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Imaginaries, Interactions and Impact

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Chapter 18
Silicon Valley's Frictionless Future: The Design Philosophy of Frictionlessness

Abstract: This chapter aims to *problematise* the seemingly benevolent philosophy of frictionlessness and to *criticise* the way in which this design philosophy is mobilised to serve Silicon Valley's ideological and economic interests. In doing so, we *reframe* the notion of friction in order to envision a more (re-)humanised automated future. The chapter realises these aims by first providing a theoretical background in order to contextualise the relationship between frictionlessness and design. We do so by charting the industry's abstract discourse around the notion of frictionlessness, in which friction is presented as an undesirable element in human–technology interactions that should be eliminated. Specifically, the meaning of friction is examined through a discourse analysis of over thirty years of trade publications, corporate materials, and news articles about Microsoft, Amazon, and Facebook (now Meta). With these statements in tow, we extrapolate the two principles of the design philosophy of frictionlessness: technological expansion and obfuscation. Keeping these principles in mind, we advance a critique of how the corporate discourse glosses over (or, worse, sanitises) a host of undesirable cognitive effects and ecologically toxic conditions. Overall, this chapter assembles the underlying values at the core of Silicon Valley's automated future and, in elucidating the harmful centrality of frictionlessness to contemporary digital technologies, concludes by emphasising the need to reframe friction as a hopeful interaction that is necessary for human agency and planetary care.

Keywords: frictionless, Silicon Valley, design philosophy, digital technology, discourse analysis

1 Introduction

From Meta's call for a 'zero friction future' (Facebook, 2017) and Amazon's professed 'obsession' with 'eliminating friction' (Colvin and Derousseau, 2017) to Bill Gates's dream of a 'friction-free capitalism' (1996: 180), Silicon Valley has been preoccupied with friction. Indeed, as media theorist Jathan Sadowski argues. 'frictionless' today serves as one of Silicon Valley's ultimate buzzwords (2020: 47). This term suggests that technology should seamlessly embed itself in the user's everyday life, facilitating instantaneous commercial transactions by eradicating all possible points of resistance. Following this vision, automation—whether instantiated within virtual assistants,

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smart objects or algorithmic recommendation systems—must be mobilised to bolster an ethos of seamless connectivity and agency.

While the discursive and aesthetic qualities of 'friction' have been incorporated into earlier studies of digital technologies (Bratton, 2015; Zuboff, 2019), friction has been undertheorised within the fields of media studies and the philosophy of design. This chapter seeks to fill this gap by drawing attention to how corporate discourses about human–technology interaction are guided by the ideal of *frictionlessness*, a distinct design philosophy that trades in the rhetoric of immaterial services in order to relocate our attention away from the deeply material aspects of its operationalisation. To investigate the content and application of this philosophy, we ask: how have Silicon Valley corporations described a growing experiential realm of flawlessly mediated interactions? Which principles of design emerge from this abstract discourse? What are the ramifications of the far-reaching glorification of seamless and immersive design? And, extrapolating from current conditions, what kind of future is Silicon Valley constructing by encoding its philosophy of frictionlessness into the fabric of automated technologies? Ultimately, we argue that Silicon Valley's design philosophy of frictionlessness predominantly mobilises automation to buttress a logic of technological expansion and obfuscation, which paves the path for an automated future that is not only undesirable, but also unsustainable.

To support our argument, we conduct a discourse analysis of three major articulators of frictionless design in Silicon Valley: Microsoft, Amazon, and Facebook (Meta). Our analysis, which concerns the investigation of 'a particular way of talking about and understanding the world' (Jørgensen and Phillips, 2002: 1), considers this design philosophy as an 'abstract discourse' (p. 20) which attends to 'general, overarching patterns [. . .] that circulate in society at a particular moment in time or within a specific social domain' (p. 20). To avoid confusion, our focus on abstract industry discourse also means we do not examine everyday discourses of addressing friction within design, such as those found in discussions of 'frictionless design' by design practitioners and HCI researchers (Cox et al., 2016). While such research into the relationship between design philosophy and design practice would be valuable, we focus predominantly on how major tech companies themselves have publicly espoused frictionlessness.

