning and Inheritable Alterations*, 28 AM. J.L. & MED. 151, 157–58 (2002) (footnotes omitted).

152. Kuzma explains the importance of consulting independent experts early in product development cycles:

> It was also recommended that independent experts (free of COI), especially in environmental science, be consulted early in product development and before oversight decisions are made. Many experts agreed that oversight should be informed by those who are not conflicted. For example, for GEOs, USDA has a dual mandate to both promote U.S. agriculture and protect plant and environmental health.

Kuzma et al., *supra* note 148, at 575.

153. *See* David S. Clark, *Nothing New in 2000? Comparative Law in 1900 and Today*, 75 TUL. L. REV. 871, 881 (2001) (suggesting that one can discover general principles by studying different countries' laws).

Third, on the interventionism "scale," a high degree of caution is required when dealing with an inchoate technology, and this degree increases in proportion to the level of inchoateness—which, in turn, increases unpredictability and the ability of the technology and its users to circumvent the regulatory objective.[154] This would militate in favor of avoiding deep regulation of an inchoate technology and letting courts adapt the extant regulatory framework to the new technology because: (a) a court ruling has a smaller regulatory footprint due to its application only to the parties to the case—subject to an expansion due to the stare decisis rule; (b) a court ruling is subject to review possibly twice (typically by a court of appeal and the Supreme Court) and may be changed to reflect the impact of new technological developments; and (c) this approach is thus an incremental and generally more situated, intertemporal response than a statute applying indiscriminately to a very wide array of factual patterns.[155]

Fourth, to know the impact of a proposed regulatory change, one should try to determine unintended consequences on future chains of events. To a large degree, this is impossible to do with any precision for inchoate technologies both because by their very nature they are unpredictable and because they can react to defeat regulatory efforts.[156] It does seem, however, that one possible way to consider the consequences of a regulatory intervention is to ask what would happen if all actors did as prompted by the regulation; that is, consider the global impact.[157]

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154. *See supra* Part IV (reviewing the complexity of inchoate technologies and the quick reaction of such technologies to both market and regulation).

155. *See supra* note 31 (referring to Professor Abramovicz's arguments for simplified regulation to reduce the danger that regulations will become obsolete); *infra* note 162 (suggesting that litigation against the government regularly induces judicial policymaking and gives meaning to public values); Graeme B. Dinwoodie, *A New Copyright Order: Why National Courts Should Create Global Norms*, 149 U. PA. L. REV. 469, 476 (2000) (arguing that national courts should not be tied by strict private international law rules). Dinwoodie further suggests that national courts should be allowed to apply rules that reflect the "values of all interested systems (national and international) that may have a prescriptive claim on the outcome. This approach to choice of law may unleash the generative power of common law adjudication . . . ." *Id.* In a somewhat similar vein, Shyamkrishna Balganesh has argued that, contrary to the common law, copyright's grant of exclusivity extends to all markets and uses for a work whether or not they were capable of forming any part of a creator's incentive, and independently of whether the incentive may foreseeably function as an incentive. *See* Shyamkrishna Balganesh, *Foreseeability and Copyright Incentives*, 122 HARV. L. REV. 1569, 1614–25 (2009).

156. *See supra* note 20 and accompanying text (referring to various previous uses of the term "inchoate" and suggesting that inchoate technologies are far from completely developed).

157. An example was the introduction of an income tax deduction of mortgage in the United States. Initially designed to promote the acquisition of homes, the tax savings

Fifth, a regulatory intervention concerning an inchoate technology is more likely to miss its target and to create unintended consequences that outweigh the benefits. Absent a sound application of the precautionary principle, in the case of inchoate technologies, regulation is more akin to gambling than traditional policymaking.[158] Not only do the markets move much faster than in traditional fields, but this moving target phenomenon is amplified by the fact that an inchoate technology may provide a better solution than regulation—perhaps industry-based standards will emerge making legal regulation unnecessary at best and potentially counterproductive.[159] The speed of technological development also means that once it enters into force, regulation may, in fact, be outdated.

A final note: One must distinguish technological regulation from the regulation of actors on other grounds. For example, if a monopoly should develop in the market, this may warrant a regulatory intervention, but the target is the monopoly and the normative underpinning lies in antitrust principles.[160]

B. A Regulatory Approach for Inchoate Technologies

In trying to recap the analysis in the previous pages, the structure of an intervention model for inchoate technologies emerges. The principles to be applied are as follows:

(a) Regulatory interventions targeting inchoate technologies are more likely to miss their target than

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were fairly quickly computed into the price and house prices increased significantly, thereby offsetting any advantage the tax measure could have for prospective buyers. The law of unintended consequences is one governments may find hard to repeal. *See supra* text accompanying notes 87–90 (pointing out Jennifer Light's research on the unintended consequences of inchoate technology regulation).

158. A ban justified by the principle might be effective within certain territories. Beyond that, the risk of regulatory failure is considerable. *See* Part VI (discussing the use of technology as regulation and the difficulties of regulating an inchoate technology).

159. The Internet protocols (http, etc.) are industry-defined, with minor governmental intervention. *See* Philip J. Weiser, *The Internet, Innovation, and Intellectual Property Policy*, 103 COLUM. L. REV. 534, 543 (2003) (discussing how the government removed restrictions on the Internet in the 1990s and left it to the private sector to chart future growth).

