Sociologica. V.17 N.3 (2023)
ISSN 1971-8853

The Resource Bind: System Failure and Legitimacy Threats in Sociotechnical Organizations

Janet A. Vertesi* [a] danah boyd [b]

[a] Department of Sociology, Princeton University (United States)
[b] Microsoft Research (United States)

Submitted: January 7, 2024 – Revised version: January 24, 2024
Accepted: January 24, 2024 – Published: March 12, 2024

Abstract

This paper decouples legitimacy crises from technical failure, observing what happens when sociotechnical organizations confront a legitimacy crisis that does not stem from a technical failure. We draw on two parallel ethnographic studies within U.S. governmental agencies which administer complex sociotechnical systems: NASA and the Census Bureau. We show how *time* and *money* have dual, contested symbolic meanings that effect both the organizations' legitimacy and the technical viability of their missions. This duality places public-sector technical organizations in a bind, and enables hostile actors to push these organizations to the brink, triggering legitimacy crises by pressuring their systems toward technical failure. Efforts on the ground may enable these projects to survive technically, but at the loss of individual and institutional reputations that reconfigure institutional fields along politically expedient lines. We demonstrate the advantage of bringing an institutional perspective to technical system threat and failure by addressing broader questions of legitimacy in high-risk organizations and sociotechnical systems.

Keywords: Failure; Legitimacy; Organizations; Technology; Science.

Acknowledgements

This work would not have been possible without the support and openness of our informants at NASA, JPL, and the Census Bureau. We are also grateful to colleagues at 4S and at Data & Society for workshopping early versions of this paper with us, and to commentary provided by Paul Edwards and anonymous reviewers. We thank Kevin Ackermann, Ryland Shaw, and David Reinecke for research assistance. Vertesi's research was supported by NSF grants 1552469 and 1633314.

* jvertesi@princeton.edu

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1 Introduction

Technical failure remains one of the biggest threats to the legitimacy of technical organizations. There is nothing like a dramatic explosion, meltdown, or major service outage to put egg on the face of the organizations that administer these systems, undermining public confidence or sinking stock valuations accordingly (Chai et al., 2022; Downer, 2011; Perrow, 1999; Schmid, 2011). In addition to the safety, environmental, and other risk concerns involved, most sociotechnical organizations feel the imperative to minimize technical failure and thereby avoid the ensuing crisis of legitimacy (Chai et al., 2022; Lounsbury & Glynn, 2001). A wide range of literature on the causes and consequences of technical failure and on the appropriate management of risks serves as their guide. Famous analyses of disasters such as the Challenger, Columbia, Three Mile Island, or Fukushima generate cautionary tales alongside mechanisms for assessing risk (Perrow, 1999; Roberts, 1990; Sagan, 1995; Vaughan, 1996). Following certain dramatic failures, organizations take pains to cast problems as learning opportunities, rhetorically orienting audiences toward their continued credibility (Downer, 2007; Garud et al., 2014).

But a dramatic system collapse is only one way to delegitimate a technical organization. This paper describes another process, which we call The Resource Bind. We draw attention to an inherent duality in the symbolic meaning of the resources necessary to support a public-sector technical organization: both to expend judiciously as buffer against risk of failure, and to conserve in a strict audit culture. We show how, in a concerted effort to avoid technical failure, these resources (and their symbolic meanings) come into inherent and unavoidable conflict. In some cases, actors may withhold resources strategically from the organization, with the end result of reconfiguring a team in crisis and placing experts under strain. As members of these sociotechnical organizations confront the specter of technical failure while seeking to execute a public mandate, the impossibility of reconciling the competing meanings of their essential resources places them in an untenable bind.

Empirically, we reveal what happens to risk mitigation cultures and practices under the conditions of extreme audit culture. When a culture of "efficiency" and "austerity" dominates, the symbolic qualities of "more money" and "more time" are fraught with constraints. Our theoretical question concerns the causal order of technical failure and legitimacy crisis, particularly in situations where resources can be withheld or politicized to the strategic benefit of macro- and micro-political players. Prior studies listed above investigate legitimacy failures that follow technical failure, assuming that both are to be studiously avoided. In this paper we show how legitimacy failure and technical failure may not be arranged as expected under certain circumstances. For example, fear of technical failure may force a crisis of legitimacy absent technical catastrophes. This can then undermine technical organizations before their system is even launched. In other words, a legitimacy crisis can trigger technical failure rather than the other way around.

Our focus is two government agencies facing the starvation of resources that, for these technical actors, are essential ingredients for buffering against technical risk: *time* and *money*. While the dynamics we describe need not be limited to public sector organizations, these are fertile sites for investigating the Resource Bind in action. We describe two moments when powerful actors pushed these two organizations — NASA and the Census Bureau — toward what was perceived on the ground as assured technical failure. The goal was not to produce a misfired product, a meltdown, or an explosive accident. Instead, those actors who controlled the resources in the institutional field knowingly triggered a crisis of institutional credibility (DiMag-

gio, 1988). The resulting loss of political capital undermined a component of the administrative state and reconfigured a project and its players toward alternative aims. The story we tell is one where failure can be achieved not through a spectacular loss, but by pushing a technical organization to the brink via other means.

2 Background and Contribution

2.1 Forms of Failure in Technical Organizations

Studies of failure in technical organizations trend toward two observations. First, the causes of failure or catastrophe are often articulated in terms of arrangements of technical, environmental, or organizational resources. Developing Normal Accidents Theory, Perrow (1999, 2008) describes disasters like Three Mile Island as the inevitable result of tightly-coupled sociotechnical components that start quick and non-linear chain reactions that are impossible to control. Organizations take center stage in studies that focus on constraining risk through attention to culture and communication, reviews and training, as in dramatic studies of the Challenger loss (Vaughan, 1996) or nuclear safety (Sagan, 1995, 2004a). Adherents of High Reliability Organizations suggest that the judicious use of redundancy, modularity, backups, and checklists can render systems more robust, as in air traffic control (Boin & Schulman, 2008; Roberts, 1990) although this increases complexity and associated risk (see Sagan, 2004b).

Second, a crisis of legitimacy engulfs organizations in charge of producing, monitoring, or otherwise accounting for the failed technology after system breakdowns. Disaster review boards consider the frailty of human decision-making or the technical errors that lead to disarray (Downer, 2014; Hilgartner, 2007). A "forensic" or "future" approach of determining where and how systems and their teams went wrong dominates analysis in an attempt to prevent such accidents in the future (Downer, 2011; Jackson & Buyuktur, 2014). Projects adapt through repair, maintenance, and re-fashioning (Jackson et al., 2012; Steinhardt, 2016). For instance, the 2018-19 Boeing 787-Max-8 crashes in Indonesia and Ethiopia, or the 2024 loss of a phantom door from an Alaska Airlines flight, led to challenges to the company, tumbling stock prices, and grounding of fleets. Boeing's engineering and managerial expertise were cast into doubt, and the company has struggled to control the narrative and to articulate how their experts are necessary to resolve the crisis, especially when they presumably caused such a crisis in the first place.