We begin by analysing Bill Gates's best-seller *The Road Ahead* (first published in 1995) where he popularised a capitalist approach to rhetorically connecting digital internet technologies with the notion of friction. In using these connections as the analytical scope of the chapter, we then examine the 'interdiscursivity' (Jørgensen and Phillips, 2002: 73) of a multitude of texts that borrow from and extend Gates's vision. These include court documents and popular press publications that detail Microsoft and Amazon's respective attempts to shape the market in accordance with their own frictionless software; advertorials and press releases dealing with Facebook's initiatives to become an infrastructure for business; and additional sources found through custom period queries of 'friction' or 'frictionless' in Google Search that concentrate on corporate and

news archives concerning these three corporations. Occasionally, documents were collected using the Internet Archive's Wayback Machine when these sources are no longer on the live web (Ben-David and Amram, 2018). In total, we collected 23 texts from 1995–2019 to outline Silicon Valley's abstract discourse of frictionlessness.

The chapter is organised as follows. We first elucidate what it means to conceive of frictionlessness as a design philosophy. We then chart Silicon Valley's dominant discourse about frictionless design which provides its central principles of simultaneous expansion and obfuscation of technology and automation. We then advance a critique of how this design philosophy seeks to delimit the shape of the future and comprises a materially and ecologically destructive project. Subsequently, we emphasise the need for a reframed interpretation of friction that recognises its value to human thought processes and activities. In doing so, our chapter seeks to pry open the black box of Silicon Valley's automated future and, in decoding the harmful centrality of frictionlessness to contemporary design, we suggest that a hopeful world rests on the collective ability to recognise the value of friction.

2 Frictionlessness as a Design Philosophy

Friction is generally defined as the resistance that is generated when different objects interact. While originating from the field of physics and tribology, this term has rich cultural associations (cf. Tsing, 2005) for describing anything from social mishaps and communicative discomforts to institutional strife and geopolitical conflict. The field of technology, too, has found ample use for the notion of friction. Here, it emerges as a productive term to characterise degrees of smoothness in human–technology interaction. While our focus is on frictionlessness as a contemporary phenomenon that most adequately captures the stakes of Silicon Valley's designs, it is important to note that its emergence is part of a longer history. For instance, one pivotal moment has been thoroughly conceptualised by Luc Boltanski and Eve Chiapello (2007) through their examination of the new spirit of capitalism that followed the student protests of 1968. This new spirit, which testifies to capitalism's capacity to sublimate dissent, precipitated the rise of a 'connexionist' world in which connectivity and activity emerged as technological, cultural, and economic imperatives. Accordingly, anything that negated smooth interaction was to be rejected, discouraging any notion that frictional interaction could possibly prove productive or pedagogical. In such a world, the reticular capacities of computational technology should be marshaled with the goal to facilitate connection. In 1995, Richard Barbrook and Andy Cameron famously related such transformations within capitalism to the emerging Californian ideology that formed from the technological centre of Silicon Valley. Adherents of this ideology believed that their neoliberal vision of community and connection could be realised through the liberatory capacities of the computer, the clear subtext being that this dissolution

of friction was an inherent quality of digital technology. In glorifying these ideas, Silicon Valley built the foundations for an automated future where all activities would be mediated through, and often even entirely delegated to, the seamless interaction with digital technologies (Kemper, 2024).

Yet what does it mean to conceptualise frictionlessness as a *design philosophy*? It is to suggest that frictionlessness generates a particular vision of what the world can and should be, and that this vision is deeply material in its operationalisation. As the American architect Louis H. Sullivan already demonstrated (1896) in his treatise on tall office buildings, a design philosophy is more than a memorable phrase like 'form ever follows function'. In his own words, it orients the act of designing towards creating objects that radiate an ontological truth—'the law'—of how things exist (1896: 408). This is also the point that Clive Dilnot made when reflecting on Tony Fry's philosophy of defuturing. He posited that a new philosophy of design is also 'a new philosophy of existence and of acting in relation to new conditions of existence' (2020: xvi). In other words, the conditions of existence are not timeless nor simply waiting to be discovered. The new methods of making—and the new materials to make with—can produce objects that actively re-articulate the conditions for bringing additional objects into existence. By implication, a design philosophy renders design as an activity that does not simply make things; it actively constructs the world (p. xvi). This perspective was echoed by Bruno Latour who argued that design is formally the practice of working on 'how to *draw* things together' (2009: 3, emphasis original). Design is therefore an argument about how we *should* gather material and semiotic relations together while simultaneously existing as evidence of the truth behind their making. We argue that frictionlessness as a design philosophy operates exactly along these lines, and that it presents a vision of automation premised on technological expansion and obfuscation. We support this argument by first answering the following question: which kinds of designed objects, relations, and conditions has Silicon Valley historically attached to the notion of 'frictionless(ness)'?

