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Article

Reengineering Financial Market Infrastructure

David A. Wishnick†

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INTRODUCTION

Scholars often portray financial regulators as eternal followers of the private sector, ever struggling to "keep pace" with technological change. While this image captures the difficulty of regulating a dynamic industry, it also obscures central aspects of financial regulatory practice. This Article challenges the conventional depiction by highlighting and examining a practice whereby regulators catalyze efforts to transform financial market technology.

Consider one ambitious Securities and Exchange Commission (SEC) effort to enhance the supervision of stock-market trading activity. Rather than hiring more staff or writing new rules of market conduct, the SEC has ordered the New York Stock Exchange, Nasdaq, and other trading-venue operators to jointly build a massive market surveillance system called the Consolidated Audit Trail (CAT). The idea is simple, yet astounding in its scope. Expected to "ingest 58 billion trade events on a daily basis" and to cost $2.4 billion to build, the CAT is poised to become "the world's largest data repository of securities transactions." With access to this big-data behemoth, the SEC

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1. See, e.g., MICHAEL S. BARR, HOWELL E. JACKSON & MARGARET E. TAHYAR, FINANCIAL REGULATION: LAW AND POLICY 32 (2d ed. 2018) (noting the common scholarly claim that "regulators cannot keep pace" with the evolution of the financial system); Leo E. Strine, Jr., Who Bleeds When the Wolves Bite?: A Flesh-and-Blood Perspective on Hedge Fund Activism and Our Strange Corporate Governance System, 126 YALE L.J. 1870, 1959 (2017) (lamenting that section 13 of the Securities Exchange Act has "not kept pace" with financial innovation); cf. CRISTIE FORD, INNOVATION AND THE STATE: FINANCE, REGULATION, AND JUSTICE 223 (2017) (observing that regulators' fears of "fall[ing] behind" private-sector innovation contribute to a narrative that is easily "co-opted by industry actors").


3. See id. at 45,723 (requiring the development of a joint plan to "govern the creation, implementation, and maintenance of a consolidated audit trail and central repository").

4. Elizabeth P. Gray & Catherine E. Fata, Increased Use of Big Data in SEC Enforcement, 50 REV. SEC. & COMMODITIES REGUL. 145, 147 (2017); Order Approving the
believe it will be better equipped to police market manipulation and address risks posed by algorithmic trading.5

The CAT is but one example of a practice in which financial regulators seek to construct or renovate financial market infrastructure.6 Sometimes, agencies build it themselves: the Federal Reserve (Fed), for instance, owns and operates payment platforms that transmit trillions of dollars each day.7 More often, as with the CAT, agencies coerce industry actors into doing the gritty work. As shorthand, I will refer to this kind of activity as infrastructural reengineering.8 Through such efforts, agencies reshape the deep design of the financial markets’ infrastructural systems—trading platforms, payment networks, data repositories, and more—in service of policy goals and statutory mandates.9

The practice has a long history. An early reengineering attempt—a failed one—took place in 1938, with then-SEC Chairman William O. Neely.

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5. See Consolidated Audit Trail, 77 Fed. Reg. at 45,731, 45,747 (describing the utility of expanded data access when investigating market manipulation and destabilizing market events like the flash crash of May 2010).

6. Throughout the Article, when using the term “infrastructure,” I mean to denote the set of networked systems that intermediate transactions in the financial markets. For detailed background on these systems, see infra Part I.

7. See Peter Conti-Brown & David A. Wishnick, Private Markets, Public Options, and the Payment System, 37 YALE J. ON REGUL. 380, 388 (2020) (“The Fed operates multiple payment platforms that its thousands of account holders—mainly banks, government entities, and private financial utilities—use to transmit over three trillion dollars between their Federal Reserve bank accounts on a daily basis.”).

8. In describing the construction and renovation of financial market infrastructure as a kind of engineering, I am picking up a longstanding—and, in my view, evocative—usage. See, e.g., ANNELISE RILES, COLLATERAL KNOWLEDGE: LEGAL REASONING IN THE GLOBAL FINANCIAL MARKETS 131 (2011) (describing a Bank of Japan effort to “engineer” a new payment system); Joseph H. Sommer, A Law of Financial Accounts: Modern Payment and Securities Transfer Law, 53 BUS. LAW. 1181, 1197 (1998) (comparing the rules governing payment and securities transfer systems to works of civil engineering); Charles W. Mooney, Jr., Property, Credit, and Regulation Meet Information Technology: Clearance and Settlement in the Securities Markets, 55 LAW & CONTEMP. PROBS. 131, 132 (1992) (discussing “the challenges that confront . . . legal ‘engineers’” when dealing with technological change in securities market infrastructure). To clear up a potential source of confusion, the engineering I am talking about is different from the “transaction cost engineering” work done by deal lawyers. See Ronald J. Gilson, Value Creation by Business Lawyers: Legal Skills and Asset Pricing, 94 YALE L.J. 239, 255 (1984) (introducing a conception of deal lawyers as transaction cost engineers). Gilson’s idea focuses on bespoke contract negotiations, see id. at 256–58, whereas the idea I am invoking focuses on the design of completely standardized transnational systems.

9. See infra Part II.
Douglas at the helm. Recent efforts in the wake of the Global Financial Crisis of 2007–09 have completely remade the infrastructure of derivatives markets by standardizing trade data and prompting the creation of central counterparty clearinghouses. In between, infrastructural reengineering has enabled regulators to do everything from prevent securities theft to eliminate once-fearsome sources of systemic risk. Existing literature has evaluated many of these efforts and proposed new ones on a market-specific basis. This Article’s contribution is to explore the practical and theoretical lessons that can be learned by examining reengineering efforts collectively, as constituents of a general category of practice.

Specifically, the Article aims to develop the literature’s understanding of why and how regulators engage in the potentially transformative (and often costly) practice of reshaping financial market infrastructure. It focuses, in particular, on three federal financial

10. See infra Part II.B.1.
regulators that Congress has directly tasked with oversight of market infrastructure: the SEC, Fed, and Commodity Futures Trading Commission (CFTC). We know a great deal about why and how these agencies use many tools in their toolkits, from supervision to capital regulation. This Article aims to develop a similarly detailed sense of why and how regulators lead efforts to reengineer the markets’ trans-actional systems. What can regulators hope to achieve by altering the underlying “rails,” “platforms,” and “plumbing” of the financial markets? How should they go about doing so? Are there pitfalls they should avoid? In addressing these questions, the Article highlights how financial regulators engage with system transformation and technological change well outside the “pace-keeping” paradigm.

The Article’s first claim is that reengineering efforts enable financial technocrats to impose a distinctive form of control over financial activity—one that legal theorists have, in other contexts, conceptualized as “architectural regulation.” Architectural regulation refers to the way that things like speed bumps, door locks, website designs, and other durable “structures of social life” regulate behavior. Scholars

15. See, e.g., BARR ET AL., supra note 1, at 259–332 (discussing capital regulation and supervision).
16. Id. at 796 (describing payment systems as “rails”).
of financial regulation have begun to explore this idea in relation to compliance and risk-management software. I build on this literature by arguing that the devices, operating protocols, and technical standards constituting financial market infrastructure exert a similar governing force—for instance, by making certain activities more or less difficult to undertake, or more or less visible to regulatory authorities. Past and present efforts to reengineer market systems alike aim at leveraging the power of these key technologies.

To shed light on this practice, the Article begins by exploring three case studies. The first highlights the way a late-1960s change to the infrastructure of the securities markets helped prevent securities theft. The second looks at the creation of CLS Bank, a payment system that currently transmits over a trillion dollars each day and that is named for its “continuous linked settlement” operating protocol. CLS Bank is famous among lawyers for raising knotty questions of software patentability; here it illustrates how financial market infrastructure can be designed to prevent undesirable risk-taking. And the third case looks at an episode of data standardization in the credit


23. See infra Part II.

24. See infra Part II.B.1. This effort also famously sped up the securities market’s back-office processes. Cf. Wyatt Wells, Certificates and Computers: The Remaking of Wall Street, 1967 to 1971, 74 BUS. HIST. REV. 193 (2000). However, I will focus on its impact on securities theft.


27. See infra Part II.B.2.
derivatives market that was a rare bright spot in the lead-up to the Global Financial Crisis.\textsuperscript{28} Taken together, these cases show how past regulators have relied on changes to technical aspects of market infrastructure to fulfill statutory mandates from investor protection to crisis prevention.

After presenting these three examples, the Article then analyzes them to develop a sense of the comparative advantages and disadvantages of reengineering in different contexts.\textsuperscript{29} When is the practice most likely to be valuable? How should regulators go about working with, and motivating, the private sector to participate in these efforts? What kinds of tradeoffs are regulators likely to face when considering reengineering efforts? Through analysis of both substantive and procedural aspects of the practice, I sketch out answers to those questions. First, I highlight the ability of infrastructural reengineering to reduce the variable costs of regulation, remove discretion from regulatory domains, and entrench governance decisions in the design of market technology.\textsuperscript{30} Second, I discuss the conditions under which regulators should seek to coordinate industry actors in reengineering efforts and the conditions under which regulators should opt for coercive tactics.\textsuperscript{31} Finally, I consider potential systemic consequences, including the possibility that regulators deepen the problem of risk-centralization through their reengineering efforts.\textsuperscript{32}

With that framework in mind, the Article then identifies and evaluates opportunities for infrastructural reengineering efforts today.\textsuperscript{33} In particular, the Article examines how the SEC can reduce the systemic risk posed by a major infrastructural institution in the securities market;\textsuperscript{34} how the SEC should proceed on the CAT;\textsuperscript{35} and how the Fed, SEC, and CFTC can work together to enhance the range and quality of market data that inform their crisis-prevention activities.\textsuperscript{36} To seize these opportunities, regulators would be wise to draw from past episodes of infrastructural reengineering to inform the work of the present day.

\textsuperscript{28} See infra Part II.B.3.
\textsuperscript{29} See infra Part III.
\textsuperscript{30} See infra Part III.A.
\textsuperscript{31} See infra Part III.B.
\textsuperscript{32} See infra Part III.C.
\textsuperscript{33} See infra Part IV.
\textsuperscript{34} See infra Part IV.A.1.
\textsuperscript{35} See infra Part IV.A.2.
\textsuperscript{36} See infra Part IV.A.3.
Taken as a whole, the Article’s account supplements prevailing paradigms about who leads efforts to integrate new technologies into the financial sector. The predominant mode of scholarship casts private actors as potentially creative (and unruly) innovators and financial regulators as under-resourced (and often hapless) technocrats who must deal with what the innovators have wrought. This frame captures some of our present reality, but it lacks a place for the regulator-led practice of infrastructural reengineering. By shining a light on the ways that the Fed, SEC, and CFTC affirmatively reshape financial market infrastructure, the Article joins a burgeoning body of scholarship examining how the financial regulatory state is not just a follower but also a leader in the process of updating financial technology.

The Article also contributes to scholarly understandings of the financial sector’s increasingly blurry public-private divide. The task


of financial regulation is inevitably a “collaborative, cooperative enterprise” operating across that boundary, albeit sometimes a fraught one. This Article shows the design of financial market infrastructure to be a key product of the collaboration.

The Article proceeds as follows. Part I takes the reader on a quick tour of financial market infrastructure—the systems that are the objects of reengineering efforts. Part II presents three case studies of infrastructural reengineering, illuminating how the practice enables regulators to control financial activity at the level of system design. Part III develops a framework for analyzing where reengineering is likely to be most useful, distilling a set of guiding principles for future reengineering efforts. With those principles in hand, Part IV suggests efforts that regulators should prioritize and reevaluates the government’s role within broader discourse about innovation in the financial markets.

I. A QUICK TOUR OF MARKET INFRASTRUCTURE

To set the stage for the Article’s analysis of the promise and perils of public-private reengineering efforts, this Part provides background on the systems being reengineered. Earlier, I described these systems in metaphorical terms—as the “rails,” “platforms,” and “plumbing” of finance. These metaphors are useful because they point to the essential roles played by market infrastructure. They also hint at the importance of standardization in making market infrastructure work. But the metaphors can only take us so far. In the field of financial regulation, “infrastructure” is a term of art, and, unlike physical rails or plumbing, some readers may lack an intuitive sense of what the

41. See supra notes 16–18 and accompanying text.
42. The importance of standardization to financial markets is an old idea. See René Demogue, Analysis of Fundamental Notions, in MODERN FRENCH LEGAL PHILOSOPHY § 262, at 471, 471–73 (Ethel Clara Forbes Scott & Joseph P. Chamberlain trans., 1916) (discussing the forces militating in favor of “making transactions rapid” through the use of “simple formalities”—a technique “peculiarly well adapted to a world of the initiated, such as stockbrokers, merchants, or investors”). The treatment of standardized financial systems as a kind of machine, however, is a new one. See Margaret Jane Radin, Online Standardization and the Integration of Text and Machine, 70 FORDHAM L. REV. 1125, 1138 (2002) (arguing that “the digital revolution is bringing about a seismic shift in our conceptual landscape, [namely] . . . the breakdown of the distinction between text and technology, or between expression and functionality, or between words and machine”); see also Shaanan Cohney, David Hoffman, Jeremy Sclaroff & David Wishnick, Coin-Operated Capitalism, 119 COLUM. L. REV. 591 (2019) (exploring this merger of text and machine through a study of smart contracts).
infrastructural systems of the financial markets do. For that reason, it will be useful to take a quick tour of their operations. Those who already possess knowledge of financial market infrastructure should skip to Part II.

A. TRADING VENUES

Our tour begins with the most prominent infrastructural institutions in the markets—trading venues. These are the sites where market participants enter into contracts to exchange money for other financial assets.\(^{43}\) As the digital age has progressed, trading venues have transmuted from physical marketplaces—iconic locations like the floor of the New York Stock Exchange (NYSE) or the octagonal pits of the Chicago Board of Trade—into online platforms.\(^{44}\) Today, the floor of the NYSE mostly serves as a television set for CNBC’s financial news coverage.\(^{45}\) Unlike the shouts and gestures of the people who populated the physical trading venues in their heyday, activity in the online venues is barely seen and never heard.\(^{46}\) But in all cases, market participants seek to trade where a critical mass of other traders gather and where prices best reflect something like “true” supply and demand.\(^{47}\)

To transact with each other, traders rely on the legal and technical aspects of platforms like the NYSE. The key legal features are membership rules (who can participate in trading), conduct rules (how participants must behave), and the private enforcement apparatus backing up those rules.\(^{48}\) The key technical features are


\(^{44}\) For detailed analysis of this shift, see Caitlin Zaloom, *Out of the Pits: Traders and Technology from Chicago to London* (2006).