To avoid such ensuing crisis, technical organizations may go to considerable lengths to frame certain forms of breakdown as success, as evidence of expertise, or as someone else's fault. For instance, private spaceflight developers like Virgin Galactic or Space-X live-stream their spacecraft blowing up on (or just off) the launchpad. Ironically for observers at NASA who would face decades of inquests, these newcomers frame their explosive losses as successful tests to bolster their legitimacy as newcomers (Vance, 2023). Or, as in the case of a deadly Virgin Galactic test flight, they may shift the blame from a nascent organization to a risk that affects the entire institutional field (Chai et al., 2022). Such efforts uphold organizational legitimacy despite technical failure. And the reputation of an organization can affect how much scrutiny it faces (Carpenter, 2010). Whether they can successfully hedge against the ensuing crisis of confidence or not, sociotechnical organizations and those who study them are attentive to legitimacy threats when they arise following technical breakdown.

If legitimacy crises are considered secondary to technical system failure, legitimacy is a constant theme in New Institutionalist studies of organizations, involving fewer spectacular

losses and more mundane mechanisms. Suchman (1995) synthesizes this perspective thus: "Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (p. 574). In other words, an organization's legitimacy rests upon a group's ability to "play the game" according to accepted rules. This game includes locally-acceptable methods of resource acquisition and rule-following (Stryker, 1994); responses to internal problems (Heckscher, 1994; Turco, 2016), uncertainty or exogenous shocks (Haveman et al., 2001; Srivastava, 2015; Vertesi, 2020), and shared cultural codes of expected behavior or structure (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). From this view, failure of mission and failure to play the game are not necessarily tightly coupled at all.

We argue that there is value in the New Institutionalist approach for studying this aspect of sociotechnical organizations. For instance, in organizational studies we observe regularly how inability to enact prescribed symbolic norms can precipitate an organization's decline in legitimacy within its institutional field, leaving such organizations to limp along without achieving their goals or to face general discredit (Hallett, 2010; Lounsbury & Glynn, 2001; Sewell, 1992; Suchman, 1995; Thornton et al., 2012). These organizations may even become caught in a vicious cycle of legitimacy loss, whereby their inability to match symbolic and practical activity compromise future acquisition of resources, which in turn limit their symbolic performance — and so on (Ashforth & Gibbs, 1990). And as organizations are known to straddle multiple fields, with local logics differing from one to another, it is fairly common to have multiple games afoot at once (Binder, 2007; Fligstein & McAdam, 2015).

For this reason, technical success may not be as critical for organizational legitimation as the symbolic management of resources and successfully playing other legitimacy-minded games. Many organizations remain legitimate institutional players even if they fail in their product or outcome goals, such as repeated losses or failure to turn a profit (Meyer & Zucker, 1989). Amid public-sector organizations, following regulation or adopting certain normative structures can be a key legitimation strategy (DiMaggio & Powell, 1983), as is subservience to political actors (Peirce, 1981). Or, as in Carpenter's study of the Food and Drug Administration (FDA), a public agency's perceived legitimacy may even rest on its ability to strategically avoid repeated oversight (Carpenter, 2001, 2010). This complexity suggests new urgency for understanding *sociotechnical legitimacy* as separate and apart from *sociotechnical failure*, especially in what Eyal (2019) terms as today's "*pushme pullyu*" of extreme reliance upon and skepticism of technical expertise.

If playing the game according to the rules is a phenomenon decoupled from outcome, we should expect shocks to legitimacy in technical organizations that do not arise from technical failure. In other words, legitimacy failure does not always follow system failure; it may be triggered in the absence of technical breakdown by a sense of not "playing the game" — a game in which avoiding technical failure is only one mode of play. And one of the most central legitimacy-oriented games for federal government agencies in the late 20th and early 21st century involves demonstrating efficiency in a language that Congress, politicians, and the public can recognize (Berman, 2022). Government workers must perform efficiency by showing that they are simultaneously working to prevent waste, fraud, and abuse while also complying with all of the "administrative burdens" introduced by Congress and the Executive Branch (Herd & Moynihan, 2019). In some situations, successfully performing efficiency is even more critical to legitimacy than executing the agency's purported mission. This tension is especially acute when the actors who help legitimize the agency do not want certain parts of the mission to be executed. For example, dynamics at both the Internal Revenue Service and the Secret Service

reveal both pressure to be efficient, and how resources are systematically constrained to achieve political agendas (Bagchi, 2016; Herd & Moynihan, 2019; Leonnig, 2021).

Because technical actors see legitimacy crises as a product of technical failures, they tend to focus on preventing technical failures rather than guarding against other sources of legitimacy crisis. Moreover, legitimacy crises can prompt leaders to constrain the very resources necessary to prevent a coming technical crisis, limiting technical actors' ability to prevent failure in future. In a public system in which the levers that control resources are politically imbricated and culturally construed, we observed legitimacy crisis was a considerable factor, and constantly at risk.

2.2 Risk Culture, Meet Austerity Culture

In our cases of technologies administered by government agencies, time and money take on a symbolic value in the legitimacy game as visible measures of public sector efficiency and compliance. Those working within government agencies have learned to operate within functional efficiency constraints and to speak the language of productivity, auditing, and accountability when articulating their needs and plans (Berman, 2022; Kraft & Wolf, 2018; Strathern, 2000). This includes judicious planning of schedule and cost estimation, detailed reviews of budget expenditures, and lengthy negotiations between parties under austerity metrics. The cultural value of money and time in this milieu — specifically, *less* money and *constricted* time as determined by cost and schedule modeling — is associated with local virtues of anti-corruption, small government, and an enterprise orientation. Public offices evaluate the use (or waste) of time and money constantly, with offices such as the Government Accountability Office (GAO) and the Office of Management and Budget (OMB) providing oversight and scrutiny, or public embarrassment for those unable to economize (Inoue, 2020).

This symbolic aspect of time or money comes into inherent conflict with its other role in sociotechnical systems: as resources necessary for the management of risky, complex, tightly-coupled technologies. Under these organizational logics, which undergird many a "risk culture" (Vaughan, 1996), technical expertise justifies the judicious expenditure of time and money in a buffering capacity to guard against disaster. This may be through the addition of redundancy (i.e. backup systems for monitoring, doubling oversight), resilience, or modularity (Boin & Schulman, 2008; Leveson et al., 2009; Roberts, 1989; Shrivastava et al., 2009). A deadline extension or an influx of cash may also help a team face an emergent problem on the fly, solve or plan for unforeseen problems, or ensure appropriate levels of redundancies in the system to guard against failure. Not spending such resources is also seen as expensive in the long run as lack of this investment it runs the risk of reviews, additional regulations, and technical losses if the project cannot be completed successfully and is not fully functional *on the first try*. For technical teams, certain temporal and monetary expenses are justified as an investment against risk of failure and as evidence of their experience and know-how.