3 A History of Frictionlessness

Bill Gates, in his co-authored book *The Road Ahead*, presented a vision of the Internet as part of a long lineage of technologies designed for reducing 'the distribution friction of information' (1996: 138). The CEO of Microsoft at the time argued that with each subsequent development of communication technologies, the physical constraints of transmitting storable media had seemingly decreased and the variety and accessibility of consumable information had increased. Yet, he lamented that it was at the till, with the high prices being paid for information goods, that the vast system of distribution was still felt—abrasively, unnecessarily—by the consumer. However, be-

cause the 'information highway' could automate the distribution system it would 'be largely friction free' and remedy the risk of money being dissipated (p. 138).

At this point in the 1990s, Gates could already point to Bulletin Board Systems and email as examples of the Internet's capacity for 'low-friction' distribution. However, to achieve a 'shopper's heaven' in the fullest, his vision required the Internet to fully support 'friction free capitalism' (p. 181). In his chapter of that name, he outlined the technological provision of 'instantaneous information about worldwide supply, demand, and prices' (p. 180). Moreover, he imagined that the decisions of buying and selling would themselves be automated through software that could track what consumers read and bought (p. 191). In other words, Gates saw the Internet's capacity to circulate data as a way to design extensive profiles of every buyer and seller, automating their relationships within the market.

It is unsurprising that the CEO of a successful software company imagined the Internet as a marketplace, one that would position software companies themselves as the architects of a space where 'all human activity takes place' (p. 6). Therefore, by making capitalist exchanges not just 'low-friction', but *friction-free*, the design of an object like the internet-as-market would make the friction of running this system recede into the background. While admonishing the metaphor of the 'information highway' (p. 6) for how it highlighted the infrastructural nature of digital technologies—and not its applications—the title and content of *The Road Ahead* announced how much Gates understood he was building an infrastructure for the market.

But Microsoft's frictionless Internet was not frictionless for everyone. In 1995—the same year *The Road Ahead* was published—Microsoft not only released a version of their flagship OS Windows that made it impossible to uninstall their web browser Internet Explorer, but they also designed the OS to ensure 'that running any other browser is a jolting experience' (United States District Court, 1999a). By purposefully making it difficult for Windows users to access the web from a competing browser, Gates created frictionless environments in one way (an OS with a pre-installed web browser), while actively obscuring how Microsoft relocated friction to both users and competitors. Another aspect of Gates's visionary terminology was that it was used to attract business clients. In a 1999 press release Microsoft announced 'Friction Free Software' that allowed for 'scalability, reliability, response time, load balancing, security'. Here, the vision of reducing friction was not for consumers, but for business clients who would use software as a service which acted as the 'plumbing' for 'business-critical applications' (Microsoft, 1999). Again, the reduction of friction was articulated in infrastructural terms.

This push toward friction-free software paved the way for a style of thinking that also took hold elsewhere. Almost echoing the language of Bill Gates twenty years earlier, a 2017 *Fortune* article lauded how Amazon, another stalwart of the 1990s Silicon Valley scene, had led the 'digital revolution [in] creating a radically more friction-free economy' (Colvin and Derousseau, 2017). This leadership in frictionless ecommerce design began with Peri Hartman's 1-Click software. As one of Amazon's programmers,

Hartman recalled how Jeff Bezos wished to streamline their ordering process. Bezos said, 'We need something to make the ordering system frictionless. We need to make it so the customer can order products with the least amount of effort. They should be able to click on one thing, and it's done' (Brandt, 2011). This idea of single click ordering became the 1-Click button that Hartman designed, a button that automatically added purchasing information related to a user when they put a product in their 'shopping cart'. By 1997, 1-Click was active on Amazon.com (Amazon PR, 1999).

Because the idea of the 1-Click button was relatively simple, Amazon's competitor Barnes and Noble implemented their own version—but they were sued in 1999 when Amazon put a patent on the system. In the court proceedings, the connection between this design and friction was highlighted by both Bezos himself and an e-commerce expert. Their statement read that 65% of all shopping cart orders were not completed, and the 1-Click button was adept at "reducing 'friction'" and therefore increased 'the likelihood that the customer will complete that purchase' (United States District Court, 1999b, §57).