\(^{46}\) See Zaloom, supra note 44, at 148, 157 (describing the din of the trading floor and the silence of electronic trading desks).

\(^{47}\) See, e.g., Macey & O’Hara, supra note 43, at 568–69.

standardized communication protocols that mediate exchange.\(^{49}\) In other words, trading platforms, like every infrastructural institution we will see on this tour, comprise private membership and conduct rules, devices, and operating rules that enable parties to transact with each other.\(^{50}\) These systems necessarily involve "a combination of human practices and technological materials."\(^{51}\) And as we shall see, the technologies and protocols used to mediate transactions govern market participants just as surely as traditional rules and regulations do.\(^{52}\)

Though this Article focuses on regulatory leadership of reengineering efforts to harness that governing power, regulators certainly are not the only potential leaders on the scene. Private actors have driven electronification in the stock market, for instance, where a growing set of electronic communications networks and "dark pools" now compete with the NYSE and Nasdaq.\(^{53}\) Private innovation is always ongoing, and it serves as the backdrop to the regulatory efforts explored below.

**B. POST-TRADE SYSTEMS**

Trading is only the first step in a successful transaction. After parties make a trade, they must perform in accordance with their

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49. See, e.g., Macey & O’Hara, supra note 43, at 590 (describing the way that “technology . . . determines [the] operational efficiency of trade processing and trading capacity” for any given venue).

50. In the field of commercial law, the idea of transactional “systems” has been used to characterize the structures in question. See Lynn M. LoPucki, Elizabeth Warren, Daniel Keating, Ronald J. Mann & Robert M. Lawless, Commercial Transactions: A Systems Approach, at xxxix, 359 (6th ed. 2016) (describing transactional systems as comprising "not only abstract legal rules, but also people who engage in commercial transactions, contracts that are designed to guide those transactions, and physical tools that facilitate those transactions"). At a higher level of generality, these systems are just a particular kind of institution that relies on what David Grewal has called "network standards." See David Singh Grewal, Network Power: The Social Dynamics of Globalization 20–22 (2008) (defining a network standard as a “shared norm or practice that enables network members to gain access to one another, facilitating their cooperation").

51. Zaloom, supra note 44, at xi.


53. See, e.g., Fox et al., supra note 13, at 191; Donald C. Langevoort, Information Technology and the Structure of Securities Regulation, 98 HARV. L. REV. 747 (1985) (addressing the implications of electronic systems and computer technology on the securities regulatory regime).
contractual promises. Though the post-trade process is entirely “un-" glamorous,” the systems that handle it are essential to financial markets.54

Post-trade systems may be divided into four categories of functionality: clearing, settlement, payment, and reporting. To keep things simple, this Part walks through each function as it plays out in the stock market. The basic concepts are similar, if not exactly the same, in other markets.55

**Clearing.** After trades are made, they are cleared. Clearing refers to the process through which traders’ obligations to each other are verified and computed.56 For instance, imagine that Dealer A sells Apple stock to Broker B through a Nasdaq trading venue. After the trade is made, Nasdaq will report the trade in a standardized data format to an institution called the National Securities Clearing Corporation (NSCC).57 The NSCC clears nearly every trade that takes place in the public stock market.58 First, the NSCC vets and validates the trade information it receives. Then, in a legal act called “novation,” it places itself between sellers and buyers.59 In our Apple example, Dealer A would owe stock to the NSCC, and Broker B would owe cash. The NSCC would, in turn, owe cash to Dealer A and stock to Broker B. This function earns the NSCC the moniker of central counterparty clearinghouse; it becomes “the seller to every buyer and the buyer to every seller.”60 The clearinghouse is a conduit every bit as important as the trading venue itself.

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58. See id. at 1607.

59. See id. at 1575.

60. See RUBEN LEE, RUNNING THE WORLD’S MARKETS: THE GOVERNANCE OF FINANCIAL INFRASTRUCTURE 22 (2011). This insulates Dealer A and Broker B from the risk of each other’s defaults—but not, of course, from the risk that NSCC itself defaults.
Settlement. After a trade is cleared, it is settled. Settlement refers to the process by which securities, commodities, or money are ultimately transferred. In the securities markets, settlement used to involve handing over gilt-edged securities certificates. But no longer. Today, nearly all corporate securities certificates are held on the shelves of an institution called the Depository Trust Company (DTC). The DTC is a large safekeeping and bookkeeping operation for the securities markets. To settle securities trades, the NSCC computes them and then instructs the DTC to update its books regarding who owns an entitlement to the securities in the storehouse. These updates are conducted after periodic netting of transactions: if Dealer A both buys and sells Apple stock throughout the day, it will only owe (or be owed) a single net amount.

Payment. Finally, in exchange for the securities transfers made on the books of the DTC, securities market participants must make payment to the NSCC, and the NSCC must make payments to participants. These are not made by sending a courier across town with a pile of greenbacks or a paper check, though they used to be. Instead, at the end of each day, after netting of monetary obligations, each market participant (Dealer A, Broker B, and so on) makes or receives a single payment to or from the NSCC.

Reporting. The final category of the post-trade system records and distributes data about market activity. The CAT project described

61. See PFMI, supra note 56, at 155 ("Settlement of a trade involves the final transfer of . . . securities . . . to the buyer [delivery] and the final transfer of funds . . . to the seller [payment].").
63. See, e.g., Geis, supra note 13, at 229.
64. See Mooney, supra note 8, at 136–38.
66. The Continuous Net Settlement System, DTCC, https://www.dtcc.com/clearing-services/equities-clearing-services/cns [https://perma.cc/ZGK3-PL9J] (stating that the NSCC’s Continuous Net Settlement system “settles trades from the nation’s major exchanges, markets and other sources and nets these transactions to one security position per Member per day”).
67. See generally NAT’L SEC. CLEARING CORP., supra note 65.
68. See Conti-Brown & Wishnick, supra note 7, at 390.
69. This is done over the Federal Reserve’s large-value payment system, Fedwire. See NAT’L SEC. CLEARING CORP., supra note 65, at 190, 274–75. For background on Fedwire, see Conti-Brown & Wishnick, supra note 7, at 401.
in the Introduction is one prominent example.\textsuperscript{70} Efforts to create similar reporting systems have proceeded across the financial markets in recent years, and enthusiasm is on the rise.\textsuperscript{71} These systems are valuable not only because they keep market participants informed of crucial information about market conditions, but also because they help regulators detect and respond to problematic conduct.\textsuperscript{72}

Post-trade processes may not be as exciting as the trading activity depicted in popular culture as the core of financial markets, but they are every bit as essential. The financial default or operational breakdown of any one of the major post-trade systems in the financial markets would spell disaster for the financial system as a whole.\textsuperscript{73} Under the Dodd-Frank Act of 2010, federal regulators have declared eight of them to be “too big to fail” and are working to ensure that they remain resilient.\textsuperscript{74}

How do regulators go about that work? Much of it happens through well-studied methods like corporate governance mandates and regulatory monitoring.\textsuperscript{75} But regulators can also change the post-trade process and its underlying technologies at the level of design. The next Part offers detail on such efforts.

II. REGULATING BY REENGINEERING INFRASTRUCTURE

What can regulators achieve by reengineering financial market infrastructure? One obvious set of goals falls under the umbrella of efficiency.\textsuperscript{76} Indeed, efficiency has long been an objective of

\textsuperscript{70} See supra notes 2–5 and accompanying text; discussion infra Part II.B.1.

\textsuperscript{71} Much of this enthusiasm relates to the goal of crisis prevention. See infra Parts II.B.3, IV.A.3.

\textsuperscript{72} See Ferrarini & Sagato, supra note 55, at 583 (explaining that reporting systems “make the relevant market more transparent, providing regulators with information on relevant transactions, and market participants with aggregated data on concluded deals”).


\textsuperscript{76} Under the efficiency umbrella, one goal is Coasean transaction-cost reduction. Cf. Adam J. Levitin, Priceless? The Economic Costs of Credit Card Merchant Restraints, 55 UCLA L. REV. 1321, 1324 (2008) (calling payment costs “the ultimate transaction cost”).
infrastructure design. But this Article’s focus is different. It concerns not how infrastructure design can make financial markets more efficient, but rather how it can support efforts to regulate harmful and risky financial activities.

A. THE ARCHITECTURE OF TRANSACTIONAL PLATFORMS

The relationship between financial market infrastructure design and the regulation of undesirable financial activities is perhaps not obvious. Most thought on how to regulate market activity centers on human actors: the rule-writers, supervisors, compliance officers, norms-entrepreneurs, and gatekeepers who govern the financial sector through their actions. But sometimes, regulation does not rely only on supervisors and gatekeepers: it relies on cameras and gates. I argue that the design of financial market infrastructure exerts a governing force on market behavior akin to a set of cameras and gates. This force makes reengineering a valuable tool in the financial regulation toolkit.

To elucidate the regulatory role played by infrastructure design, it is useful to draw on work in legal theory dealing with what Lawrence Lessig has characterized as society’s “architecture”—the durable environments within which action takes shape. The animating insight of this work holds that society's architecture governs behavior alongside other, better-studied forces and therefore deserves to be taken seriously as a kind of clandestine regulator. The particular methods through which architecture governs behavior are quite different from its peers. While law classically works through conduct rules backed by state violence, norms work through social sanction, and markets work through prices, architecture governs by “creating the parameters of action” in the first place. Seeing how it operates alongside those other regulatory forces reveals its surprising power.


77. See generally BARR ET AL., supra note 1 (providing a survey of the field).
78. See generally Lessig, supra note 20.
79. See generally Lessig, supra note 20.
80. See generally Lessig, supra note 20.
To fix the conceptual differences between the forces, consider how each of them governed market participants in the trading pits at the Chicago Board of Trade circa the turn of the millennium. Participants’ entry to the pits was governed by market forces (the price of a seat) and law (membership rules).82 Once inside, their behavior was governed by more law (conduct rules)83 and by norms (reciprocity, retaliation).84 Crucially for our purposes, it was also governed by multiple types of Lessigian architecture. Straightforwardly, the octagonal, bowl-shaped design of the pit created a kind of panopticon for traders.85 This design made most on-site actions visible to market participants and regulators alike and thereby disciplined traders’ behavior.86 Less straightforwardly, the protocols used to communicate and memorialize deals also constituted a kind of Lessigian architecture. These included an open-outcry method of establishing trades and carbon-copy memorialization cards to be processed by legions of clerks.87 Each of these elements affected the trading environment, determining who could deal with whom easily, how quickly trades could be made, what information was reliable or less reliable, and who saw what. In the words of Caitlin Zaloom, those elements combined to “define the actions that [could] happen” at the Chicago Board of Trade and also “define[d] the actions that . . . must happen there to produce successful deals.”88 They regulated action by constituting the very environment in which it could be conducted.

To describe a physical trading pit circa 1999 is, of course, to imply that market technology can be reengineered. By now, physical buildings and paper transactional systems have been near-completely replaced by cyberspace architecture—what Lessig called “West Coast code.”89 Private interests often drove that reengineering process. But in the cases that follow, public regulators played leading roles.

83. See id. §§ 500–590.
84. See Zaloom, supra note 44, at 99–100.
86. See id.; cf. Bernard E. Harcourt, The Illusion of Free Markets: Punishment and the Myth of Natural Order 1–33, 180 (2011) (characterizing the Chicago Board of Trade as a “disciplinary mechanism” and reflecting on the role of market surveillance in creating the conditions for disciplined behavior).
87. See MacKenzie, supra note 85, at 58, 61.
B. Three Examples

1. The DTC: Structural Constraints on Securities Theft

Law and regulation prohibit many forms of market misconduct, from price manipulation to insider trading.\(^{90}\) Usually, these prohibited acts are deterred by public enforcement and quelled by corporate compliance efforts.\(^{91}\) But sometimes, the design of financial market infrastructure can also prevent them. To illustrate this possibility—and to introduce the role of regulators in affirmatively pursuing it—this Part considers a multi-decade SEC effort to constrain brokers and clerks from stealing customers’ securities.

When the SEC was formed in 1934, and for more than three decades thereafter, Wall Street operated a "paper-based system of securities transfers."\(^{92}\) Because the possession of paper certificates was evidence of securities ownership, these certificates had to be physically transferred, "pass[ing] from seller to buyer like the deed to a house or title to a car."\(^{93}\) This system made it surprisingly easy for brokers and clerks to misappropriate customers’ securities.

The problem first came into public view in 1938 with a "shocking" Wall Street scandal.\(^{94}\) In this scandal, a former president of the NYSE named Richard Whitney was caught using his customers’ securities to serve as collateral for his own loans.\(^{95}\) He was able to commit this act—a felony, for which he went to prison—because of his near-unilateral control over customers’ certificates.\(^{96}\)

\(^{90}\) See 15 U.S.C. §§ 78i–78j (prohibiting various forms of securities manipulation).


\(^{92}\) James Steven Rogers, Policy Perspectives on Revised U.C.C. Article 8, 43 UCLA L. Rev. 1431, 1447 (1996).

\(^{93}\) Geis, supra note 13, at 232; see also Charles W. Mooney, Jr., Beyond Negotiability: A New Model for Transfer and Pledge of Interests in Securities Controlled by Intermediaries, 12 CARDOZO L. Rev. 305, 307 (1990) (describing the ways in which the commercial-law regime applicable to securities at the time was "cut from the familiar fabric of property law").

\(^{94}\) Malcolm MacKay, Impeccable Connections: The Rise and Fall of Richard Whitney 11 (2011); see also id. (quoting the society column of the New York Daily News as stating, “Not in our time, in our father’s time, nor in our grandfather’s time has there been such a social debacle”).


In response to the Whitney scandal, then-SEC Chairman William O. Douglas proposed a comprehensive reengineering of Wall Street’s system for securities clearing and settlement. His plan called for the development of a “brokers’ trust company,” which would centralize all settlement activities. The institution Douglas envisioned looked, in many ways, like the modern-day DTC, described above in Part I.B. Though Douglas simultaneously pushed for legalistic reforms to curb abuses—heightened oversight responsibilities for the NYSE, increased enforcement efforts by the SEC—it was the infrastructural proposal that Douglas most favored. His SEC argued that the physical separation of brokers from customers’ securities would “obviate the need” for much regulation because, as he put it, the very structure of the system would “reduce or eliminate” the risk of Whitney-style theft. Douglas’s SEC pushed hard for industry adoption of the proposal, but the effort went dormant once Douglas was appointed to the Supreme Court.