We should not be surprised to see time and money acquire symbolic meaning in technical communities. A litany of sociological studies demonstrate how temporality and financialization are subject to social forces and contextual interpretation. Studies of time show how its meaning shifts and changes under particular circumstances, from the "clock time" of the factory, to the invention of the railway, to the experience of fast-paced global capital on our smartphones (Schivelbusch, 1986; Wajcman, 2015; Zerubavel, 1976). Socioeconomic accounts of money, currencies, and financial products demonstrate how value is predicated upon social relations, urban struggles, histories of colonialism and racialized relations (MacKenzie, 2006; Mu-

niesa & Callon, 2007; Robinson, 2020; Wherry, 2012; Zelizer, 1997). In these cases, neither time nor money are "fixed" but locally ascertained according to hierarchies of value (and technologies that naturalize such values), making these resources inherently "sociomaterial" (Haraway, 1997; Orlikowski 2007).

Yet austerity culture and its auditing toolkit (Strathern, 2000) sit awkwardly alongside the pressures of risk culture and its associated expertise (Beck, 1992; Vaughan, 1996). When two opposing cultural values of time and money come into conflict, we observe what we call *the resource bind*. Schedule releases or cash infusions can assist projects where the possibility of operational failure runs high, but adding redundancy or oversight is an expensive proposition. In the face of this symbolic aspect of cost and schedule in the public sector, the technical scientists, engineers, and managers we observed were placed in an impossible quandary. They could play the resource game by one set of rules to appear legitimate and expert in the eyes of their funders and continue the flow of resources. But to do so, they would need to put their time-honored risk-management techniques on the chopping block: eliminating spare hardware, canceling backup systems, compressing testing schedules, cutting software functionality, or restricting in-person meetings. In their eyes, such actions would risk the game by triggering technical failure and unleashing an ensuing legitimacy crisis due to loss of face in the public eye.

The result is a system rife for exploitation. Starving public sector institutions of resources and watching while they falter in their aims is not a new phenomenon in the United States or elsewhere (Berman, 2022; Carpenter, 2001; Maniha & Perrow, 1965; Pardo-Guerra, 2022; Pozen & Scheppele, 2020). While the work of government agencies is maintained primarily by civil servants and contractors, politically elected actors and partisan politics have control over many facets of the work, including both the legal requirements of the efforts and the purse strings. Continuing acquisition of core resources must be negotiated with these external stakeholders: the same stakeholders who also adjudicate the organization's legitimacy based on management of these resources. Public sector employees therefore experience cost and schedule as externally evaluated and controlled resources, negotiable but within well-defined limits, even as they grapple with how these values misalign with their keenly felt moral imperatives — a combination of local civic, technical, and professional logics. Further, when it comes to partisan politics, some have argued that there is no guarantee that those in power want a particular governmental agency or its mission to survive (e.g. Lewis, 2019; Moynihan, 2022b). The core finding of our paper is that this essential tension between these competing dimensions of cost and schedule produces a form of systemic threat, suggesting new questions for the study of failure and legitimacy in technical organizations.

3 Ethnographic Setting and Methods

To illustrate this in action, we discuss cases gathered by our two authors, each of whom conducted ethnographic fieldwork within a U.S. federal scientific agency. First, we draw on boyd's study of the 2020 U.S. Census. After completing background documentation, security checks, and trainings, and following two years of observing census planning preparations, boyd received permission to conduct research alongside civil servants: first on-site starting in 2019 at the Census Bureau Headquarters in Suitland, Maryland and then virtually in March of 2020 due to the Covid-19 pandemic. She had permission to attend meetings involving senior civil servants, project teams, and external coordination. boyd's initial involvement in what qualified as "Year 7" of preparations enabled her to build relationships with both bureau staff and external stakeholders in advance of the intense phase of the census. The study involved over one

thousand hours of direct observation of Census Bureau team meetings, as well as hundreds of one-on-one conversations with government employees and stakeholders. To supplement these observations, she also analyzed written communications and organizational documents and conducted 83 semi-structured interviews with those directly involved in the 2020 census. Fieldwork concluded at the end of 2022.

Next, we draw on Vertesi's study of NASA's mission to Jupiter's moon, Europa Clipper. This was largely conducted at the Jet Propulsion Laboratory (JPL) in Pasadena, California: the primary contracting center in charge of building the spacecraft and coordinating among contracted component and instrumentation providers. Principal Investigators (PIs) led the planning and construction of scientific instruments at multiple scientific institutions, with their science team distributed across universities and research institutes in the United States. Beginning in 2011, Vertesi attended planning meetings for this prospective mission, which was eventually approved for funding and development in 2015. For 14 months between the summer of 2016 and fall of 2017, she had badged access to JPL and a carrell with a desk in the mission planning center, where they attended meetings and other mission activities regularly. She also flew to mission meetings or scientific conferences located in other institutions, visited affiliated institutions affiliated, and participated in online meetings related to mission development until the summer of 2019. Findings are based on meeting observation and attendance, backstage chatter with mission personnel, 40 semi-structured interviews, daily recorded fieldnotes, and numerous conversations, memos, and jottings.

These ethnographies took place across the Obama, Trump, and Biden Administrations, a period of considerable fiscal and political uncertainty for public sector projects in the United States. The bureaucrats and scientists employed in both sites are well accustomed to political shifts. Throughout their careers, they have been consistently squeezed to do more with less, even when such efforts render their agencies and efforts brittle. Yet the heightened austerity prompted by the financial collapse of 2009, a non-traditional approach to the management of government agencies led by Donald Trump, and the Covid-19 pandemic from 2020–2022 meant that the work of procuring time and money while maintaining legitimacy became increasingly precarious. Under the resource bind, the very tools that sociotechnical organizations might use to reduce risk were not external symbols of resilience and responsible risk management so much as indications of agency inefficiency and waste. In both sites, the ethnographers watched as our informants scrambled to hold their projects together while being edged off a cliff.

4 Case 1. Scheduling a Census

For the U.S. Census Bureau, time limits are absolute, predetermined, and statutorily dependent. The census' temporal rhythm is enshrined in the Constitution and formalized through statute (Anderson, 2015). First completed in 1790, the census takes place every decade. Initially, Congress set the schedule anew each decade, but the Reapportionment Act of 1929 and Title 13 of the U.S. Code in 1954 codified a precise schedule defining when data are to be collected and delivered. By law, April 1 is "National Census Day": the day by which enumeration must officially begin unless there is "reason of climatic or other conditions which would materially interfere." Law also dictates that data representing the tabulation of the population must be delivered to the Secretary of Commerce (and thus the President) within eight months of the official April 1st start date so as to reapportion the House of Representatives. For almost

100 years, the Census Bureau dutifully delivered data by December 31st every 10th year of each cycle.