160. Kevin Werbach explains this distinction:

> The goal of public policy in platform industries is to create optimum incentives for both the platform owner and its users. Too many restrictions on the platform would result in insufficient investment in creating an environment that would produce significant value. On the other hand, an unregulated platform monopolist may over-extract rents from the platform ecosystem.

See Kevin Werbach, *Higher Standards: Regulation in the Network Age*, 23 HARV. J.L. & TECH. 179, 185 (2009). This seems commensurate with the regulatory goal not to interrupt technological and innovation "chains of events."

other types of regulation. That risk increases with the degree of inchoateness of the technology and with the scope (breadth) of the regulation.[161] This conclusion also applies to later phases of rapid growth or change to the technology. Conversely, a stable technology subject to smaller incremental change is a better potential target. This means that smaller-scale policy determinations by agencies and courts are perhaps more situated and thus, less likely to fail; but they also may have a smaller scope, and consequently, a lesser impact. They are also more nimble and malleable;[162]

(b) Technology, especially in its early stages of deployment, reacts to the market (user demand) and regulation but has a "life of its own" (unforeseen "eureka" inventions, inventions generated by inventors not seeking market dominance, user-driven demand informed by social norms, etc.). It can morph to circumvent regulation too far askew from users' desires and the potential of the technology. Regulation may induce unintended changes in the technology that create problems equal to or worse than those identified in the original regulatory objective;

(c) Any regulatory intervention should be preceded by a thorough analysis of possible unintended consequences, including in different (though usually related) fields;

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161. As such, a form of regulation which may be less risky is to empower a regulatory agency to make smaller scale (even "case-by-case") determinations with a reduced regulatory footprint (hence the size of the risk is smaller and there is arguably a greater chance that the factual determination will result from a better understanding and acuity because of its more focused beam). *See* Edward L. Rubin, *The Regulatizing Process and the Boundaries of New Public Governance*, 2010 WISC. L. REV. (forthcoming 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1549823 (exploring the boundaries of the New Public Governance approach to regulation at both the macro and micro level and discussing its application to the commercial aviation industry).

162. Consider Rubin and Feeley's explanation of policy making within the judiciary:

> [P]olicy making inheres in the basic structure of a modern judiciary. For the foreseeable future, therefore, any discussion of litigation against the government must incorporate the fact that such litigation will regularly induce the judiciary to make public policy. Perhaps the strongest defense of this position is Owen Fiss' claim that as "coordinate branches" of government the federal courts have not only a right, but an obligation to make policy. He argues that the Constitution "creates the agencies of government, describes their functions, and determines their relationships," but that in addition it "also identifies the values that will inform and limit this governmental structure." "Adjudication," he maintains, "is the social process by which judges give meaning to our public values."

Edward L. Rubin & Malcolm M. Feeley, *Judicial Policy Making and Litigation Against the Government*, 5 U. PA. J. CONST. L. 617, 618 (2003) (footnotes omitted).

(d) Regulatory interventions that are technology specific and target an inchoate technology are suspect owing to a plethora of unintended consequences on the regulated technology itself (e.g., the regulation may force evolution down a suboptimal path) and also other technologies; and

(e) A regulatory intervention specific to an inchoate technology should be warranted by a sound application of the precautionary principle.

IX. CONCLUSION

In this Essay, I argued that certain technologies I call inchoate should be regulated differently. I am not making a normative claim about the freedom of technology. My thesis is that inchoate technologies are inherently unpredictable and thus are moving targets for regulators that sometimes react to defeat the very purpose of the regulation that targets them—especially when the use of technology that the regulator wants to prevent is supported by social norms. I do not exclude the possibility that other factors might apply, but I hope to have demonstrated that the inchoateness of a technology is a key determinant of the likelihood of success of a regulatory intervention (measuring success in this context as the degree to which the underlying policy objective was achieved).[163] Put differently, one of my aims was to demonstrate that inchoate technologies introduce a dimension into a regulatory equation that applies independently of the desired policy objective. If one accepts this proposition, even arguendo, then a model that reflects this difference is required, and this was the other aim of the Essay. While I do not purport to offer a complete model, I offer analytical conclusions and principles derived from such conclusions that a workable model should stand on.

Because the law of unintended consequences applies forcefully here and means that regulating an inchoate technology may break future, potentially positive chains of technological development, I suggested that the best, and possibly the only, applicable analytical framework to regulate inchoate technologies is the precautionary principle. My purpose is to generate a scholarly response to the proposed model with a view to developing the model further and to identifying its flaws and deficiencies. I cannot apply the model structure proposed in this

163. That said, I readily acknowledge that the factors used to define inchoateness and its various degrees require further, interdisciplinary work.

Essay to all inchoate technologies, not even to a representative array. I used copyright regulation on the Internet to illustrate some of the key points and referred to others, including a more or less choate field of science, biochemistry, and a very inchoate one, nanotechnology, in the text.[164]

Hopefully, the vast, interdisciplinary inquiry of technology regulation pitfalls outlined in this Essay will have shed light on useful questions even if the reader does not agree with the suggested answers, the method, the proposed model, or indeed the underlying analytical grid. I welcome feedback on the possible value of the model and approach.

164. *See supra* notes 20, 120 (discussing various uses of the term "inchoate" and suggesting that inchoate technologies are far from completely developed).