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97, 113–17 and accompanying text (describing the importance of the paper certificate to securities theft).


98. Id. Indeed, the central institution Douglas proposed went even further; in his sketch, it would control all “receipts and deliveries of securities, receipts and payments of cash, the obtaining of credit for security purchases, [and] clearing of securities.” Id. at 177 (internal quotation marks omitted). This idea had technical and institutional components. At the technical level, the trust institution would enact a physical separation between brokers and their customers’ assets and rely on book-entry registration procedures. See SEC, Draft Report on New York Stock Exchange Regulation Following the Failure of Richard Whitney & Co. 14 (1938), http://www.sechistorical.org/collection/papers/1930/1938_0921_SECWhitneyT.pdf [https://perma.cc/7CA7-9MQJ] (describing how the trust idea would undermine “the freedom with which customers’ money and securities can be used by the broker for his own purposes” by separating the broker from them entirely). At the institutional level, the trust would be structured to ensure dutiful care of those assets and would also simplify the transactional and bookkeeping activities involved in clearing and settling trades. See 1 SEC, In the Matter of Richard Whitney et al., Report on Investigation 172 (1938) [hereinafter SEC Whitney Report Vol. 1] (describing reductions of transaction-cost “overhead,” costs of resolving broker-dealer bankruptcies, and the “safeguards” attendant to the trust as an entity form).

99. See Seligman, supra note 97, at 163–72 (describing proposed reforms to NYSE rules and public regulations).

100. SEC Whitney Report Vol. 1, supra note 98.


The SEC returned to Douglas’s idea for a centralized trust institution in the 1960s, most famously to cut the transaction costs associated with rising trading volumes, but also in part because it could help curb securities theft at the level of architecture.

Securities theft had become an increasing problem in the late 1960s because of an episode known as the "Paperwork Crisis." Trading volumes were swiftly rising on the stock market; so much stock was being traded that the paper-transfer system simply broke down. Brokers’ back-office operations could not “locate, process, and move certificates fast enough” to keep up with the pace of trading. The NYSE began closing on Wednesdays to focus on paperwork, but even this stopgap was not enough. Brokerage firms increasingly failed to honor their settlement commitments to each other. As the paper piled up, accounting discrepancies and outright thefts of certificates mounted. In particular, organized crime operations began exploiting the “chaos” of the Paperwork Crisis “to dip into the securities till.” All told, securities worth over $400 million were stolen in 1969 and 1970 alone. Due to all this, many brokerage firms were nearing or falling into insolvency, and something had to give.

What gave was the old, paper-based settlement system. In its place, the SEC prodded Wall Street’s leading firms to develop the DTC. Later, this Article will discuss the tactics that the SEC used to lead the reengineering effort. But for now, it is important to focus on what the SEC aimed to achieve. In addition to speeding up the settlement process (something again on the table today), the effort aimed to make securities heists much more difficult to carry out.

103. See generally Wells, supra note 24 (describing the Paperwork Crisis).
104. See id. at 200–07.
105. Id. at 203.
106. See id. at 204, 207–08.
107. See id.
109. Rustin, supra note 108.
111. See Wells, supra note 24, at 203–07.
112. See infra text accompanying notes 252–57.
The effort illustrates the value of architectural regulation in the financial sector. It was well-known at the time that organized crime operations were exploiting the paper-based settlement system; as a result, reducing the use of paper certificates could help undermine those preconditions.\(^\text{114}\) This is exactly what the DTC reengineering effort achieved. As one insider explained to Congress in 1973, the DTC design "reduce[d] the chance for securities theft and counterfeiting operations" in multiple ways.\(^\text{115}\) First, it "reduce[d] the number of locations in which securities [we]re held," resulting in "fewer locations to guard and examine."\(^\text{116}\) Second, it "reduce[d] the number of securities movements . . . necessary to transact business," resulting in "fewer shipments of securities to guard and examine."\(^\text{117}\) Third, it "reduce[d] the physical size of the inventory that [wa]s necessary to transact securities business," resulting in "fewer [certificates] . . . to guard and examine."\(^\text{118}\) In essence, the DTC's operational design itself curbed the ability of insiders to steal customers' securities.

In this way, the DTC functions as what one theorist of architectural regulation, Edward Cheng, has called a "structural constraint." Structural constraint exists wherever architecture "prevent[s] undesirable activity in the first place by making it more difficult" or impossible to undertake.\(^\text{119}\) In the realm of the built environment, structural constraints are everywhere. From guardrails that prevent traffic collisions to bank vaults that prevent robberies, physical architecture controls what is possible or impossible, difficult or easy within an environment.\(^\text{120}\) The same is true of the code-defined architecture of cyberspace, which enables and disables various forms of online


\(^\text{116}\) Id.

\(^\text{117}\) Id.

\(^\text{118}\) Id. at 556–57; see also id. at 623 (statement of Donald L. Calvin, Vice President, New York Stock Exchange) (stating that the DTC "reduces both the opportunity for theft and the possibility of loss").

\(^\text{119}\) Cheng, supra note 21, at 664.

\(^\text{120}\) Cf. Neal Kumar Katyal, Architecture as Crime Control, 111 Yale L.J. 1039, 1067–68 (2002) (discussing bank design). The fact that structural constraint is effective says nothing, of course, of whether a particular constraint ought to be celebrated or condemned. See, e.g., Schindler, supra note 20 (showing how urban built environments in the United States are replete with structural constraints that wrongfully segregate and exclude citizens from civic life).
interaction.\textsuperscript{121} No matter where one looks, architecture in this broad sense—the durable elements of "the world as [we] find it"—creates the conditions of social possibility and also operates as a form of social control.\textsuperscript{122} Here, it shows up in a system for securities holding and settlement.

2. CLS Bank: Network Architecture and Settlement Risk

Strategic risk-taking is at the very core of financial activity. But not all risk-taking is socially beneficial. In particular, one class of risks—systemic risks—are potentially harmful to public welfare because they threaten to undermine the stability of the financial system.\textsuperscript{123} To rein them in, financial regulators can use a range of approaches. They might forbid certain firms from participating in certain financial markets, or they might prohibit certain financial products from being bought and sold in the first place.\textsuperscript{124} But as with plainly wrongful securities theft, regulators can also turn to the design of financial market infrastructure.

To show how financial risk-taking can be constrained by infrastructure design, this Part describes the construction of an international payment system, called CLS Bank, and the role of the Federal Reserve in making it happen.

Foreign exchange markets enable participants to trade one currency for another. The rise of today’s high-volume, telecommunication-based foreign exchange market began in the early 1970s.\textsuperscript{125} But, as with the stock market situation described in Part II.B.1, back-office

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\textsuperscript{121} See, e.g., LESSIG, supra note 89; Christopher S. Yoo, Modularity Theory and Internet Regulation, 2016 U. ILL L. REV. 1, 47–48 (evaluating how the Internet Protocol suite both favors and disfavors different potential Internet applications).

\textsuperscript{122} Lessig, supra note 20, at 663.


\end{flushright}
settlement practices for foreign exchange were not well-matched to the pace of growth in front-office trading.126

The first signs of serious design problems arose when losses by a now-infamous market participant, the high-risk Bankhaus Herstatt of Cologne, West Germany, plunged the bank into insolvency.127 When it failed, Herstatt had a huge volume of "open" foreign exchange transactions.128 For instance, its U.S. correspondent, Chase Manhattan Bank, had received currency from Herstatt’s counterparties for a day’s worth of trades, but—to the tune of $3.3 billion in today’s dollar-equivalents—had conservatively refused to make the quid pro quo payments.129 Banks exposed to losses from Herstatt’s defaults scrambled to avoid defaulting on their own obligations, and the market as a whole suffered a contraction of short-term credit.130 Even once the

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126. To clear and settle their foreign exchange transactions in the early 1970s, dealers active in the market would contract with a network of correspondent banks with access to the major wholesale payment systems for each of the currencies they traded. See Kurt H. Nadelmann, Rehabilitating International Bankruptcy Law: Lessons Taught by Herstatt and Company, 52 N.Y.U. L Rev. 1, 3, 5 n.23 (1977) (describing Herstatt’s local correspondent relationships). In essence, a promise of delivery of dollars on the books of the Federal Reserve would be consideration for a promise of delivery of yen on the books of the Bank of Japan or pounds on the books of the Bank of England. These would be effectuated via payments on each country’s local large-value payment system to the correspondents. See id.


128. See Mourlon-Druol, supra note 127, at 316.

129. See Schenk, supra note 125, at 1139 (stating that Chase "was caught with about $620m of transfers due to customers on account of Herstatt"); CPI Inflation Calculator, U.S. Bureau of Labor. Stat., https://www.bls.gov/data/inflation_calculator.htm (last visited Apr. 11, 2021) (used to calculate the value of $620 million June 1974 dollars in terms of February 2021 dollars). For the upshot of one counterparty’s grievances, see Delbrueck & Co. v. MRS. Hanover Tr. Co., 609 F.2d 1047 (2d Cir. 1979).

130. See generally Richard Herring, The Challenge of Resolving Cross-Border Financial Institutions, 31 Yale J. on Regul. 853, 863–64 (2014) ("Herstatt also made clear that the impact of the failure of even a small bank can be amplified if it interrupts an important clearing and settlement process. In this case, the dollar/deutsche mark market, at the time the largest foreign exchange market in the world, came to a virtual halt..."
acute panic subsided, sorting out who owed what to whom was herculean work for the bankruptcy courts, and the confusions surrounding it prompted attempts at reform.131

But despite international regulatory attention, settlement risk continued to create problems throughout the last quarter of the twentieth century. In 1990, when leading Wall Street investment bank Drexel Burnham Lambert Group filed for bankruptcy, many parties ceased patterns of regular transacting out of fear they would be stuck in essentially the situation of Herstatt’s uncompensated counterparties.132 And a year later, in 1991, the liquidation of the Luxembourgian Bank of Commerce and Credit International left several of its foreign exchange counterparties in the United States, the United Kingdom, and Japan uncompensated in open foreign exchange transactions.133 Regulators, including the Federal Reserve, increasingly searched for new ways to risk-proof the foreign exchange settlement system.

The push gained force in 1996 when an international consortium of regulators called the Committee on Payment and Settlement Systems announced a position that central banks like the Fed should take affirmative measures to “induce private sector progress” in reducing settlement risk.134 Some of these measures were traditional, nuts-and-bolts risk regulation. For instance, regulators imposed “tough risk control” rules and standards backed by the threat of legal sanctions.135 But they also pushed the leading international participants in the foreign exchange market to build a new payment system that met the regulators’ specifications.

The result was a major international success: a technologically advanced system that eliminated Herstatt risk entirely for those who

for more than a month until the authorities and the New York Clearing House could restore confidence.”).

131. See generally Schenk, supra note 125 (describing the bankruptcy cases and the Herstatt crisis’s role in prompting financial regulatory reforms, including the founding of the Basel Committee on Bank Supervision).

132. See Herring, supra note 127, at 105–07.


use it.\textsuperscript{136} The system is called CLS Bank, for its "continuous linked settlement" technology. It reveals how infrastructure design can obviate certain forms of financial risk-taking.

CLS Bank transforms the previously risky business of foreign exchange settlement into a process where settlement risk has been eliminated. It does so first through a fundamental change to the foreign exchange network topology. Because CLS Bank itself holds accounts at the Fed and sixteen other central banks in countries where its members trade currency, it acts as the central payor and payee for every foreign exchange transaction that its members undertake.\textsuperscript{137} Second, in addition to being central payor and payee, CLS Bank also is designed to render unfunded transactions impossible within its software.\textsuperscript{138} As a result, each transaction is settled on a "payment versus payment" basis.\textsuperscript{139} This design completely eliminates the risk of the one-way delivery that accompanies Herstatt-style transactions.\textsuperscript{140}

3. The Fourteen Families: Visibility and Counterparty Risk

In addition to imposing structural constraints on undesirable behavior and reorganizing network topology, reengineering efforts can also affect what types of information are visible within firms, horizontally across markets, and vertically by regulators. The major determinants of visibility are not limited to disclosure rules and supervisory powers; they also include the data standards and technologies

\textsuperscript{136} See CLS GRP., INTRODUCTION TO CLS 4 (2015), https://www.newyorkfed.org/medialibrary/media/banking/international/14-CLS-2015-Kos-Puth.pdf (https://perma.cc/R96E-WYRK) (stating that CLS Bank was "created as a result of regulatory concern regarding the potential for FX settlement risk to be a major source of systemic risk").

\textsuperscript{137} See David Humphrey, Payments and Payment Systems, in THE OXFORD HANDBOOK OF BANKING 423 (Allen N. Berger, Philip Molyneux & John O.S. Wilson eds., 2d ed. 2015) ("CLS is open simultaneously, in all the countries whose currency it trades, for approximately five hours during the day with final settlement through CLS accounts it holds with the central banks of the traded currencies. Member banks each have a multicurrency account with CLS and make payments into these accounts to cover the trades they wish to make. The trades are transacted by simultaneously debiting the account of the bank in the currency being sold, and crediting the account of another bank in the currency being purchased. Trades take place if, and only if, both sides of the trade successfully complete all the requirements of the payment.").


\textsuperscript{139} Id. at 197.

\textsuperscript{140} Id; see also David F. DeRosa, Sponsored Transactional Patterns: Comments on Mehring's Essential Hybridity: A Money View of FX, 41 J. Compar. Econ. 364, 366 (2013) (describing the resulting payments as "better than gold").
employed to organize and distribute information about market activity in the first place.\textsuperscript{141} These elements of the financial markets’ West Coast code have gained prominence in the wake of the Global Financial Crisis, and they present an important frontier for regulatory leadership in the future.