Civil servants at the Census Bureau, who never consider delaying their statutory deadlines, wrap their lives and plans around executing the schedule accordingly. In an effort to reduce *temporal* risk, the Census Bureau strategically builds temporal buffer into its plans. Years before the census begins, the distributed units submit time estimates to planners tasked with creating a master schedule. Managers and other leaders add a certain degree of additional time as buffer along the way. Congress, meanwhile, chastises bureaucrats for these temporal buffers, lamenting the lack of efficiency. Under the resource bind, this temporal buffer is seen as a tool of resilience to the executing party, and a product of wastefulness to its stakeholders.

The 2020 census operational plan had significant temporal buffer built into its original schedule, but, in the end, it was not enough. The practical work of conducting a census during a global pandemic created significant delays. Political fights over and legal micromanagement of the schedule added additional complexity. And just as the census was shifting into full gear in March 2020, municipalities around the country began issuing lockdown orders. The bureau announced that it was pausing its field-based data collection operations. The team began revising the operational schedule and procedures to account for stay-at-home orders. The most important factor in shaping their re-plan was the statutorily imposed deadline for delivering the data essential for the Constitutional mandate of reapportionment.

To maintain temporal buffer, the Census Bureau immediately sought an extension of said deadline to account for delays in data collection and process changes that would become necessary to account for disruptions introduced by the pandemic. Only Congress has the ability to officially grant an extension. The Secretary of Commerce assured civil servants that the White House was supportive and was working with Congressional liaisons to get a formal extension. Confident in the political machinery, the Census Bureau published a revised operational plan predicated upon delivering the first apportionment product in April 2021 — four months late. The bureau redirected the timelines of hundreds of thousands of workers and thousands of processes.

But Congress never passed a bill to extend the deadline. Then, in July 2020, the White House announced that President Trump would veto any bill that delayed the delivery of the census data. The Secretary of Commerce told the Census Bureau to rework its schedule (again) in order to deliver the data by the statutory deadline of December 31. The bureau announced this replan on August 3. The new plan shortened the length of field operations and post-data collection processing, but the primary cuts were to the temporal buffer.

Internally, this was called "the happy path" because there was no longer any space in the schedule for things to go wrong. But many things went wrong. Disruptions due to the pandemic were ongoing, the 2020 hurricane and wildfire seasons upended fieldwork, and efforts to collect data about college students were regularly stymied. This alone was enough to undermine the "happy path." Then the lawsuits began. A coalition of civil rights groups, local governments, and Tribal Nations sued the Census Bureau over its new schedule. Not only did the bureau need to devote significant resources to respond to the court case, but judges kept issuing orders that altered the schedule and workloads in ways that upended the system of people and processes. Eventually, the Supreme Court ruled that it had no standing to overturn the statutory deadline; this was up to Congress. The Census Bureau closed field operations two weeks later than its own estimate of the latest possible date in which data could be processed and delivered on time.

For the Census Bureau, a temporal buffer was essential to accommodate conditions that

drastically impeded their work. The schedule delays directly affected the production work. At the same time, the political spectacle and legal fight challenged the legitimacy of the bureau's work and the reputation of those involved in the system. Outside of public scrutiny, the bureaucrats focused on accommodating new threats (e.g., people being encouraged to fill out the census for others to avoid undercounts). However, they lacked the capacity and political savvy to curb the legitimacy attacks that emerged as external actors began to proclaim loudly that the census was fatally flawed.

As enumerators' jobs ended, public attention to the census waned; those who needed the data were simply left with an impression that the quality was dreadful. For the internal team however, the hardest technical work was just beginning. Data processing begins when the data collection ends. This involves a network of teams who must coordinate to process, evaluate, link, merge, edit, de-duplicate, verify, and finalize the data. Each tightly coupled step involves a series of technical, procedural, and human dependencies, and relies on the data existing in an exact format. Data processing was initially projected to take five months, adjusted to six months (a.k.a. 182 days) under the extended Covid-19 plan to account for the pandemic. By the time that the courts had finished ruling on their schedule, the Census Bureau was expected to execute these tasks in 77 days. With no relief in the statutory deadline, the bureau was pushed to the brink. Executives concluded that they could do it in 84 days if every procedure was tightened as much as possible, and nothing else went wrong.

Things went wrong. Almost immediately, "technical anomalies" were discovered. The team had expected these; they created temporal buffer to accommodate them. After all, due to lack of funding earlier in the decade, the team was unable to test all of the processing tools. The team didn't expect that dormant code brought back into view after a decade would run exactly as planned with new data streaming into the infrastructure for the first time in a decade. The "happy path" had no room for these technical anomalies. Temporally "in the red" due to Covid-related delays, under political pressure to speed up the work, and subject to legal dynamics where judges micromanaged the schedule, the bureau's production teams saw disaster on the horizon even as they worked long hours to resolve emergent problems in situ.

No one inside or outside the Census Bureau was certain what would happen if the census data were not delivered by the statutory deadline of December 31, *because it had never happened before.* Consistent with the resource bind, we observed a combination of honor and professional responsibility that drove these civil servants to see the statutory deadlines as inflexible. However important the statutory deadline is, the identity that anchors the bureau's statisticians is a devout commitment to data quality. As the situation was unfolding, numerous civil servants discussed quitting if they would be asked to publish shoddy data. Certainly, no census data are perfect, and the hard deadline has historically enabled a cultural process by which "good enough" does not get in the way of perfection. But the dynamics of the 2020 census positioned time and quality as oppositional goals. To complicate matters, the court cases had made visible how the bureau's baseline for quality permitted imperfection in ways that outraged external stakeholders who expected unachievable perfection. This helped fuel an external legitimacy crisis.

After working around the clock for over a month and repeatedly encountering technical anomalies, civil servants decided to warn the White House that they would need 20 extra days. Only a week later, an additional problem was detected that would require even more time. Civil servants understood the political ramifications of this — and they were anxious about how the White House might respond. In short, the delays would mean that the data would be delivered to incoming President Biden instead of outgoing President Trump. Many executives at the

bureau had been lambasted for being insubordinate; they feared being fired for doing their job. Representatives of the Trump Administration repeatedly told senior leaders that it was their job to deliver the data before the President left office on January 20, no matter what. The goal post had shifted — it was no longer about the statutory deadline, but the political one.

Civil servants did not try to delay the delivery of the data. To the contrary, they worked nights, weekends, and holidays trying to achieve what they understood to be impossible. In interviews afterwards, they described their fears and anxieties of failing to meet the expectations of the president. Senior leaders also recounted the political threats they faced from members of the Trump Administration along the way; they would publicly articulate some of them to journalists months later (Bazelon & Wines, 2021).

The situation came to a head on January 5, 2021 when the Director of the Census Bureau, a political appointment, requested that the Census Bureau deliver incomplete data. Civil servants were shocked by this request — which they saw as an attack on their professional responsibility — and used the whistleblowing processes to report malfeasance to the Office of the Inspector General (OIG). The next day's insurrection at the Capitol made the issue moot; the Trump Administration shifted its focus elsewhere. However, two weeks later, the OIG issued a report; short afterwards, the Director chose to step down before his term was over.