Amazon spent the next twenty years expanding the premise of the 1-Click button with their In-App Purchasing and Login with Amazon services, each of which promoted the way that reducing friction would 'drive more revenue' and 'order conversion' (Amazon PR, 2012, 2013). This logic was also extended to developing platforms that offered services to automate the storage, access, and computation of massive amounts of data. For example, their foray into cloud services in the late 2000s promised to provide 'minimal friction', 'avoid the friction' of scaling new data infrastructures, and create a 'friction-free experience' (Amazon PR, 2008–2010). Beyond these examples, Amazon's scope extended toward automating 'replenishment' orders through devices and software that would 'automatically reorder physical goods from Amazon' when they ran out (Amazon, 2016). Amazon's smart speaker and voice assistant technologies, too, have long been framed to eliminate friction: as Ruhi Sarikaya—director of applied science for Amazon AI—effusively explains, Amazon Alexa is designed to remove 'friction in [. . .] customer's interaction with the physical and digital world' (2018). It is from the steadfast integration of the logic behind the 1-Click button into a wealth of other technologies that Amazon's drive to tie automation to the reduction of friction in consumption and datafication can be gleaned.

Around the same time as Amazon was expanding into cloud services, Facebook began touting the benefits of frictionlessness as a design philosophy. One experiment came in 2011, when Facebook attempted to implement seamless or 'frictionless sharing'. During Facebook's developer conference f8, Mark Zuckerberg described how Open Graphs would enable user activity on connected apps to automatically generate Facebook posts or content about that activity. During the conference, Zuckerberg provided a demo of this form of sharing by interacting with a song on Spotify that another user was listening to (The Guardian, 2011). Information from one app would pass instantaneously into another app without a user's active choice to do so (Bump,

2011). A year later the plans for frictionless sharing were scrapped, apparently due to negative responses by users (Greenfield, 2012).

But Facebook tried again in 2017, this time shifting its attention away from user information and toward persuading businesses directly. In an advertising feature hosted by *The Economist* and produced by Facebook IQ and The Boston Consulting Group, Facebook provided instructions on how to create a 'Zero Friction Future' that meets 'consumer needs at the speed of now' (Facebook IQ, 2017). This included a report that explained that '[a]nything that causes a consumer to abandon their purchase journey before completion—be that a lack of information, poor service or slow transaction times—is called friction' (Facebook IQ and The Boston Consulting Group, 2017: 3). In addition to 'understanding shoppers', so as to identify why and when they 'abandon their shopping carts', businesses needed to identify and remove friction that arose during the discovery, purchase, and repurchase stages of consumption (Facebook, 2019). Of course, the answer to reducing friction was to utilise all of Facebook's properties; its assortment of ad services, Instagram for shopping, and Messenger or WhatsApp for customer service (Facebook IQ, 2018).

With language that echoed Gates's 1995 best-seller, Facebook proclaimed that no matter what the future can be, it must be one that 'belongs to businesses who remove friction for their customers' (Facebook IQ, 2018). It is this conceit of *the future* belonging to friction-obsessed businesses (and not to anyone else), that most forcefully accentuates the implications of the discourse of frictionlessness. Silicon Valley has a clear vision of the world that frictionless design (and its associated set of market-based objects, relations, and conditions) should inaugurate: digital technology is to become the unthought undertow that guides the navigation of everyday life. Digitisation and automation converge to remove the friction from all mundane activities—from (online) shopping to consuming cultural content, from socialising to coordinating household activities. Silicon Valley envisions a world replete with the comforts of one-click shopping and same-day delivery, seamless streaming and instant access. Burdened less and less by the cumbersome temporalities of contemplation and decision-making, this abstract discourse presumes the requirement of ubiquitous, automated assemblages of sensors, platform-mediated services, and 'smart' objects that shape a nirvana of reliable, comfortable consumption.