To understand why, consider an episode involving the credit derivatives markets. While the legal literature contains much engagement with post-Global Financial Crisis mandatory central counterparty clearing,\textsuperscript{142} this episode comes from the pre-Crisis era. As students of the Crisis well know, these markets were burgeoning prior to 2008.\textsuperscript{143} But their post-trade systems remained stuck in the 1990s. In a typical pre-Crisis credit default swap transaction,\textsuperscript{144} two parties to a trade handled all post-trade processes bilaterally.\textsuperscript{145} Until 2005, traders and their clerks still recorded their agreed-upon transactions by hand and faxed them to their counterparties.\textsuperscript{146}

As the market grew, the back-office state of affairs worsened. For a large set of derivatives trades, parties left those faxed details unconfirmed for months at a time.\textsuperscript{147} Parties were left in the dark about the assignment of their trades to third parties.\textsuperscript{148} In the event of insolvency of one of the major market participants—and there would be

\begin{itemize}
\item \textsuperscript{141} On the role of data standards in financial regulation, see Richard Berner & Kathryn Judge, \textit{The Data Standardization Challenge}, \textit{in Systemic Risk in the Financial Sector: Ten Years After the Great Crash} 135 (Douglas W. Arner, Emílios Avgouleas, Danny Busch & Steven L. Schwarz eds., 2019).
\item \textsuperscript{143} See, e.g., Anupam Chander & Randall Costa, \textit{Clearing Credit Default Swaps: A Case Study in Global Legal Convergence}, 10 Intl’l L. 639, 640 (2010) (“When the credit crisis struck in the fall of 2008, there were $57$ trillion in outstanding notional amount of CDS. In each of the preceding three years, the amount of CDS had nearly doubled. In 2004, positions in CDS stood at $4.5$ trillion.” (footnotes omitted)).
\item \textsuperscript{144} “In simple terms, a credit default swap is a promise by one party to pay another party in the event that a third party defaults on its debt.” Jeremy C. Kress, \textit{Credit Default Swaps, Clearinghouses, and Systemic Risk: Why Centralized Counterparties Must Have Access to Central Bank Liquidity}, 48 Harv. J. on Legis. 49, 52 (2011). The promisor is known as a “protection seller,” and the promisee is known as a “protection buyer.” \textit{id.} Over the course of the transaction, the protection buyer makes periodic payments to the protection seller, who bears the risk of owing the buyer a lump payment in the event of third-party default. \textit{Id.}
\item \textsuperscript{145} See Chander & Costa, \textit{supra} note 143, at 649–51.
\item \textsuperscript{147} See sources cited \textit{supra} note 146.
\item \textsuperscript{148} See sources cited \textit{supra} note 146.
\end{itemize}
one such insolvency during the Crisis, along with many near-insolvencies only avoided by extraordinary governmental intervention—
the other participants would have had no idea of their exposures.

Regulators at the Federal Reserve Bank of New York (New York Fed) and the SEC engaged in close collaboration with the major market participants, known colloquially as “the Fourteen Families,” to clear the fog. Specifically, the regulators pressured the Fourteen Families to act using the powers of supervisory oversight and moral suasion. In response, the Fourteen Families reduced trade-confirmation backlogs, adopted technical standards for computerized trade-tracking, and adopted protocols to ensure awareness of third-party assignments. Through a new platform called Deriv/SERV, they collectively automated many aspects of the information-distribution process.

This reengineering of the derivatives post-trade process proved to be crucial. Had this paper-and-fax system remained in place, the confusion it created would have worsened the eventual crisis. As Tim Geithner, who had been the President of the New York Fed at the time, put it, “In a crisis, nobody would have [had] any idea who owed what to whom, or whether whoever owed it would be able to pay.”

149. Of the fourteen major market participants at the time, Lehman Brothers would fail, while Bear Stearns, Credit Suisse, Citigroup, UBS, Merrill Lynch, and Wachovia were only saved by massive support from the Fed and the Swiss National Bank. See U.S. Gov’t Accountability Off., supra note 146, at 11 n.16 (listing the fourteen dominant credit derivatives dealers); Adam Tooze, Crashed: How a Decade of Financial Crises Changed the World 177–78, 181–85, 220–23 (2018) (describing the bankruptcy of Lehman Brothers and the government support that averted the bankruptcies of Bear Stearns, Credit Suisse, Citigroup, Merrill Lynch, and UBS).

150. See Geithner, supra note 146, at 103. The details of the collaborative process are discussed infra Part III.

151. See U.S. Gov’t Accountability Off., supra note 146.

152. Id. at 18–25.


154. The basic mechanism of exacerbation would have been opacity about counterparty risk relationships, which would have increased the likelihood of contractions in short-term credit and of asset fire-sales. See Kathryn Judge, Information Gaps and Shadow Banking, 103 Va. L. Rev. 411, 457 (2017).

155. Geithner, supra note 146, at 103; see also Frank Partnow & David A. Skeel, Jr., The Promise and Perils of Credit Derivatives, 75 U. Cin. L. Rev. 1019, 1036 (2007) (discussing the downsides of market opacity).
The extra knowledge afforded by newly-digitized clearing systems limited the contagion of the failures that eventually did take place.156

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These three examples are very different—in terms of policy rationale, efficacy, ease of implementation, and more. Yet, together they show how regulators can embed policy goals into the design of market infrastructure. They also suggest the importance of public-private reengineering efforts within the broad set of approaches available to regulate the financial system.

III. EVALUATING THE PRACTICE

As the theoretical discussion and case studies presented in Part II suggest, financial regulators can leverage the design of market technology to achieve a range of policy goals. But that fact alone cannot tell a regulator whether to pursue a reengineering effort in lieu of, or alongside, other techniques of governance. The answer to that question will depend on the comparative advantages and disadvantages of reengineering in a given context. This Part develops a framework for evaluating a reengineering idea’s context-specific utility. Part A focuses on efficacy. As a technique, how effective is architectural “governance by infrastructure design”157 at achieving policy objectives compared with direct conduct regulation or, say, the promotion of behavioral norms? Next, Part B turns to process. How should regulators think about the pros and cons of enlisting the private sector to engage in a reengineering effort? Finally, Part C steps back to consider systemic implications. How are individual reengineering efforts likely to interact with the broader project of financial regulation? Taken together, answers to these questions can shed light on reengineering’s proper place in the financial regulatory toolkit.

A. THE EFFICACY OF REGULATING THROUGH DESIGN

When pursuing policy goals, financial regulators often write rules prohibiting harmful conduct, bring enforcement actions penalizing rule-violations, or extol behavioral norms from the bully pulpit. Infrastructure reengineering efforts are different. They aim to change the design elements of standardized financial platforms—elements that


themselves will do the work of controlling behavior or making it susceptible to surveillance.\textsuperscript{158} To the extent that rulemaking, enforcement, or moral suasion are involved in reengineering, those tools are used to cajole market participants into altering market infrastructure; it is the infrastructure itself that imposes the desired governance. The qualities associated with this mode of governance render it fit for a range of purposes within the traditional financial regulatory ambit. This Part draws on Part II’s cases to describe these qualities and then assesses the tradeoffs they are likely to produce in the context of financial market infrastructure.

1. Infrastructure Design as Mechanical Governance

The most important quality of infrastructure design relates to the way it operates on behavior. Specifically, its modes of control are mechanical. In Part II’s cases, I highlighted how the design of financial market infrastructure can serve policy goals by imposing structural constraints on behavior or increasing the visibility of market activity.\textsuperscript{159} Once installed, these structural constraints and surveillance technologies operate like clockwork, “without further human intervention.”\textsuperscript{160} They operate on behavior not through ex-post enforcement but rather through ex-ante conditions that apply in an immediate and automatic way to participants in a given financial market.\textsuperscript{161} They do so because they become fixtures of the very environment within which market activity takes place.

What does mechanical governance look like in the financial sector? The cases presented in Part II help shed light here. Though the process of reengineering infrastructure in each case was of course anything but mechanical,\textsuperscript{162} the products now operate in a mechanical way. First, take the way the DTC helps address securities theft. While traditional methods of policing securities theft rely on ex-post prosecution, the central securities depository design delivers ex-ante prevention. The replacement of a decentralized, paper-based settlement process with a centralized process relying on electronic records at the DTC deprives would-be embezzlers of their back-office access to

\textsuperscript{158} See \textit{supra} note 7 and accompanying text.

\textsuperscript{159} See \textit{supra} Part II.B.

\textsuperscript{160} See Grimmelmann, \textit{supra} note 22, at 1723.

\textsuperscript{161} On the immediacy and automation of architectural regulation generally, see \textit{Lesse}, \textit{supra} note 89, at 236–37. On the immediacy of software, in particular, see Grimmelmann, \textit{supra} note 22, at 1729–30.

\textsuperscript{162} For discussion of the process aspects of reengineering, see infra Section III.B.
misappropriate securities certificates. It is the complex-systems equivalent of a locked vault. Similarly, CLS Bank’s design removed the ability of its users to incur Herstatt risk. A cop need not be on the beat to ensure it; the CLS Bank system automates the payment-versus-payment requirement.

Participants in CLS Bank could not subvert it if they tried. Finally, consider the changes to the standard data forms and trade-confirmation practices in the credit derivatives markets. These changes rendered information about counterparty risk visible internally, between firms, and to regulators. And they did so not through the imposition of ex-post reporting requirements but rather by changing the technical standards according to which deals are conducted in the first place. In the run-up to the Global Financial Crisis, this had the effect of heightening private-sector and public-sector awareness of the markets’ growing risks.

The mechanical nature of governance-by-infrastructure-design renders it different from other techniques of regulating financial markets along two key dimensions: its cost structure and its relationship to bureaucratic discretion. Though these differences by no means guarantee that reengineering ought to be employed in any particular case, they do present a number of reasons why regulators may benefit from pursuing it in general.

Reduced Variable Costs. The first consequence of the mechanical nature of governance-by-infrastructure-design is that it likely will reduce the variable costs of achieving particular agency objectives when compared with traditional regulatory techniques. In the case of securities theft, for instance, William O. Douglas saw this in the 1930s. Though the mischief of securities theft can of course be addressed by heightened investigation and enforcement efforts, Douglas advocated the construction of a central securities depository to “obviate the need” for the ongoing costs such efforts would generate. Similarly, when regulators around the world considered the problem of Herstatt-style settlement risk in the foreign exchange markets, they pursued a regime of governance reforms and capital regulations that require ongoing investment and oversight to render effective. CLS Bank represents an effective substitute for this regime as a method of dealing with the particular problem of Herstatt risk. It therefore takes

163. See supra Part II.B.1.
164. See supra Part II.B.2.
165. See supra Part II.B.3.
166. See supra note 100 and accompanying text.
one task off the plate of the financial regulatory regime when dealing with systemic risk regulation.

Reduced variable costs are significant, of course, because agencies always select priorities in the shadow of budget constraints. When embedding a given priority into market infrastructure obviates the need for ongoing rulemaking, monitoring, and enforcement related to that priority, it frees up agency resources for other matters. A Fed that worries less about Herstatt risk can devote more resources to dealing with operational risk, for instance. But just as the purchase of a sturdy bank vault reduces the need for hired guns, reengineering efforts hold out the promise of reducing the ongoing costs of addressing problems in the financial sector.

The Removal of Discretion. A second quality of mechanical governance is that it eliminates human agency and discretion from a given policy space. This is not only a potential source of cost-savings in the budgetary sense; in some cases, it also can increase the reliability of regulation. Most prominently, eliminating discretion can be useful in situations where line personnel might bring in undue bias or might become excessively cozy with the firms they supervise. For instance, one reason why it took so long to uncover the scandal of Richard Whitney’s securities thefts was that his reputation as the “white knight” of Wall Street rendered him above suspicion. Regulatory

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172. See Beschloss, supra note 96.
discretion allowed him to go relatively unchecked for too long. Similarly, consider the example of CLS Bank. The pre-CLS Bank era was rife with prudential discretion for bank supervisors over Herstatt risk. How seriously should they view the risk? Should they penalize banks that transact with risky counterparties? How severely? With regard to foreign exchange settlement risk, CLS takes these questions off the table. Finally, consider the problem of regulatory access to high-quality data about the financial markets. Such data—essential to the task of financial crisis prevention—might be produced post-hoc, through periodic reporting, or might be produced by a system that is integrated with a given market’s trading operations. Only the latter will automatically deliver timely, useful data as a matter of course, without room for shirking by regulated firms. And the latter is what the Fourteen Families’ derivatives reengineering produced, enabling regulators and firms to obtain at least a partial handle on the risks arising in the credit derivatives markets.

Of course, there are also potential downsides to the absence of discretion. A fundamental quality of traditional regulation is that its enforcers may exercise discretion to temper the severity of any given regulatory decree. In the context of the common law, this possibility falls under the rubric of equity; in the context of financial regulation, it is typically thought of as forbearance. Financial regulators exercise discretion against applying legal rules and standards for many reasons—to achieve deregulatory goals, to bargain with regulated entities, or even to mitigate the effects of a crisis. Mechanical governance takes these options off the table. Because it is automatic, no human agent can play the role of “shield[]” between a policy and its unwise application.

In practice, financial regulators are likely to be capable of balancing the tradeoffs inherent in removing policy discretion fairly well. Consider, for instance, a recent rulemaking proceeding over the design of the Federal Reserve’s large-value payment system, Fedwire. Each day, Fedwire facilitates payment of over $4 trillion between the banks and other financial institutions that hold money in accounts at
the Federal Reserve.\footnote{See Fedwire Funds Service - Annual Statistics, FED. RSRV. BANK SERVS., https://www.frbservices.org/resources/financial-services/wires/volume-value-stats/annual-stats.html [https://perma.cc/V8HX-RCBH].} Currently, Fedwire allows those institutions to overdraw on their account balances, leaving the Fed on the hook in the event of default.\footnote{Policy on Payment System Risk and Expanded Real-Time Monitoring, 83 Fed. Reg. 20,074, 20,074 (2018) ("[T]he Reserve Banks could face direct risk of loss should institutions be unable to settle their daylight overdrafts in their Federal Reserve accounts before the end of the day.").} To reduce its risk, the Fed can monitor account holders’ creditworthiness, charge fees, or demand collateral.\footnote{See id. For an ethnographic account of hand-wringing at the Bank of Japan regarding daylight overdrafts when it began operating a payment system similar to Fedwire, see Annelise Riles, Real Time: Unwinding Technocratic and Anthropological Knowledge, 31 AM. ETHNOLOGIST 392 (2004).} At first, the Fed proposed to curb overdrafts through limits built into the Fedwire system, making it functionally impossible for institutions to run up their overdraft debts.\footnote{See Policy on Payment System Risk and Expanded Real-Time Monitoring, 83 Fed. Reg. at 20,074–76.} But the pushback from Fedwire’s users was swift: they worried about the automated prohibition on overdrafts leading to gridlock in the interbank payment system.\footnote{See Letter from Alaina Gimbert, Senior Vice President & Assoc. Gen. Couns., The Clearing House Payments Co., to Ann E. Misback, Sec’y, Bd. of Governors of the Fed. Rsrv. Sys. (July 6, 2018), https://www.federalreserve.gov/SECRS/2018/July/20180726/OP-1607/OP-1607_070618_132121_420589738959_1.pdf[https://perma.cc/7N4S-B28F].} In some situations, this gridlock might exacerbate a liquidity crisis.\footnote{Id. at 2.} The Fed evidently agreed and has backed away from its governance-by-design proposal.