Congress never changed the statutory deadline, but President Biden issued an Executive Order on the first day of his term that explicitly stated that high quality data was more important than the statutory deadline. This did not provide statutory relief, but it gave the Census Bureau political air cover. The bureau offered a new schedule based on where it was at with its data processing and quality checks. No one challenged this new schedule. The first tranche of data was delivered in April 2021, almost exactly as the initial Covid-19 replan predicted. However, the costs of the resource bind to internal morale, the quality of the data, and the reputation of the bureau far exceeded projections.

Bureau employees recognized early on that the Covid-19 pandemic would challenge their schedule, even with the temporal buffer that they had baked into the plan. Their temporal buffer was designed to guard against a range of unpredictable technical delays, including a pandemic. But it was no match for a resource bind. Litigation that stemmed from and contributed to the legitimacy crisis while also further limiting its buffering resource. As the court cases unfolded, journalists and the public — not to mention politicians, data users, and civil rights advocates — began questioning the validity of the data while attacking the reputation of civil servants. Civil servants felt attacked on all sides, even as they were desperately focusing on preventing a technical meltdown. The Census Bureau delivered its key product, but the legitimacy and civil authority of the operation was left in tatters.

5 Case 2. The Costs of Clipper

The census case shows how time can be subject to a resource bind. On NASA's Europa Clipper mission, we observed similar dynamics around money — articulated as "budget" or "cost". Sending satellites into near-Earth orbit is expensive enough, but sending spacecraft into the outer solar system places additional demands on propulsion, navigation, radiation shielding, communications, autonomous systems, and scientific instrumentation. Efforts to get past the asteroid belt on the cheap fail to do so for less than a billion dollars in today's money, and each mission has unique requirements, posing challenges for an economy of scale. Historically speaking, NASA regularly faces the challenge of achieving its moonshot technical and scientific mandates while staying under cost projections at the same time.

Amid this background, the Clipper mission was born in a period of fiscal instability. Plans for investigating Jupiter's icy, water-world moon were conceived in the mid-1990s and a small group of dedicated scientists returned to these plans in the early 2000s. A Europa expedition was one of two missions placed into a "finalist" category to be considered for the next big-ticket mission to the outer solar system. At point of selection the mission was projected to cost in the mid-$2bn range (excluding launch vehicle cost), although this was contested by an independent cost review which put the price-tag over $4bn. When the market crashed in late 2008 and a new fiscal reality settled over Washington, officials rescinded the green light and insisted the team go back to the drawing board. A sample return mission to Mars was their top priority, the first portion of which would be flown as the Perseverance rover in 2020. The Europa mission could only fly if it could be redesigned for less. NASA even solicited proposals for a mission to Europa that could be flown for under a billion dollars.

An alliance between the Jet Propulsion Laboratory (JPL)'s director and an enthusiast Congressman from Texas kept the project alive (Brown, 2021). The Congressman wrote the mission's funding into a bill, requiring its launch in addition to the Mars Rover. This seemed a win for JPL: now they had two large missions in house, which meant money to keep the lights on and their experts employed. But at each request from Congress and NASA Headquarters, scientists and engineers had to squeeze their needs into an ever-smaller fiscal package while still meeting the technical challenges of getting to Jupiter, surviving its harsh radiation belt, and achieving basic science goals. JPL renamed their mission "Clipper" to recall the small, inexpensive shipping sailboats of the 19th century, communicating their commitment to austerity. Meanwhile, other scientists and aerospace contractors complained that JPL was eating everyone else's lunch and bitterly resented that — despite top billing in two decadal surveys in a row — in their view, the mission was moving forward thanks to a lab director's professional relationship with a Congressman (an arrangement not unheard of in NASA history).

Mission planners experienced their resource bind as mixed messaging about expenditures in an environment focused on austerity. The "science definition team" who recommends a suite of detectors for a nascent craft recommended a payload of six instruments. But NASA officials gave the green light to *nine* instruments to satisfy top level scientific goals, with no concomitant increase in cost agreements. Any instrument that went over its budget would be threatened with removal. Selected team members called this a "*Survivor*" approach to science, referring to a television series in which individuals who are unable to keep up with a demanding set of activities — and maintain good relations with audience members throughout — are voted off the show. Soon, instrument PIs were exhorted to cut costs by cutting back on the size and scope of their science teams. But one PI, whose instrument was inexpensive precisely because they had few collaborators, was confused when asked to *add more* scientists to their team to assuage risks of insufficient staffing and expertise.

Practical attempts to maintain the mission and constrain costs resulted in overages. For example, the Congressional bill required that the mission be designed to accommodate *one of three* potential launch vehicles, promoting fierce competition especially between SpaceX's Falcon Heavy and NASA's Space Launch System (SLS). Neither had yet been completed, designed, or tested, but all Clipper technical design decisions had to be made in triplicate to fit each rocket's unique payload faring and to satisfy this political requirement. This added cost and complexity. In another instance, NASA required all PIs to use specific cost estimation software in their proposals to standardize and produce trustworthy estimations. Several PIs confessed in interviews that they did not think this system adequately represented the cost of their instrument, with one admitting in an interview to purposefully underbidding to win the

contract. NASA also required all proposals to include a preliminary statement of cost from contracting companies to fix the budget up front. But PIs found that contractors' costs inflated from "projected" to "actuals" once their instrument was selected. By the time of its inception, the mission was *already* projected to run tens of millions of dollars over its projected cost.

Certain practices that emerged to contain costs jeopardized other elements of mission success. For instance, PIs were asked to meet early during planning to consider giving up certain aspects of their instruments, to offer elements up for redesign or review, to avoid full instrument removal. The project was also asked to track both cost and *cost risk*: a novel measure of how likely it was that an instrument's cost would exceed its budget. The administrator at NASA Headquarters required PIs to agree to both a "cost cap" and a "cost trigger process." If an instrument's risk of going over their cap appeared to increase, this would "trigger" a series of reviews and oversight from Headquarters to produce course correction. Now both cost-actuals and cost-risk needed to be measured, monitored, and contained, and PIs needed to demonstrate that both were under control. There was no explicit discussion of whether the additional overhead of these imposed reviews or tracking would increase costs by increasing personnel hours.

Power played a key role in the surveillance of resources subject to this bind. Frank budget discussions were generally taboo. Numbers related to projected overruns were kept secret and fluctuated with some frequency. The Project Manager (PM) held regular meetings with each PI to go over their current and planned expenditures. Mistrust abounded as PIs came to believe that the PM kept his own budget indicating what *he* thought their instrument should cost, judging their requests or reports against his "shadow budget" to determine their risks of cost increase. They feared this made it likely they would be voted off the island.

Like the Census Bureau's temporal buffer, NASA PMs are given some money to put aside, called "reserves," to resolve problems that emerge during development without having to return to Congress to ask for more funds. Clipper PIs believed this money was supposed to be earmarked for changes leveraged upon their instrumentation due to design changes made by the central project office. But the Project Manager was disincentivized to release "reserves" to instrument PIs. Since "reserves" were a fixed amount to use throughout the lifetime of mission development, he did not want to spend them too early. Still, the mission's three female PIs observed in interviews that the male PM was more likely to affably offer flexibility to some of their male PI colleagues with whom he had a prior relationship.

The resource bind was experienced as a dramatic tension in which PIs were held to the weighty requirement to demonstrate control over cost, while at the same time having little to no control over whether or not cost escalated in reality. More than one PI interviewed was reduced to tears or bursts of anger expressing that they had done everything they were supposed to do, they were on track for instrument testing, scope, and maturity, but due to factors outside their control their feet were being held to the fire. They were justifiably concerned if rumors about their costing woes would reach various higher up officials and affect their reputations, impacting the future viability of their instrument, science or leadership. The PIs were not the only ones under stress: the lab's legitimacy was also on the line, stretched as it was for personnel under the development of two major missions at the same time.

The resource bind also offered certain actors the opportunity for strategic restructuring. In 2018, the above-mentioned "cost trigger process" was set off by the least expensive instrument, the magnetometer. To ensure correct readings of the magnetic field, this instrument is typically placed on a boom that extends from the body of the spacecraft. When the team switched from nuclear to solar power early in development, this had downstream effects on the heating of the boom and its cabling that impacted the magnetometer. Many ensuing problems could have

been solved with a different kind of fiber-optic cable, directing reserves for procurement and putting additional experts on the problem. But under the resource bind, money was not forthcoming. The PM did not give out project reserves to the instrument PI. Her institution was already strapped for expert personnel due to the Mars mission under development. When other instrument PIs offered their own reserves to help procure the cable for her or find a cheaper version, the PM forbid it: they would each need their own reserves in case of future problems.

Other PIs leapt to her defense. This was disproportionate and unjust, they claimed. Since *cost risk* was a percentage measure pitting overrun against projections, an instrument pitched at $17 million incurring an additional $2 million looked like a large increase of cost risk on the chart, while a projected-$70 million instrument run by a male PI which regularly faced increases of far more than $2 million had not "hit" its trigger. But which cost mattered? The budget she had pitched was inflated at point of selection, and this differed again from her cost trigger point and projected cost including reserves. These many possible numbers made the problem and its cause open to interpretation. A series of reviews over several months saw the PI flown from California to Washington DC to present the ongoing situation to higher ups at NASA. In a few months, a PI at the same lab developing a Mars Rover instrument hit his trigger too and was called to reviews. It was whispered at the lab that Headquarters was determined to teach the lab a lesson about persistent cost overages. The question was which mission would bear the brunt.

A few months after the Europa-friendly Congressman lost his re-election in November of 2018, the magnetometer PI faced her final review. In an interview, she reported feeling good about her chances. She had figured out a way through the problem, had "constrained" (i.e. charted and figured out) the costs involved, negotiated a discount on the cable, and felt confident about the way forward. She hoped to convey that as PI she was taking full responsibility for her instrument's new plan and had both cost and cost risk under control. Her superiors, meanwhile, took a less optimistic view of the numbers. She was removed as PI, her instrument was downgraded, and authority over its construction was assumed by the PM.

Just as the Census schedule crisis reconfigured political actors, this moment reconfigured the field. The revised magnetometer had only basic capabilities, compromising Clipper's ability to deliver on the science goals that had sold it in the first place and leaving Europa scientists scrambling to figure out how to recover this essential data. The PM on Clipper kept his reserves and took further control over spacecraft redesign. Mars mission members interpreted the loss of the Clipper instrument as a shot across their own bow: fortunately for them, Perseverance cleared their review and kept their instrument. Headquarters representatives pointed to the magnetometer example as a lesson to their grantees to treat costs seriously. The descoped PI, meanwhile, faced reduced funding and loss of opportunities for the next several years in the scientific community. Five years later, the price of the replacement magnetometer is estimated at $80 million. As Lynne Zucker frequently reminds us (i.e. see Meyer & Zucker, 1989), the legitimacy game afoot may not have been about actual cost containment, even if its performance was important for the continuing status of its players.

Under the resource bind, demands for cost constraint repeatedly came into conflict with ongoing mechanisms for cost and risk control, stoking rising prices and rising blood pressure. This tension was especially keenly felt among PIs, who were under pressure to demonstrate efficiencies and savings while subject to rules that increased costs at the same time. PIs' resulting perceived inability to manage budgets triggered legitimacy crises in the absence of any technical failure. Meanwhile, the bind presented opportunities for enacting power and restructuring towards its centralization. Micro-political players deployed personnel, reviews, "triggers" and

other mechanisms to force individuals and institutions into a corner, preserving certain players at the cost of others. This reconfigured the mission and its capabilities, not the least through the reconfiguration of a key (and initially inexpensive) science instrument. Small wonder that for the scientists exploring Europa, orbital dynamics often appeared to be more accommodating than these otherwise intractable, unpredictable, and personally devastating interactions about cost.

6 Discussion

Neither project failed from a technical standpoint. The Census Bureau delivered a census, and Clipper is on track to launch in late 2024. However, near-failure looms large in both stories, alongside struggles to negotiate threats to legitimacy and play a broader array of games that have little to do with technical success. The participants we observed operated frenetically at what they saw as the brink of twin catastrophe: the potential inability to deliver on their technical and scientific requirements, and the potential inability to deliver on schedule or on budget. Caught in their respective resource binds, they experienced overwhelming pressure to fulfill both needs at the same time. As they labored to ensure both operational and organizational credibility, they confronted ever-present threats to their personal reputations, to the validity of their scientific findings, and to their institution's status. They repeatedly experienced a feeling of being the proverbial frog in the slowly boiling water, aware that everything was on the brink of collapse, desperate to avoid it, and unable to avoid the increase in temperature. We believe that these conditions suggest new ways forward for linking the literatures on failure and institutional analysis in sociotechnical organizations.

6.1 Decoupling Technical Failure and Legitimacy Crisis in Sociotechnical Systems

In prior cases of scholarship on technical failure, scholars assume that failure is a situation to be avoided. Funders want projects to succeed. Actors on the ground go to tremendous lengths to adequately capture, characterize, and constrain risk, or to recharacterize a loss in such a way as to preserve the legitimacy of their organization. However, the formative case studies that undergird analyses of public sector technical failure largely took place during the latter half of the twentieth century: a time of government support for infrastructural resources, investment in public technoscientific literacy, and widespread trust in technical expertise.

We suggest that these conditions have since changed. The public sector projects we observed were underway at a time when American support for government is in freefall (Andrews & Boyne, 2008; Light, 2014), public confidence in technoscientific experts is under continual challenge (Eyal, 2019), austerity measures imposed by politicians have heightened existing inter-agency competition (McCurdy, 1994), and politicians call for the dismantlement of the administrative state (Lewis, 2019; Moynihan, 2022a; Rose-Ackerman, 2019). We return to the implications of this empirical setting below. Conceptually, however, such times bring new features of sociotechnical system management in the public sector to light, revealing prior assumptions based on institutional stability that were perhaps misplaced.