Taken from a broader perspective, the tradeoff between discretion and automation is likely to be less problematic in financial markets than in other contexts. In the context of cyberspace regulation, a generation of scholars has lamented the costs of automatic governance by code because of its effects on the values of public discourse and free social life.\footnote{See, e.g., Mulligan & Bamberger, supra note 157, at 701 (arguing that “governance-by-design has taken us down the path towards governance dystopia”).} But rigid regulation in the financial markets has lower stakes because the values involved are instrumental ones. Further, the parties most likely to be affected are not individual citizens whose power is negligible but rather large financial institutions who can push back against excessive rigidity through interest-group action. As a result, the ability of agencies to tame certain forms of line-
level discretion through reengineering efforts is likely to be valuable without running amok.

2. The Durability of Infrastructure

A second important quality of design changes to financial market infrastructure is that they are likely to be durable. The infrastructural changes described in Part II, for instance, are between one and five decades old at this point, but they continue to shape the path of market infrastructure development. The DTC now operates as the near-universal standard for securities settlement in the United States;\textsuperscript{184} CLS Bank intermediates the lion’s share of foreign exchange transactions between the jurisdictions it serves;\textsuperscript{185} and the 2005–06 data reforms laid the groundwork for the transformation of the credit derivatives markets post-2008.\textsuperscript{186}

The durability of these systems can be chalked up to a combination of network effects, organizational embeddedness, and regulatory linkages. Network effects arise because market participants have incentives to use the transactional infrastructure that gives them access to large numbers of other market participants.\textsuperscript{187} In the context of trading, larger networks tend to redound to greater market liquidity;\textsuperscript{188} in the context of clearing and settlement, they tend to create benefits from transactional netting.\textsuperscript{189} While economists debate the conditions under which these incentives contribute to inefficient lock-in, in all cases network effects bind market participants to dominant infrastructure.\textsuperscript{190} So, too, does the organizational embeddedness of technical systems. Because technical systems require highly specialized knowledge to operate or participate in, that knowledge often


\textsuperscript{188} See id.

\textsuperscript{189} See \textit{Lee}, supra note 60, at 61.

\textsuperscript{190} See Farrell \\ & Klemperer, \textit{supra} note 187.
becomes institutionalized within particular organizational roles and departments and routinized into organizational processes.\textsuperscript{191} Today, entire bank departments owe their existence to the task of processing trades through the DTC, CLS Bank, and their infrastructural peers.\textsuperscript{192} Such institutionalization tends to further entrench a given system. Finally, similar linkages between financial market infrastructure design and regulatory regimes tend to add inertia as well. Because regulatory rules often fit particular technical systems, regulators and compliance professionals alike are loath to let dynamism lead to misalignment.\textsuperscript{193}

These forces of durability will increase the usefulness of reengineering in situations where they wish to insulate policies against change. When agencies pursue regulatory projects, those efforts are always contingent. As Chris Brummer has highlighted, they can be undermined by a variety of forces, from technological dynamism to shifting market structure.\textsuperscript{194} They also face the threat of what J.B. Ruhl and Jim Salzman have called “regulatory exit”—the “intentional, significant reduction” in a regulatory program’s vitality by agency action.\textsuperscript{195} Though some exits are planned by the authors of a program in the first place, others represent direct affronts to the policy goals that animate the programs. These unplanned exits may come through formal repudiation in the pages of the Federal Register; they may also come through informal means, such as “slashing agency budgets, reassigning staff, declining to enforce a regulatory program, or seeking delays in the courts.”\textsuperscript{196} Because agency staff typically wish to see their work live on after their departure, they often seek ways to “insulate or

\textsuperscript{191} See Mulligan & Bamberger, supra note 157, at 743 (describing how technical systems “often beco[m]e[] embedded in organizations and social structures, and in the practices of a culture, community, or profession and then fade[] into the background”); Porter, supra note 184 (describing the integration of the financial markets’ technical systems into organizational routines and professional identity).


\textsuperscript{193} See HO, supra note 192 (arguing that regulatory governance regimes tend to be complementary to, and integrated with, technical systems in the financial sector).

\textsuperscript{194} See Chris Brummer, Disruptive Technology and Securities Regulation, 84 Fordham L. Rev. 977, 1020–35 (2015) (analyzing how disruptive information and communications technology can undermine otherwise-settled regulatory practices and regimes).


\textsuperscript{196} Sarah E. Light, Regulatory Horcruxes, 67 DUKE L.J. 1647, 1650 (2018).
harden” their favored projects against exit by their successors.197 Due to the durability provided by network effects, organizational embeddedness, and regulatory linkages, infrastructural reengineering is likely to be effective at providing just such insulation.

Of course, there are downsides to this kind of entrenchment, too. Embedding regulatory values into market infrastructure may lead to harmful protectionism by dominant players in transactional networks. Reengineering efforts risk producing this effect because they may give rise to strong industry coalitions. These coalitions—take, for instance, the broker-dealers and custodians that control the DTC—may gain positional power due to their newfound centrality in financial intermediation chains, and they also may hold sway with regulators due to their value as partners in the reengineering effort.

As Kathryn Judge has written, when intermediaries possess such advantages, they generally seek to “affect the processes through which institutions evolve in self-serving ways.” 198 Because the (newly) existing infrastructure design will favor their business models, they will take concerted action to maintain the (new) status quo. In her account of this process of “intermediary influence,” Judge shows how securities firms with control over the NYSE successfully resisted efficiency-enhancing changes to tick size for many years through effective collective action.199 A similar process of intermediary entrenchment has played out over multiple decades in the case of the DTC. While scholars and policymakers intermittently lament flaws with the DTC model from the perspective of intermediary risk, corporate voting, and more, the model has gone untouched by serious competitive disruption or regulatory upheaval since its creation half a century ago.

Does the DTC’s problematic entrenchment reveal that it was a fundamental mistake to prod its construction? Though this is perhaps the view of some commentators,200 I do not think so. The myriad problems that converged in the Paperwork Crisis were themselves longstanding, as evidenced by the 1930s SEC’s interest in resolving them, and later in the early-1960s SEC’s similar interest.201 The infrastructural solution mitigated these problems for the long haul. Indeed, the DTC, along with CLS Bank and other important infrastructure

197. See id.
198. Judge, supra note 77, at 577.
199. See id. at 594–96.
201. See supra Part II.B.1.
institutions, continued normal business even amid the stress of the Global Financial Crisis, becoming widely lauded as the few large, systemically important “dog[s] that didn’t bark.” While scholars might debate whether this or that design would have been better to promote in the late 1960s, the general effort to produce the DTC was a valuable one. Similarly, though CLS Bank and ongoing derivatives reforms have undoubtedly strengthened the competitive positions of their insiders, this fact alone cannot motivate a wholesale indictment of those efforts. Instead, in any particular case, regulators and scholars must balance the weight of entrenchment against the governance benefits of reengineering.

B. The Challenge of Private-Sector Enlistment

The prior Part looked at the characteristics that make reengineering useful as a technique of governance and the tradeoffs those characteristics produce. This Part turns to process considerations. In particular, it highlights a second set of reasons regulators might wish to consider reengineering efforts: they can leverage private-sector capacity to serve public-law goals.

Across the cases presented in Part II, regulators relied heavily on private actors for both idea formation and blueprint implementation. They drew on extensive industry knowledge and detailed understandings of market dynamics. In the case of what became the DTC, William O. Douglas first developed the idea based on a proposal circulating in the stock-brokerage industry. Eventually, the DTC was built by a consortium of brokerage houses in cooperation with a team within the NYSE. Similarly, CLS Bank’s development occurred at the behest of central banks around the world, but the effort was carried out by a private-sector “G20” of the world’s largest foreign exchange dealer banks and eventually implemented through a technology

202. Gordon, supra note 156, at 148; see also Scott & Gelpert, supra note 54, at 792 (noting that the infrastructure of financial markets “performed well during the financial crisis that began in 2007”).
204. See Douglas, supra note 101, at 6 (stating that the central depository trust idea “emanate[d] from the brokerage business itself” and “was suggested [in the United States] at least as [early] as 1932”).
205. See Donald, supra note 200, at 54–59.
services contract with IBM. And with credit derivatives reform, the idea took shape due to an “early warning” provided by an industry actor, who told the president of the New York Fed about the risks posed by the dated practices of the derivatives post-trade process. In light of those risks, the Fourteen Families engaged in coordination and standardization efforts over the course of multiple years to meet regulators’ requirements for transparent post-trade practices.

The advantages to regulators of working with private actors to achieve public ends come not only in the forms of local knowledge and specialized expertise but also in the simple form of resources. While public monitoring and enforcement require large budget allocations, the act of leveraging private-sector capacity only costs the regulator the price of the leverage. By using the ability to both coordinate and coerce industry actors to make infrastructural changes, regulators who lead reengineering efforts are able to take action even if they are severely under-resourced in the budgetary sense.

In each of these regards, reengineering efforts resemble other methods of financial regulation that enlist private-sector actors to do the work of the state, from self-regulation to gatekeeping regimes. Like those better-studied methods of collaborative governance, reengineering will only succeed in contexts where regulators are able to work effectively across the public-private divide without succumbing to capture or capriciousness. On this front, it is essential to evaluate whether the legal and bureaucratic structures through which the

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206. See Schaller, supra note 134.
207. Noam Scheiber, The Escape Artists: How Obama’s Team Fumbled the Recovery 210 (2012) (citing an interview with a New York Fed official). That this industry actor, a Goldman Sachs partner named Gerald Corrigan, had only recently passed through the revolving door from the Federal Reserve to Goldman perhaps suggests why his warnings were both credible and effective. See id.
208. See U.S. Gov’t Accountability Off., supra note 146, at 18–25.
211. Cf. Van Loo, supra note 209, at 510–11 (describing how regulators “can dramatically expand the administrative state’s regulatory workforce” by conscripting large firms to police their suppliers); Lesley K. McAllister, Regulation by Third-Party Verification, 53 B.C. L. Rev. 1, 23 (2012) (identifying similar advantages to third-party verification regimes).
agencies are "regulating architecture to regulate behavior" are sufficient to prevent those unwanted outcomes.

1. The Utility of Coordination

For a reengineering effort to succeed, regulators must usually facilitate private-sector coordination of some kind. Coordination occurs when industry actors undertake a joint course of action to solve a shared problem. Regulatory facilitation of industry coordination is a common enterprise, and it occupies a core place in discourse about the public-private interface. It was instrumental to the reengineering efforts profiled in Part II.

At the most basic level, industry coordination can serve public purposes by bringing local industry knowledge and concerted industry action to bear on a given problem. Regulators can facilitate this through simple acts like convening key industry actors together in one location and setting an agenda for them. The value of even small coordinating actions like this can be seen in the cases. For instance, in 2005, when the New York Fed realized that the credit derivatives market’s antiquated back-office systems could cause major problems, they called an ad-hoc meeting with the Fourteen Families. Gathering in the New York Fed’s dining room, the representatives of the Families discussed how best to mutually adopt new, digital post-trade

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213. Lessig, supra note 20, at 668.
214. Cf. Richard H. McAdams, Beyond the Prisoners’ Dilemma: Coordination, Game Theory, and the Law, 82 S. Cal. L. Rev. 209, 219 (2009) ("Generally, the problem of coordination arises where two or more individuals can reach some mutually desired outcome—or avoid some mutually undesired outcome—only by combining their actions in a certain way, but where more than one possible combination will suffice. The presence of multiple ways to combine actions requires that individuals coordinate on the same combination." (emphasis omitted)).
216. See Ahdieh, supra note 215, at 293 (discussing the power of convening industry actors).
217. See Geithner, supra note 146, at 103; U.S. Gov’t Accountability Off., supra note 146, at 19.
The regulators invoked no formal legal mechanism to call the meeting or motivate action. Instead, they aimed to bring awareness to a shared problem and used a mix of “moral persuasion” and calls to the enlightened self-interest of the banks to do so. As Timothy Geithner, then the president of the New York Fed, put it, the dealers “had a mutual interest in upgrading their derivatives infrastructure, so we managed to persuade them to upgrade it.” Within a year, the banks had coordinated on a solution: they reduced trade-confirmation backlogs and increasingly adopted technical standards for computerized trade-tracking, all of which helped dampen the catastrophe of the Global Financial Crisis.

In addition to the simple power of convening industry actors in one place and setting an agenda for them, regulators can also gain value from creating focal points around specific infrastructural solutions to industry problems. The cases exemplify the value of this practice. For instance, when it was becoming clear that the securities clearing and settlement system would be overwhelmed by the rising trading volumes of the 1960s, the SEC published a prominent report summarizing the state of the market’s operations and challenges. Through that report, the SEC raised the profile of one way to implement something like the depository trust institution that William O. Douglas had first put on the table in the 1930s. The SEC’s move was not to mandate adoption of a depository trust or even to clearly...

218. See id.; SCHEIBER, supra note 207, at 211 (describing the scene of the meeting of the Fourteen Families).

219. The New York Fed only supervised two of the fourteen institutions. See GEITHNER, supra note 146, at 103. The others were supervised by the other regulators at the New York Fed-convened table. See id.


221. See GEITHNER, supra note 146, at 103–04.

222. See id.

223. See U.S. Gov’t Accountability Off., supra note 146, at 18–25.

224. See supra Part II.B.3.

225. A focal point arises when one solution to a coordination problem gains salience, thereby creating momentum in support of its adoption among the coordinating parties. See McAdams, supra note 214, at 231–35. Regulators can use the power of their bully pulpits to create such focal points for industry actors. Cf. Peter Conti-Brown & David A. Wishnick, Technocratic Pragmatism, Bureaucratic Expertise, and the Federal Reserve, 130 YALE L.J. 636, 664–65, 692 (2021) (highlighting the discursive powers of the Fed).


227. See generally id.
threaten regulatory consequences for failing to adopt it. Rather, the SEC brought awareness to one solution to the paperwork problem and gave it a “best practices”-like imprimatur of SEC blessing. 228 By creating a focal point, the SEC catalyzed the effort to build what eventually became the DTC. 229 This kind of approach is epistemically modest, in that it still relies on the local knowledge and expertise of industry players to guide infrastructural evolution, but it places a public force into the process.

2. The Necessity of Coercion

The tools of coordination are useful, but coordination can only go so far. At root, coordination is a non-interventionist regulatory stance. It “emphasize[s] the shaping of expectations rather than the alteration of incentives,” aims to disseminate “information and knowledge,” and “focus[es] on the dynamics of groups.” 230 When engaging in coordination, regulators act as public supporters of private ordering by removing cognitive and transactional barriers to mutual advancement. But to get off the ground in the first place, coordination efforts often need a source of external motivation. In such cases, regulators will need to coerce reengineering efforts into being, not merely to coordinate them.

The fundamental limit to coordination is that it fails to address the divergence between even enlightened industry interests and the policy interests often at stake in situations where reengineering is being considered. Take, for instance, a potential reengineering effort that aims at reducing systemic risk: “the risk of socially unbearable macroeconomic consequences” arising from the bankruptcy, distress, or breakdown of individual financial firms or infrastructure institutions. 231 It is fundamental that private actors do not have incentives to optimally limit systemic risk. “Without regulation, the externalities caused by systemic risk would not be prevented or internalized because the motivation of market participants ‘is to protect themselves but not the system as a whole.’” 232 These same incentives are at play when it comes to market infrastructure design. No amount of convening, “moral suasion,” or calls for “enlightened” self-interest will

229. See supra Part II.B.1.
231. See Levitin, supra note 12, at 446.
232. Schwarcz, supra note 123, at 206.
make industry actors care about the negative societal spillovers of systemic risk.\textsuperscript{233}

To make optimal use of reengineering where externalities are at stake, private-sector coordination needs motivation by a bit of muscle. The tools regulators have available for this purpose are threats and mandates.

\textit{Threats.} Agency threats come in many shapes and sizes. Some involve informal statements that, absent "voluntary" industry action, an agency will write a new rule or impose legal sanctions through enforcement.\textsuperscript{234} Others involve threats to industry members' reputations.\textsuperscript{235} And some involve the threat of new legislation from Congress.\textsuperscript{236}

Regulators used threats to prod along the infrastructural reengineering efforts described in Part II. One particularly stark example involved then-SEC Chairman William O. Douglas after the Whitney securities theft scandal.\textsuperscript{237} At the time, the SEC lacked any direct statutory authority to mandate reengineering of the securities settlement system used on Wall Street.\textsuperscript{238} But recall that Douglas thought that a re-designed settlement system would prevent securities theft and also, as the Commission put it, "obviate the need" for new regulations at the same time.\textsuperscript{239} At first, he used soft tactics, calling on the brokerage industry to "work together" with the SEC to "make this segment of capitalism work" by "launch[ing] a joint program" to develop a central depository trust.\textsuperscript{240} But when the industry did not move quickly to pursue Douglas's idea, he turned to negotiation and threat. Specifically, he treated the SEC's report on the Whitney scandal as a bargaining chip. He proposed that the SEC would withhold portions of the report from public view for a few months "on [the] condition that the...
President of the [NYSE] and others would use their best efforts to bring about the adoption of a central depository institution.241 When the NYSE still failed to take up the proposal, Douglas ultimately made good on his threat and publicized the SEC’s report.242 Douglas also threatened that if the industry still dallied, the Commission “might find it necessary to recommend to the Congress a program of legislative action” to force the central depository into existence.243 Fortunately for the industry, Douglas was at that point nominated for the Supreme Court.244 His successor (the famed legal realist Jerome Frank) lacked either the interest or the will to carry through on Douglas’s threats, and the reengineering plan went dormant until the 1960s.245

A more successful use of threats spurred the construction of CLS Bank. Recall that the design of the foreign exchange payment system led to recurring episodes of instability in the banking system throughout the 1970s, 1980s, and early 1990s.246 Though regulators had tried to spur private-sector action using coordination tools, nothing came of it until an international consortium of regulators including the Fed announced they would soon take affirmative measures to “induce private sector progress” in reducing settlement risk.247 This announcement was perceived as “a very clear threat . . . on the part of the major central banks” that the private sector “had a certain amount of time to come up with a satisfactory solution to FX settlement risk, or else the central banks would themselves ‘seek’ a solution.”248 The top-down options that were “in the wind” during the period included “tough risk

241. Memorandum from Francis T. Greene, Assistant Dir., Trading & Exch. Div., SEC, Conference on Monday, August 8, 1938, Relative to Proposals of the New York Stock Exchange and This Commission for the Safeguarding of Customers’ Funds and Securities 2 (Aug. 25, 1938), http://www.sechistorical.org/collection/papers/1930/1938_0825_SafeguardingConferenceT.pdf [https://perma.cc/G76X-WUJA]; see also id. (“It was made clear by Chairman Douglas that should the efforts of the Administration of the Stock Exchange to bring about the adoption of a program revolving about a central depository and ultimately a trust institution be unsuccessful, the Commission would promptly release the Whitney Report discussing all of the proposals which might thus become necessary.”).
242. See SEC WHITNEY REPORT VOL. 1, supra note 98.
245. See supra Part I.C.
246. See supra Part II.B.2.
248. Lacker, supra note 135, at 229.
control" imposed through traditional regulatory methods, and for "the central banks themselves to construct their own jointly-operated, centralized [payment-versus-payment] system."249

As intended, these threats from the Fed and other central banks provided "a wake-up call for the industry."250 To stave off stronger regulatory intervention, leading global banks quickly made plans to build their own private version of the payment-versus-payment system idea.251

These instances of threat-based motivation are undoubtedly significant in the history of infrastructural reengineering. But they are being overtaken by instances where regulators rely on explicit statutory grants of authority to mandate infrastructural change.

**Mandates.** Statutorily authorized mandates are likely to be more effective, not to mention more legitimate, than threats. The most important sources of statutory authority for our purposes are found in the Securities Acts Amendments of 1975 (’75 Amendments) and the Dodd-Frank Act of 2010.252 These laws enable financial regulators to facilitate and mandate infrastructural reengineering; I will call them the sources of "reengineering authority." They are the main statutory tools that regulators should consider invoking to mandate private-sector involvement in any reengineering effort.

First, the SEC can use wide-ranging authority in the ’75 Amendments to "play an active role in structuring the public securities markets."253 These laws enable the SEC to facilitate technological change in the "communication and data processing facilities" that undergird the securities trading venues and post-trade systems.254

A second set of statutory tools to prompt infrastructural reengineering can be found in the Dodd-Frank Act. While the ’75 Amendments focus on securities market infrastructure and empower the SEC alone, the Dodd-Frank Act grants authority to the Fed, SEC, and CFTC

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249. Id.
250. Schaller, supra note 134, at 44.
251. See id. at 47–48.
254. 15 U.S.C. § 78k-1 (directing the SEC "to carry out the objectives" of "linking ... all markets for qualified securities through communication and data processing facilities"); see also Jonathan R. Macey & David D. Haddock, Shirking at the SEC: The Failure of the National Market System, 1985 U. Ill. L. Rev. 315, 332 (stating that the ’75 Amendments establish that "the SEC must implement communications technology to facilitate trading activity among multiple markets").
over a wide range of market infrastructure. Most prominently, Dodd-Frank mandated the construction of central clearinghouses for certain derivatives contracts that had been cleared on a bilateral basis. In addition, Dodd-Frank requires the CFTC and SEC to develop standardized data formats for trade reporting in various derivatives markets. Finally, Dodd-Frank also contains a sweeping source of authority to regulate the design and operation of any market infrastructure that the group of agency leaders composing the Financial Stability Oversight Council (FSOC) deems to be "systemically important." Specifically, Dodd-Frank authorizes the regulators to "promote uniform standards for the . . . conduct of systemically important" financial activities—language that is broad enough to authorize a range of reengineering endeavors.

Taken together, these sources of reengineering authority enable regulators to coerce the private sector into acting, even when doing so is not in their self-interest. Notably, the absence of this kind of coercive power inhibited pre-Crisis reforms. To remedy this problem, the drafters of Dodd-Frank gave the constituent agencies of the financial regulatory state "adequate authority to compel corrective actions," rather than merely exhort them. Given the incentives at work in most important reengineering projects, the Dodd-Frank power to compel beneficial updates to market infrastructure is crucial.

255. See Griffith, supra note 11, at 1309-24.
258. Id. § 5461(b); see also id. § 5464(a)(1) (stating that the agencies "shall prescribe risk management standards" governing covered activities of "designated financial market utilities" and governing "the conduct of designated activities by financial institutions").
259. See U.S. DEP’T OF THE TREASURY, FINANCIAL REGULATORY REFORM: A NEW FOUNDATION 51 (2009), https://www.treasury.gov/initiatives/Documents/FinalReport_web.pdf [https://perma.cc/V33L-ZEEX] ("Progress in strengthening payment and settlement arrangements is inherently difficult because improvements in such arrangements require collective action by market participants. Existing federal authority over such arrangements is incomplete and fragmented. In such circumstances, the Federal Reserve and other regulators have been forced to rely heavily on moral suasion to encourage market participants to take such collective actions.").
260. Id. at 52.
C. REENGINEERING IN SYSTEMIC CONTEXT

The prior Parts examined the first-order utility of reengineering as a regulatory technique and the public-private interaction it entails. This Part steps back to consider reengineering in systemic context.

Individual reengineering efforts tend to be market-specific interventions. The DTC only addressed securities theft in the corporate securities markets;\textsuperscript{261} CLS Bank only addressed Herstatt risk arising from trades in particular foreign exchange markets;\textsuperscript{262} and the digitization efforts of the Fourteen Families may have improved data quality in the credit derivatives markets, but they left many other markets in the dark.\textsuperscript{263} Reengineering is potentially useful, in other words, at regulating particular financial activities,\textsuperscript{264} and doing so within the confines of today’s existing regulatory regime. By contrast, it cannot address the deep problems of our crisis-prone financial sector at a fundamental level.\textsuperscript{265}

But that does not mean that reengineering efforts will lack systemic implications. Rather, as this Part argues, reengineering efforts hold the capacity to support some approaches to sector-wide governance while also running the risk of creating new problems along the way. Regulators considering reengineering efforts in the future must contend with both of these dynamics.

\textsuperscript{261} Cf. Porter, supra note 184, at 121 (noting that the Fedwire infrastructure handles settlement in government securities markets).

\textsuperscript{262} See Bech & Holden, supra note 185 (documenting the range of currency pairs not currently supported by CLS).

\textsuperscript{263} See supra Part II.B.3.


\textsuperscript{265} For proposals that do aim to achieve such a fundamental restructuring, see WILMARTH, supra note 124, which argues for the reinstatement of a modernized version of the Glass-Steagall Act; Saule T. Omarova, The People’s Ledger: How to Democratize Money, Finance, and the Economy, 75 VAND. L. REV. (forthcoming 2021–22), and Ricks et al., supra note 38, which explore the implications of widespread availability of access to Fed bank accounts; and Adam J. Levitin, Safe Banking: Finance and Democracy, 83 U. CHI. L. REV. 357, 417 (2016), which argues for a separation of lending and safe-keeping activities in favor of “an absolutist version of 100% reserve banking.” For commentary on the deep problems left unaddressed post-2008 and the potential for fundamental reform, see Adam J. Levitin, The Politics of Financial Regulation and the Regulation of Financial Politics: A Review Essay, 127 HARV. L. REV. 1991 (2014).
1. Reengineering as a Complementary Technique

To address problems in each of Part II’s cases, regulators had a range of regulatory tools available to them. And just as agencies often mix policymaking forms like rulemaking and adjudication to achieve their statutory goals, so too can agencies mix and layer different governance approaches. Take securities theft: Over decades, the SEC experimented with a mix of industry self-regulation, administrative enforcement, and eventually the infrastructural effort of pressuring industry participants to create the DTC. And in the case of Herstatt risk, the Fed pursued a similar multi-tool approach. It supported the adoption of Basel-style capital requirements, continued with workaday bank supervision, and pushed for the construction of CLS Bank. In both cases, reengineering efforts did not foreclose the use of other regulatory tools; they complemented them.

In general, reengineering efforts are likely to complement other approaches to financial regulation in a few ways. First, as in the two cases just described, a reengineering effort resulting in structural constraints on particular activities might increase the efficacy of other regulatory tools. Consider the work of a Fed supervisor pre- and post-CLS Bank. In the pre-CLS Bank days, a supervisor of a bank with significant foreign exchange exposures would have had to scrutinize its settlement risk profile. As noted above, this would have been an ongoing task with high variable costs, and the task would have been made difficult by the dynamic market environment. But in the post-CLS Bank world, the same supervisor can look to CLS to achieve the goal of controlling settlement risk. This not only reduces the variable costs of addressing settlement risk; it also frees up the supervisor’s (and the supervisory agency’s) resources to deal with other matters while CLS Bank does important work, automatically and in the background.

Second, when reengineering efforts make rule violations and financial risks more visible, they make those violations and risks more susceptible to both private and public discipline. As a result, any increase in surveillance caused by reengineering will complement other regulatory approaches. In the case of the derivatives back-office

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266. See M. Elizabeth Magill, Agency Choice of Policymaking Form, 71 U. Chi. L. Rev. 1383, 1399 (2004) (discussing how agencies rely on adjudication, rulemaking, or a combination of the two).
267. See supra Part II.B.1.
268. See supra notes 127–31 and accompanying text.
269. See supra Part II.B.2.
270. See supra Part II.B.2.
reforms, for instance, a shift in visibility led to private discipline.\textsuperscript{271} When the Fourteen Families came to understand the risks that their trading practices were producing, they quickly sought to increase their use of netting arrangements to reduce the magnitude of their counterparty risks.\textsuperscript{272} Though these efforts were hardly sufficient to stop a world-historical financial crisis from taking place, they did help contain what would have been an even worse meltdown in the OTC derivatives markets. Similarly, when regulators prompt the adoption of improved data standards or the construction of trade reporting infrastructure, the resulting increase in market visibility will complement public discipline. Regulators and supervisors who have access to real-time, machine-readable trade data will be in much better positions when it comes to risk regulation and conduct policing than their peers were in prior days.

2. Centralization and the Stakes of Catastrophe

Of course, reengineering efforts will not only be complementary to other regulatory programs. Sometimes, they may make other aspects of the regulatory task more difficult; sometimes, they may create new problems altogether.