One such assumption is that legitimacy crises must necessarily follow system failure. We argue these must be analytically decoupled, and that moments of legitimacy crisis prompted by fear of failure or lack of resources deserve closer attention. In the NASA case, overall technical success was still achieved and the spacecraft will (hopefully) not blow up on the launchpad, at the sacrifice of individual, laboratory, and agency reputations along the way. But the very

mechanisms put in place to perform efficiency toward agency stakeholders in many ways continue to undermine that same efficiency, making true savings increasingly difficult to achieve. It will take additional labor, money, and (it turns out) strain on the spacecraft to achieve its science goals. And the project will not stay under its budget. These circumstances pose ongoing legitimacy threats to the sociotechnical system, undermining the organization's continued credibility and reconfiguring the system accordingly.

Similarly, the 2020 census was performed, and data continue to be delivered. But draining the bureau of additional time in a period of crisis undermined its institutional legitimacy and the validity of its scientific product in ways that are still affecting the agency. While there will never be a perfect census count, there *is* an internal definition of success that census employees adhere to. However, the struggle to deliver the data in a highly politicized context helped reveal epistemic disconnects between stakeholders and the bureau (boyd & Sarathy 2022). While previous methodology controversies obfuscated political battles (Bouk & boyd 2021), political struggles for legitimacy polluted how people perceived methodological decisions during and after the 2020 census. In short, various stakeholders believe that the data were fatally flawed because of what had unfolded and they interpreted the data accordingly. Given this, it is important to attend to how legitimacy crises help push organizations to produce products that are deemed untrustworthy, a technical failure in the eyes of bureaucrats. Legitimacy crises can still reconfigure the organization and institutional field in important ways, even if they are not a product or trigger of technical catastrophe.

6.2 The Resource Bind in Action

The resource bind is not merely experienced by schedulers, cost estimators, or managers. It works its way into the everyday practices of members of each organization as a core tension. For the workers we observed in government agencies, economizing time or money was a virtue, as a call both not to "waste tax-payers' dollars", and to "deliver on schedule" Concern for saving money and time has been part of each government agency since the late 1960s, picking up steam in the 1980s and 1990s. For instance, NASA experimented with a guiding agency philosophy of "Faster, Better, Cheaper" (Kaminski, 2012; McCurdy, 2003) while the Census Bureau created an "Innovation and Operational Efficiency" program to help justify innovation through the language of "cost-savings" (Callen, 2016). And cost and schedule estimation are an essential part of any technical manager's training since their formulation as domains of expertise in the 1960s.

Still, the increased pressure to do more with less grows increasingly untenable. NASA's "Faster Better Cheaper" program was widely seen as a failure when two high-profile Mars missions built under this philosophy were lost in the late 1990s. Under that mandate, teams traded (less) time and (less) money for (more) risk, causing scientists and engineers to grumble: "Faster, better, cheaper — pick two!" Contemporary teams spend considerable time in prioritization meetings aiming to identify which core capabilities can be traded away for "cheaper" and "faster." Meanwhile, even though the Census Bureau continues to publicly speak of "cost-savings," those involved with the work privately recognize that, at best, innovation reduces the scale of escalating costs as the bureau struggles to do more with less. In other words, the symbolic meaning of economization is not external to the organization, but felt deeply by its members and, additionally, experienced in tension with their technical requirements and pride in expert execution.

The resource bind also deeply impacts bureaucrats' sense of technical virtue and personal

expertise, which further degrades the morale in the public sector. We observed technical experts attempting to prevent catastrophic failure even as their actions weakened their organizations' reputations, attracted the ire of political appointees, and risked the legitimacy of their project in the eyes of certain stakeholders. They appeared to hope that technical success would regain any credibility lost in the process. But failure to deliver on schedule and within budget produces reputational damage, as evident in the case of the PI and the lab, or the perception of census data quality. Moreover, agencies must suffer the reputational consequences even if the conditions are configured externally to ensure that successful completion of on time and within budget is impossible. Teetering legitimacy makes it even more challenging for civil servants to effectively appeal to a Congressional committee for additional time or money, creating a caustic feedback loop.

We also witnessed accountability shift onto actors within our field sites who were made to absorb organizational delegitimization, both personally and reputationally. The sociotechnical configurations of these systems were already brittle, spread across politically appointed stakeholders and external contractors. The PI on Clipper whose instrument was cut suffered reputational damage. It was only a few years later, when the PM retired, the laboratory director was replaced, and the Headquarters administrator departed, that her story was revisited. Still, continuing reviews plague her institution, whose overruns undermine its credibility as contracting partner.

If the NASA case concerned institutional micropolitics, the Census Bureau case revealed a macropolitical dynamic. Actors in this case responded to pressure quite differently. After a year of political games surrounding the schedule, as civil servants attempted to appease Capitol Hill's pressure to do the impossible, civil servants decided to push back. Not only did they inform the political leaders that their schedule was infeasible, some leaked this impossibility to the press while others used the whistleblowing system within government to ensure that external stakeholders knew that they had put their foot down (Bazelon & Wines, 2021). In doing so, they attempted to shift the burden back up the chain to the politicians. While such an act of bureaucratic resistance did not prompt Congress to provide statutory relief, it created just enough temporal flexibility to keep working. Civil servants drew on the illusion of neutrality through commitment to process to shield their organizations from accusations of politicization, but by the end, accusations of political interference and questions of legitimacy were pervasive.

While neither performance of efficiency was ultimately efficient, these legitimacy-oriented performances are not "merely" performative: they have consequences for resulting technological arrangements (MacKenzie, 2006) as well as for configuring the institutional field. On the technical side, changes in scope, rescheduling, contracts, and similar efficiency mechanisms altered the apparatus and functioning of each system, increasing technical complexity and risk. Within the institutional field, these same mechanisms upheld the narrative that the private sector was more efficient and that the public sector employees and laboratories were less competent. We overheard versions of this story at the Census Bureau in reference to social media data as a population registrar or at NASA with respect to their partners in "New Space". The loss of face and sense of exhaustion we observed among workers at government agencies often translated to their departure, taking their knowledge with them. As a deinstitutionalization mechanism, then, the resource bind contributed to a neoliberal technopolitical orientation (Hecht, 1998; Mitchell, 2002) visible both in the technological systems themselves, and in a shifting institutional field that increasingly built up capacity outside of the agency and hollowed out government expertise (Barley, 2010). We turn to this issue in more detail below.