The most striking new problems that may result from reengineering efforts arise from increased centralization of market activities. Both the DTC and CLS Bank exemplify this. Though they each did much to address preexisting problems that had eluded simple regulatory solutions for years, they also produced new risk of their own. For these two systems, much of it falls under the umbrella of operational risk.\textsuperscript{273} If one of these systems were to be unavailable for even a short period of time, they could destabilize every one of their participants. This genre of centralized operational risk is not hypothetical. In 1987, telecommunications breakdowns in post-trade networks deepened the Black Monday crash.\textsuperscript{274} Recent Fedwire outages have caused

\begin{itemize}
\item \textsuperscript{271} See supra Part II.B.3.
\item \textsuperscript{272} See supra Part II.B.3.
\end{itemize}
minor trouble across markets. A similar breakdown—or cyber-intrusion—into a centralized financial market infrastructure today could create or deepen another crisis. Similarly, as thousands of law review pages attest, reengineering efforts that centralize clearing have the effect of concentrating financial risks.

The stakes of centralization are such that the drafters of the Dodd-Frank Act addressed them directly. In title VIII of the Act, Congress gave the FSOC the power to designate “financial market utilities” or “payment, clearing, or settlement activities” as systemically important via supermajority vote. Such a vote subjects designated entities and activities to heightened regulation and supervision, even over the objection of their “home” agency. Under the scrutiny of their home regulators, along with the FSOC and the Fed, these “systemically important financial market utilities” (SIFMUs) become subject to mandatory reforms to their internal processes and to invasive supervision designed to reduce the chances of financial catastrophe.

These risk-management and oversight measures are, of course, hardly costless. And the harm that could be done if they were to fail is potentially enormous. This raises the question: has the centralization of clearing and settlement processes through reengineering efforts been worth the trade? On this front, it is both striking and ironic that by my count, regulators have had a guiding hand in the creation of over half of the SIFMUs subject to heightened supervision today.

Section 5463(a). The Secretary of the Treasury, acting as FSOC chairperson, must be a part of the supermajority. Id. §§ 5464, 5466–5467.

See id.


In addition to the DTC and CLS Bank, see supra Parts II.B.1–2, regulators have been moving forces behind the creation or expansion of two systemically important derivatives clearinghouses, see, e.g., Yadav, supra note 142, and the precursor to the
Because the systemic risks posed by the SIFMUs involve low-probability, high-stakes scenarios, it is a matter of abundant speculation whether the centralization of post-trade infrastructure has ultimately been a good or bad deal. At the very least, the creation of new, systemically risky entities cannot be anything approaching a “final act of policy” that allows regulation to leave the scene. Instead, it trades one set of problems for another. In light of this dynamic, regulators considering new reengineering efforts should clearly be wary of creating new SIFMUs, and indeed should be especially attuned to ways of de-risking the existing ones. The next Part turns to a few ideas along those lines.

IV. FUTURE PROSPECTS

So far, this Article has examined the potential utility of reengineering efforts and developed a framework for evaluating the tradeoffs they tend to pose. This Part looks to the future. It applies the framework developed in Part III to evaluate current and potential future reengineering initiatives, and it explores how regulatory mentalities should shift to best capitalize on those possibilities.

A. THREE INITIATIVES

1. T+1: A Structural Constraint on Systemic Risk

Earlier, the case of CLS Bank demonstrated how regulators can employ reengineering to combat systemic risk. Regulators should more aggressively pursue similar systemic risk-reductions today. This Part explores one promising idea involving the NSCC. The idea exemplifies the value of mechanical enforcement discussed in Part III.A and it does so in service of reducing centralized systemic risk.

Recall from Part I.B that the NSCC is the central counterparty clearinghouse for the corporate securities markets. After market participants trade with one another, the NSCC steps into the middle, becoming “the seller to every buyer and the buyer to every seller” of

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Footnotes:

283. For a summary of a decade’s worth of debate on derivatives CCPs, for instance, see Yadav, supra note 142.
284. This phrase comes from Annelise Riles’s discussion of the Bank of Japan payment system. See RILES, supra note 8.
286. See supra Part III.A.1.
287. Cf. supra Part III.C.2 (discussing the centralized risks posed by SIFMUs).
those trades.\(^{288}\) As a result of this role, the NSCC is a quintessential “too big to fail” institution.\(^{289}\) It is both a debtor and a creditor of every major securities dealer and intermediary in the country. If one or more of those firms were to default on debts to the NSCC, the NSCC itself would be on the hook to cover the shortfall.\(^{290}\) It would do so by using its own resources and by drawing on the resources of other securities firms that participate in the clearing network. Such an event would put pressure on those firms and could lead to the deepening of an incipient financial crisis.\(^{291}\) Its negative spillover effects could be many, including a contraction of credit and a widespread reduction in economic prospects.\(^{292}\) For these reasons, financial regulators have designated the NSCC as “systemically important.”\(^{293}\)

To reduce the risk that the NSCC fails, regulators have a range of options at their disposal. First, they can impose new risk management requirements.\(^{294}\) Second, they can supervise the institution with greater intensity.\(^{295}\) A third possibility, complementary to the other two, is to impose a structural constraint on the extent of NSCC risk-taking.

Today, the SEC indeed may reengineer the NSCC to do just that. The opportunity involves what is known as the “settlement cycle”—the time it takes from trade to ultimate settlement.\(^{296}\) This cycle recently gained notoriety for a strange reason: when the retail broker Robinhood halted trading in volatile “meme” stocks in January 2021,
its CEO laid blame on the settlement cycle’s pace. But its import here has little to do with retail brokerage. Rather, from a systemic risk perspective, the settlement cycle matters because it directly controls the extent of the financial risk the NSCC itself bears at any given time. Each day that a trade remains unsettled, the NSCC is exposed to the risk of counterparty default. The current timeline for settlement is two days—the so-called “T+2” settlement cycle. A shift from the current cycle to a T+1 cycle would cut the NSCC’s exposure by a day’s worth of trades, thereby vastly reducing the risk it bears and the risk it poses to the stability of the financial system. A switch to T+0 would reduce NSCC’s exposure even further by limiting it to risks carried on an intraday basis.

If a speed-up of the settlement timeline would reduce the NSCC’s systemic riskiness, why hasn’t the SEC gone forward with it to date? It is not for lack of awareness. The SEC has long been aware of the technological possibility of a T+1 or T+0 settlement cycle, and in 2015, a group of independent advocates on the SEC Investor Advisory Committee argued to the SEC that faster settlement would serve the public

297. Specifically, the CEO suggested that extremely high collateral demands made by the NSCC led to Robinhood’s trading halts. See Annie Massa, Robinhood Says Stock Settlement Times Are a Wall Street Risk, BLOOMBERG (Feb. 2, 2021), [https://www.bloomberg.com/news/articles/2021-02-02/robinhood-saga-renews-wall-street-group-s-move-to-limit-risks][https://perma.cc/88K3-9B89]. In my view, that account is incomplete, at best. Robinhood itself could have engaged in better liquidity planning to accommodate its business model, or it could have altered its business model to reduce liquidity risk. Cf. James Surowiecki, Why Robinhood’s PR Nightmare Keeps Getting Worse, MARKER (Feb. 22, 2021), [https://marker.medium.com/robinhood-demonstrates-how-not-to-communicate-in-a-crisis-3b31c0e60cbc][https://perma.cc/V6EE-SR8Q] (discussing Robinhood’s liquidity problems in late January 2021). It makes more sense to blame Robinhood for its trading halts than NSCC collateral requirements.

298. See T+2 Settlement Cycle Adopting Release, supra note 57, at 17–18 (stating that a shortened settlement cycle “should reduce systemic risk”).

299. Id.

300. Id. at 2.

301. See Depository Tr. Clearing Corp., ADVANCING TOGETHER: LEADING THE INDUSTRY TO ACCELERATED SETTLEMENT 2, 5, 9 (2021) (arguing that a shortened settlement cycle would reduce risk to the NSCC and reduce Members’ expected margin requirements).

interest. Based on these precedents, the SEC could adopt existing models to speed up securities settlement today.

The better explanation is that the SEC has decided to let the securities industry lead on its own. Since the move to a T+2 cycle in 2017, no member of the Commission or its staff has publicly pushed for faster settlement. Indeed, even amid public debate and early industry explorations of T+1 in the wake of January 2021’s strange meme stock episode, the SEC has so far stayed silent. This hands-off approach follows the pattern of many past SEC exercises of the ‘75 Amendments’ reengineering authority. As Yuliya Guseva has written, the SEC has only engaged this authority “following clearly expressed market concerns and consensus” among industry participants. For instance, when considering the eventual shift to T+2, the SEC “did not choose sides” but rather “allowed the industry to move naturally.”

This approach of letting the industry decide when and how to update the settlement cycle is wrongheaded. As we saw in Part III.B, when it comes to systemic risk, the incentives of private actors are out of alignment with the public interest. Though the firms that mutually own and operate the NSCC of course would not like to see it fail, they nevertheless do not internalize the damage that an NSCC failure would inflict on the public at large. Not only could an NSCC failure require a bailout from the Fed, but it would also roil the markets and


304. See id. (“[M]atching the settlement period that already exists for Treasuries and many mutual funds, would greatly reduce systemic risk . . .”).


306. See DEPOSITORY TR. CLEARING CORP., supra note 301.


308. Id. at 1730.

309. Cf. Saguato, supra note 290, at 631–32 (discussing situations in which clearinghouses are “unable to contain and internalize” the costs of their failures); id. at 613 (noting that NSCC is a member-owned mutual firm).
contribute to broader panic in a crisis situation. To prevent these negative spillovers to the public, the NSCC should not be left to its own devices. Rather, because of the value to the public of reducing the NSCC’s systemic riskiness—not to mention reducing the need for SEC oversight and supervision—the SEC should consider coercing an effort to shorten the settlement cycle.

To place pressure on the industry and ensure it neither stalls nor slow-walks a beneficial change, the SEC should make more aggressive use of the powers contained in the ’75 Amendments. First, the SEC should use its statutory authority to reconvene an expert body called the Market Transactions Advisory Committee (MTAC), which has been dormant since the 1990s. The MTAC would be a fifteen-member committee, organized and operated pursuant to the Federal Advisory Committee Act. It would enable SEC commissioners to leverage subject-matter expertise from outside the agency but without having to rely too heavily on the expertise of interested industry participants. And it could be charged by the SEC with reporting on a wide range of matters related to securities transfer procedures. The Commission should use this power to task the MTAC with studying the question of settlement cycle speed. Specifically, a revived MTAC should have the remit of gathering evidence on the feasibility, costs, and benefits of reengineering a faster securities post-trade process. With that power in hand, the MTAC could engage with technology vendors, investor advocates, and public-interest groups to assess how best to de-risk securities clearing and settlement. In so doing, it would bring an independent and well-informed perspective to bear on a

310. Cf. Baker, supra note 73, at 109–10 (describing the expansion of the Federal Reserve’s “safety net” to include clearinghouses that have been designated as systemically important by the FSOC).


312. See 15 U.S.C. § 78q-1(f)(4)(A) (“The Advisory Committee shall be directed to consider and report to the [SEC] on such matters as the [SEC], after consultation with the Secretary of the Treasury and the Board of Governors of the Federal Reserve System, determines, including [matters related to the laws governing securities transfer].”).
topic that is simultaneously technical and of significant public importance.\textsuperscript{315}

If the SEC does not take up this effort, the Federal Reserve should use its title VIII authority to step into the void. Pursuant to that authority, the Fed has the power to backstop the SEC’s oversight of the NSCC. If the SEC’s requirements are “insufficient to prevent or mitigate . . . risks” to financial stability, then the Fed can force remedial evaluation.\textsuperscript{316} The SEC would then be required by law to revisit its own approach to NSCC risk management.\textsuperscript{317} While it is possible that the implementation costs of speeding the settlement cycle could exceed the benefits, that judgment could be made only \textit{after} a public-interested regulator has taken a wide range of technical options under consideration. Federal Reserve leadership on this question would represent an improvement on the SEC’s current approach of deference to industry members. That approach is a clear abdication of the congressional mandate found in the ’75 Amendments and the Dodd-Frank Act and a failure in light of the basic mismatch between the NSCC’s interests and the public interests that Congress has entrusted to the SEC.\textsuperscript{318}

2. The CAT: Cross-Venue Surveillance in the Securities Market

The problem of market manipulation—whether through front-running, spoofing, insider trading, or otherwise—threatens to undermine the integrity of the securities markets.\textsuperscript{319} As one might expect, the market manipulators who engage in these tactics usually aim to cloak their actions in secrecy. One goal of the SEC’s CAT effort, first mentioned in the Introduction, is to bring emerging forms of market manipulation out of the shadows. Though it exemplifies the potential utility of architectural regulation, it has largely been a failure in terms of process.

\textsuperscript{315} Cf. Omarova, \textit{supra} note 40, at 488–89 (describing the value of independent experts in terms of bringing “political visibility and social salience” to issues that are frequently off the public radar).


\textsuperscript{317} \textit{See id.} § 5464(a)(2)(D) (requiring the SEC to respond to any Federal Reserve challenge “with a detailed analysis as to why existing prudential requirements are sufficient, or submit an explanation describing the actions to be taken in response” to the Federal Reserve challenge).

\textsuperscript{318} \textit{See discussion supra} Part III.B.2. \textit{See generally} 12 U.S.C. §§ 5461(a)(4)(C)-(D), 5464(b)(3)-(4) (stating the purposes of the Dodd-Frank market infrastructure oversight provisions, including the purposes of “reduc[ing] systemic risks” and “support[ing] the stability of the broader financial system”).

\textsuperscript{319} “Market integrity” refers to the goals of fairness, orderliness, and pricing that accurately reflects a security’s fundamental value. See, \textit{e.g.}, Roberta S. Karmel, IOSCO’s \textit{Response to the Financial Crisis}, 37 J. Corp. L. 849, 897 (2012).
The surveillance functions for which the SEC aims to build the CAT are as old as the markets themselves. The earliest form of market surveillance was informal and peer-based. As with the lobstermen famously profiled by James Acheson and the goldminers of Jackass Gulch recently described by Gillian Hadfield, the traders of the NYSE and other exchanges kept tabs on each other with a watchful eye. This “crowd monitoring” relied on the physical architecture of the trading floor. Participants were, as one NYSE official put it, “not over in a closet or up on a pillar [but rather] . . . standing down on the floor . . . so that there is almost—you might say—a check-up on [them] every single minute.” Reports of participants ratting each other out for prohibited actions are numerous. The rules of the floor were supported by the mutual surveillance of the crowd.