6.3 The Resource Bind as Tactic

Why would those who administer large sociotechnical systems purposefully court failure? This was a puzzle to us throughout our fieldwork. Admittedly, individual agency is a long-standing puzzle in institutional theorizing (DiMaggio, 1988). From the ground, at least, it seemed that certain stakeholders were "willful actors" (Abdelnour et al., 2017) who actively vied for technical failure as a strategic outcome to undermine the project and to contribute to what DiMaggio identifies as deinstitutionalization, a reconfiguration of the institution, its goals, and agential players (DiMaggio, 1988). Certainly, it was in an outgoing president's political interest to demand a deadline for the census before departure and to stir public ire against the bureau when they could not deliver. It was also politically advantageous for civil rights advocates and Democrats to upend the schedule through litigation to prevent on-time delivery, regardless of the reputational costs. So too was in the Project Manager's interest to remove an instrument to facilitate an architectural change without losing precious reserves. And to NASA Headquarters, sanctioning the magnetometer served as a warning to constrain costs on the adjacent Mars mission without compromising its technical capacity.

As much as there are moments where where we might surmise external stakeholders have a vested interest in shaping the schedule or resources, this does not explain why some actors are willing to risk the legitimacy of the work altogether. Hence, when considering the outcomes of field reconfiguration as a result of the resource bind, we find it useful to consider how such activities constitute "policymaking by other means" (Herd & Moynihan, 2019). A politically constructed ideal of *efficiency* has been used by politicians to undercut government projects with increasing intensity since the Johnson administration (Berman, 2022; Gore et al., 2001), including the use of austerity measures as a tactic to dismantle government agencies and reconfigure them toward outsourcing or downsizing (Barley, 2010; Mettler, 2011). Excessive use of procedures is another path (Bagley, 2019). However, we may be witness to a new battleground in the deconstruction of the administrative state (Moynihan, 2022b). Placing technical organizations into a resource bind — in which they must accept a trade-off between their organization's continuing credibility on the one hand, and the technical capability of their product on the other—is another way in which hostile actors may influence government organizations under this mantle. When a policymaker cannot dismantle or control an organization through fiscal starvation or legislative action, they can introduce alternative requirements that set agencies up to fail by creating impossible binds, and watch the ensuing reputational damage to civil servants or public agencies as they fail to play the game.

We noted that the result of this hostile use of the resource bind is a reconfiguration of the institutional field (or, "deinstitutionalization," per DiMaggio, 1988). We saw talented public sector scientists and technicians retire early due to sheer exhaustion or leave their positions for private sector jobs. Additional personnel policies — even the proposed but not implemented Schedule F (Moynihan, 2022) — also demoralized workers. Fiscal uncertainty produced by increasing rates of government shutdowns and budget continuing resolutions added additional pressure. These collectively weaken the administrative state while also increasing the likelihood of future catastrophe due to loss of expertise and community ties. While our data left us unable to understand the true motivations of the political actors who stoked the resource bind and left our fieldsites in crisis, future work should return to this question to more robustly theorize questions of intentionality and agency in institutional contexts.

The public sector technology agencies we describe reveal the paradoxes of the resource bind in technicolor. Yet there is no reason to believe these mechanisms are limited to government. Fi-

nanciers and executives regularly push for efficiency in corporate life, and organizational leaders use a wide variety of carrots and sticks to incentivize and pressure workers to achieve particular outcomes. Of course, it is commonly understood that managerial tactics are used to produce *more* not to achieve *less*, let alone to outright trigger failure as in the case of the resource bind. And unlike federally mandated agencies, companies regularly close down when market fit disappears, financial conditions change, or the team is unable to deliver on promises. Yet powerful actors in a corporation can create the conditions to intentionally spur the collapse of a division or ensure organizational meltdown through acquisition, private equity, or hostile takeovers. Future work may articulate how actors on the ground respond in these settings respond to a resource bind where sociomaterial values of key resources experience a rapid, paradoxical shift.

7 Conclusion

Scholars of sociotechnical systems would do well to consider the institutional fields in which their organizations operate, the competing cultural valences of relevant resources, the political characteristics of restrained resource management, and the contradictory mechanisms of legitimacy between, in our case, technical authority and audit cultures. Examining situations where micro- or macro- actors push toward failure through the withholding of sociomaterial resources — and imbue requests for such resources with negative qualities of wastefulness and inefficiency — shows how these organizations end up with compromised systems and egg on their faces to boot. Such legitimacy crises ultimately impact an organization's opportunity to appeal for further buffering resources in the management of their continuing sociotechnical systems. Continued funding and schedule opportunities are on the line should an institution face delegitimization in the view of political actors who define the system's constraints.

Bringing an institutional eye to high-risk systems-in-formation during this historical moment in public sector work reveals previously unexposed factors that push toward failure in multiple ways. Decoupling technical failures from legitimacy failures enables us to observe those moments when systems are placed in an impossible bind. When an organization's reputation bears the brunt of crises as fiscal and operational efforts are squeezed, this rearrangement may be to the benefit of a competing organization, or an agency with oversight situated among a broader institutional field of players. We suggest that legitimacy crises among sociotechnical organizations are far more commonplace and even politically expedient than we would otherwise assume, and do not always occur as a result of technical loss.

In many ways, legitimacy crisis without technical failure may appear easier to the public eye. The census did not fail at collecting data, and nothing blew up on the launchpad. There are also elements of these organizations that are, admittedly, uniquely extreme. For example, it is not possible to reduce risk through radically reducing the scope or scale of the product (Brown & Jones, 1998; Light, 2014; Miles & Snow, 1992) when these are federally mandated. Further, there was nothing *entirely* exogenous about the impacts in the cases we observed, as the scientists and civil servants we witnessed walked onto the floor of Congressional hearings to account for their activities and petition for resources directly. Given the active and highly sociopolitical mechanisms we witnessed, we are hesitant to view these stories in the light of 'mere' resource-dependency and more as a question of how actors manage competing logics associated with those resources in institutional fields. We witnessed how keeping up appearances and managing these competing forms of legitimacy produced continuing cascades of risks to sociotechnical system design. Even if a system manages to scrape by or avoid catastrophe, its

sociotechnical organization accumulates blame and further resource loss over the "mismanagement" of their system. This makes their mission quite simply impossible.

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Janet A. Vertesi – Department of Sociology, Princeton University (United States)
https://orcid.org/0000-0003-4579-6252 | jvertesi@princeton.edu
https://janet.vertesi.com
Janet A. Vertesi is Associate Professor of Sociology at Princeton University (United States). A specialist in science, technology, and organizations, she is best known for her ethnographic studies of NASA's robotic spacecraft program, including two books, *Seeing like a Rover* (Chicago, 2015) and *Shaping Science* (Chicago, 2020), and for her editorship of *digitalSTS* (Princeton, 2019).

danah boyd – Microsoft Research (United States)
https://orcid.org/0000-0002-7722-7778
http://www.danah.org/
danah boyd is a partner researcher at Microsoft Research, a distinguished visiting professor at Georgetown University, and the founder of Data & Society (United States). She is known for her studies of how structural inequities shape and are shaped by technologies, especially in media manipulation, algorithmic bias, privacy practices, social media and teen culture. Her best known book is *It's Complicated: The Social Lives of Networked Teens* (Yale University Press, 2014).