As market activity grew over the course of the twentieth century, the private stock exchanges and the SEC increasingly turned to “programmatic” surveillance methods. For instance, by 1992, the NYSE’s Intermarket Surveillance Information System was already producing a massive audit trail—“a sequential reconstruction of trading in each stock, identifying the time of trade, the buying and selling member firms, the Floor brokers who represented the orders involved, and whether the trade was for a member firm proprietary account.” Analysts would sit at “sophisticated computer workstations” to “quickly reconstruct market activity” if something looked amiss. The SEC, for its part, has long acted as “an additional independent monitor for all securities transactions.” The Commission not only oversees the surveillance activities of operators like the NYSE; it also ingests a range of private data feeds to sift through when

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323. Id. at 65.
324. See id. at 66–67 (detailing a trading story from Robert Seijas).
327. Id.
it seeks to uncover problematic conduct or engage in a market crash post-mortem.

Over the past two decades, however, this system of surveillance has broken down. The cause of the breakdown is the increasing decentralization and fragmentation of trading activity across many trading venues. As Yesha Yadav has recently written, this fragmentation "generates enormous logistical and institutional costs for exchanges seeking to monitor, surveille, and discipline" wayward traders. Impermissible actions that surveillance might have caught in the days of centralized trading now go undetected.

A range of regulatory interventions might remedy this situation. Yadav, for instance, has proposed a change in liability regime to address the problem of weak oversight. The CAT represents a technological complement to such proposals. In essence, the CAT aims to recreate what has been lost through the fragmentation of the stock market and, further, to deepen the granularity of data that the SEC receives. The plan for the CAT is to become the "ultimate unraveler of the mysteries of the stock market: a vast database [to] enable regulators to look at who has been trading what in the sub-second trading world that exists today. And not just trades that take place: every bid and offer ... [whether] executed or not." When it is completed, it will gather this information, in standardized formats, from every regulated securities and SEC-regulated trading venue, requiring alterations in underlying data structures or translational systems across numerous operators.

But the CAT blueprint has taken exceedingly long to even begin constructing. And the slow pace of the project highlights the inherent risks of failing to effectively manage a reengineering effort’s core public-private relationships. Recall from Part III.B that the 175

330. Id.
331. Id; see also Frank Pasquale, Law’s Acceleration of Finance: Redefining the Problem of High-Frequency Trading, 36 CARDOZO L. REV. 2085, 2114–16 (2015) (describing the SEC’s frustrations on this front).
332. See Yadav, supra note 329, at 1809 (proposing a liability regime for trading venue operators).
Amendments gave the SEC wide-ranging authority to coerce industry actors into reengineering their own infrastructure. The importance of using these provisions with a real enforcement threat behind them is exemplified by the SEC’s struggle to get the CAT project off the ground. Almost nine years after its kick-off, the CAT remains in a state of partial completion.\textsuperscript{335} The story is one of delay after delay: a four-year search for a database provider, insufficient plans rejected by the SEC, and the longest hiring process for a chief information security officer “in history.”\textsuperscript{336} As presidential administrations changed over from Obama to Trump to Biden, and the SEC switched from majority-Democrat to majority-Republican and back again, one constant has been the CAT: a potentially valuable system to help the SEC carry out its statutory duties to police market integrity, but a policy albatross and a procedural quagmire.\textsuperscript{337}

A large portion of these delays can be chalked up to failed incentives. To date, not one fine has been issued by the SEC for industry slowness, and the SEC has indicated that it will continue to let construction delays slide.\textsuperscript{338} In the future, regulators using the ’75 Amendments should be sure to back up their calls for action with real threats of civil penalties for failure to act.

3. Data Standardization: Primitives for Systemic Oversight

A third example of potentially valuable reengineering can be found in the realm of systemic oversight. To prevent crises before they happen (and to contain them once they begin to unfold), financial regulators are increasingly working to develop the “robust ability to


\textsuperscript{337} See Ramonas, \textit{supra} note 335 (noting that then-current SEC Chairman Jay Clayton has called the CAT “one of the worst conceived, worst executed projects I’ve seen,” but has also doubled down on its completion).

\textsuperscript{338} See Rundle & Malakian, \textit{supra} note 336 (noting that, despite delays, “an enforcement action from the SEC failed to materialize”).
monitor the economy and quickly detect mounting risks.”339 This oversight ability requires an essential input: useful data.340 Specifically, to effectively monitor the financial system as a whole, regulators need access to financial data that are detailed, comprehensive, rapidly-updated, and machine-readable.341 While many useful sources of data exist today, regulators should work to identify ways of producing and centralizing that data more effectively.342

The necessity of wide-ranging data was revealed in the Global Financial Crisis, when regulators were caught off-guard by their ignorance of important market activities and counterparty relationships.343 For instance, they lacked information about major dependencies between firms transacting in crucial short-term funding markets.344 They also lacked awareness of the systemic importance of some firms operating outside the traditional regulatory perimeter.345


340. See McCoy, supra note 339 (describing the issue of information deficit post-2008).


342. See, e.g., Henry T.C. Hu, Disclosure Universes and Modes of Information: Banks, Innovation, and Divergent Regulatory Quests, 31 YALE J. ON REGUL. 565, 647 (2014) (“Massive amounts of data relating to banks and individual financial transactions are available to a spectrum of governmental bodies.”); cf. Berner & Judge, supra note 141, at 5–7 (“In this environment, policymakers inevitably operate with an incomplete understanding of how the financial system works and how it will respond to regulatory intervention.”). For a discussion of ongoing efforts and their place within the financial regulatory state, see generally Dan Awrey & Kathryn Judge, Why Financial Regulation Keeps Failing Short, 61 B.C. L. REV. 2295, 2340–42 (2020).

343. See, e.g., Michael S. Barr, The Financial Crisis and the Path of Reform, 29 YALE J. ON REGUL. 91, 99–100 (2012) (“Before Dodd-Frank, no regulator or supervisor had the authority to look across the full sweep of the financial system—including less-regulated segments—and take action when it perceived a threat. In fact, regulators and market participants did not even have enough data to understand how interconnected the market was.”).

344. Id.; see Saguato, supra note 13, at 113–14, 120–25 (describing repo market opacity and proposing enhanced visibility for the market).

Taken as a whole, during the Crisis, “[t]he lack of high-quality, consistent, and accessible data was a key source of risk.”

While regulators have undertaken efforts to shore up the data picture, today’s sources still overlook key areas of financial activity. They also suffer from design flaws related to the intermittent nature of their transmission, the low level of detail they contain, and the poor quality of their presentation. For example, the recent market turmoil sparked by the COVID-19 pandemic raised questions about regulators’ access to necessary data about leveraged lending to corporate borrowers across economic sectors. These loans—which are extended to corporations with high levels of debt and often bundled into collateralized loan obligations (CLOs)—have grown significantly over the last few years. Though it has not yet come to pass in the current crisis, widespread defaults on these loans have been theorized as a potential trigger for deep distress among financial institutions who hold them on their balance sheets, risking a systemic event.

(describing the opacity of the American International Group’s systemic importance before its downfall).


347. See Saguato, supra note 13, at 120–25 (arguing for reforms to make the repo market more transparent); Pasquale, supra note 331, at 2113–17 (describing efforts among financial regulators to collect sufficient data to support effective supervision and enforcement).


351. See Kim, supra note 350, at 110–12 (explaining that a “cross-default” scenario is a sufficiently foreseeable reason to regulate in the face of “inevitable downturns”). But see Christina Parajon Skinner, Nonbank Credit, 9 HARV. BUS. L. REV. 149, 152 (2019) (arguing that many leveraged lenders provide a countercyclical source of credit).
Yet, despite their growing systemic importance, leveraged loans currently exist in a relative data desert. At present, there is no central market infrastructure that collects transaction-by-transaction data in standardized, machine-readable formats for leveraged lending. Further, many market participants fall outside the existing regulatory perimeter for entity-specific data collections. And while private data sources provide some information, these sources are often prepared monthly; they also only provide a sliver of insight into the interconnectedness and dependencies that regulators must understand to do their jobs.

In many ways, the leveraged loan and CLO markets exist in a state of opacity comparable to the derivatives market in 2005. With no centralized infrastructure for trade-data collection, regulators are cobbling together existing data sources to develop a sense of market activity. But this approach leaves them prone to overlooking risks and relationships that pose destabilizing threats. In particular, as the Financial Stability Board recently stated, “limited information on indirect linkages between bank and non-banks [through the leveraged loan and CLO markets] makes it difficult to assess possible risks from spillovers and interconnectedness, and their systemic implications.”

One lesson of the Global Financial Crisis is that no important market should be so opaque from the macroprudential perspective.

Though regulators could attempt to increase firm-specific data collections to address the problem, a less discretionary, more durable approach would be to pursue a reengineering effort, calling on industry actors to construct a trade repository for leveraged lending. By contrast to firm-provided data collections, a trade repository would collect relevant trade data as a mandatory byproduct of transacting in the first place. The attractiveness of the option would depend on the value of immediate, automated data delivery compared with the

353. See Parajon Skinner, supra note 351, at 155 n.32 (stating that “regulatory data on private funds is sparse”).
354. Cf. CLOs: Not So Opaque, Loan Syndications & Trading Ass’n (June 20, 2019), https://www.lsta.org/news-resources/clos-not-so-opaque [https://perma.cc/6XJP-3426] (arguing that the availability of Thomson Reuters’s “Leveraged Loan Monthly” should allay policymakers’ concerns about the market’s opacity).
355. See supra Part II.B.3.
difficulty of enlisting industry actors to coordinate on the development of a new infrastructural system. In this, public benefits in terms of improved macroprudential supervision would trade off against private costs of construction and public costs of oversight. But here again, regulators should not wait for poorly incentivized private firms to act.

**B. A Proactive Role for Regulators**

The ideas presented in the preceding Part represent the tip of the iceberg of possibilities for infrastructural reengineering, but they nevertheless offer a sense of how regulators should think about engaging in the practice. They also highlight the public-private dynamics that reengineering inevitably entails. If regulators hope to leverage the power of market technology, they will need to do much more than respond to private innovation; they must play a catalytic role in pressing for change.

Doing so may require an ideological shift within the agencies. Decades of practice and theory have made the roles of reaction and facilitation—of “keeping pace” and not “getting in the way”—central to the financial regulatory mindset. Indeed, today, leaders at the SEC, CFTC, and Fed continue to espouse those conceptions of their tasks. They express fears of “heel-dragging” in response to private technological innovation and hopes for “enabl[ing]” the development of private technologies. They even have built entire organizational sub-units devoted to celebrating the creativity of private innovators. For instance, the CFTC has created LabCFTC to serve as “the focal point for the CFTC’s efforts to promote responsible financial technology (fintech) innovation,” and the “hub for the agency’s

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357. Regarding public-private reengineering efforts, see, for example, Charles W. Mooney, Jr., *Beyond Intermediation: A New (Fintech) Model for Securities Holding Infrastructures*, 22 U. P.A. J. Bus. L. 286, 387–89 (2020), which calls for the reengineering of the central securities depository system. See also Berner & Judge, supra note 141, at 3–5 (exploring opportunities for greater data standardization); Saguato, supra note 13, at 88–89 (arguing for reforms to repo infrastructure); Hilary J. Allen, *Payments Failure*, 62 B.C. L. Rev. 453 (2021) (exploring technological solutions to operational risk in the retail payments system). For purely public ideas, see sources cited supra note 38.

358. See sources cited supra note 1; cf. Coglianese, supra note 19 (discussing the pace-keeping problem across the administrative state); Marchant, supra note 19, at 199 (same).


engagement with the fintech innovation community.”361 By contrast, they espouse less enthusiasm for affirmatively leading the process.

These views fit with dominant academic conceptions of the regulatory role, as well. The main narrative applied to the regulation-innovation relationship in the financial sector always begins with a novel financial product or market technology developed for private profit.362 From the electronic trading venues currently ascendant to innovations driven by distributed ledger technology being championed across the financial sector, the narrative aptly captures important innovations—but only those developed by the “Wall Street rocket scientists”363 of the private sector. It has no place for regulatory leadership in infrastructural reengineering.

To remedy this regulatory and scholarly mismatch, we need a conception of regulators as affirmative catalysts for technological and institutional change. Scholarly insights from outside the field of financial regulation can inform the development of a new approach. In different domains, legal scholars have begun developing ideas about what it takes for successful “entrepreneurial administration” and about the role of the state as an affirmative driver of technological change.364 Future work in financial regulation should endeavor to build on these insights and apply them to the context of the financial sector.

Once the reality of regulatory leadership becomes apparent, a range of questions opens up. For instance, which institutional forms best support it? What does the role of regulator-as-catalyst require in terms of personnel? In addition to learning from the past efforts examined in this Article, financial regulators also have much to learn from innovation-generating regulatory approaches across the administrative state. But regardless of the specific shape it takes, a dynamic financial regulatory state will be able to actively lead efforts of technological change.

362. See, e.g., sources cited supra note 37.
363. Hu, supra note 18, at 1613.
364. Philip J. Weiser, Entrepreneurial Administration, 97 B.U. L. Rev. 2011, 2012 (2017); see, e.g., Zachary Liscow & Quentin Karpilow, Innovation Snowballing and Climate Law, 95 Wash. U. L. Rev. 387, 392–95 (2017) (“Most basically, innovation policy should be at the core of environmental policy—and likely other areas of policy as well.”).
CONCLUSION

Financial markets rely on complex infrastructural systems to intermediate transactions. Though many of these systems are constructed and operated by private-sector actors, they need not be designed to serve private interests, alone. To the contrary, financial regulators have the ability to reengineer infrastructural systems in service of public policy goals.

As this Article shows, the significance of this ability cuts against conventional understandings of the role of the state in financial-market evolution. It also highlights a range of possibilities for regulators to achieve policy goals through the governing force of market infrastructure design. But though the practice of infrastructural reengineering can be powerful, it is far from automatic, nor automatically beneficial. Regulators who attempt it must think creatively about how technology can be utilized to achieve regulatory priorities, must manage complex public-private interactions, and must take stock of the systemic consequences of infrastructural reengineering. They must also reimagine their own roles by embracing their ability to galvanize technological and institutional change. Only then will they be able to take full advantage of the ability to reengineer the infrastructure of the financial markets.