4 Principles of the Design Philosophy of Frictionlessness

Frictionless design as envisioned by Silicon Valley is primarily defined by a combination of two main principles: technological expansion and technological obfuscation (Kemper, 2024). It designs digital technologies to extend their capacity to shape everyday life while becoming ever more invisible. Starting with the former, technology is

leveraged to mediate a growing degree of activities; Silicon Valley has long been characterised by a relentless search for ways to introduce digital technology into spheres from which it was previously (more or less) absent. Gates's notion of friction-free capitalism indeed implies that our long-established habits and activities are deeply inefficient, and that digitisation and automation can smoothen the rough edges of human practice. Amazon's relentless promotion of new 'friction-free experience[s]' (Amazon PR, 2008) and frictionless interactions (Sarikaya, 2018) further demonstrate how new apps, platforms, and services constantly appear, often with the promise to disrupt and subsequently optimise quotidian life. The end goal of these processes is for digital connection to become less and less of a choice, as agency becomes increasingly tied up with access to networked devices and services (Paasonen, 2021; cf. Gates, 1996: 6).

This also relates to the second trait of frictionlessness: technologies are increasingly designed to disappear. Indeed, as Olia Lialina and Dragan Espenschied contend, 'the computer's ultimate purpose is to become an invisible 'appliance,' transparent interface and device denying any characteristics of its own. Most computing power is used in an attempt to make people forget about computers' (2009: 9). Microsoft, Amazon, and Meta's discourse directly reflects this rationale of technological invisibility, as they persistently frame technology and automation as forces that should seamlessly merge into mundane practices.

These rhetorical moves capture the logic behind Silicon Valley's obsession with eradicating friction; if technology is to be successfully integrated into all aspects of life, every moment of its recognition must be tracked down and removed from the 'user journey' (Facebook IQ, 2017). A technology without friction is therefore a technology that dissimulates itself and avoids drawing any conscious attention; its lacquered exterior eludes an awareness of the algorithms that curate content, the smart objects that regulate environments, and the automated processes that bolster and intensify consumption habits. Recalling Facebook's description of friction as anything that could lead the user to abandon their 'purchase journey' (Facebook IQ and the Boston Consulting Group, 2017: 3), frictionlessness invokes a world of near-instant connections, unobtrusive devices, immediate information, and interfaces that seemingly disappear into unmediated experience. Frictionlessness as a design philosophy thus appeals both to functionality and aesthetic, producing technologies that automate a growing sphere of human activities while posing progressively fewer cognitive and aesthetic demands.

While frictionlessness is presented to ease the life of the user—just as Gates argued in his book—its primary aim is in fact to bolster the logic and operations that support two recent expressions of capitalism. The first is surveillance capitalism, which takes an extractivist approach to data by leveraging it to modify consumer behaviour. Surveillance capitalism has been functionally dependent on Silicon Valley's success in designing digital technologies to 'be operational everywhere and detectable nowhere' (Zuboff, 2019: 227). This, indeed, describes exactly the twinned movement of dissimulation and expansion that defines frictionlessness. Similarly, the expansionist

principle of frictionlessness is encoded into platform capitalism (Srnicek, 2017) and the attendant process of platformisation, which describes 'the penetration of economic, governmental, and infrastructural extensions of digital platforms into the web and app ecosystems' (Nieborg and Poell, 2018: 4276), and, from there, into the conduct of everyday life (Sadowski, 2020: 61–62). The platform economy takes shape by rearranging the composition of everyday life, commodifying resources and activities through integrating them into platform-mediated services that seek to become both infrastructural and transparent. One could already see this logic reflected in Gates's early vision for digital technology as the effortlessly efficient realm where 'all human activity takes place' (1996: 6). Like surveillance capitalism, the process of platformisation is reliant on a simultaneous logic of extension and reduction, seeking to expand its reach while ridding commercial transactions of friction (Poell et al., 2021: 185).[1]

Because of its focus on technological extension and seamless integration, frictionlessness describes the aesthetic and design-based logic that is most reflective of the demands of platform and surveillance capitalism. While Zuboff and Srnicek have aptly identified the issues with control, privacy, and data extractivism these economic systems presently engender, the focus on frictionlessness also enables us to ask: what are the ramifications of the automated *future* Silicon Valley designs into existence?

5 Implications of a Frictionless Future

Whereas the last two sections covered the history of frictionlessness, this penultimate section shifts the temporal register toward the current and future implications of a world in which automation is leveraged mainly to eliminate friction in human–technology interaction. First, we claim that, by staging interactions that are immediate and seamless, frictionlessness reduces the possibility for critical reflection, even though this faculty is central to retaining human agency in an increasingly automated future. Our second point is essentially ecological in nature: the automated future of frictionlessness is structurally dependent on an obfuscated yet all-too-material foundation of exploitation and extraction.

The elusive capacities of frictionless design prevent sustained reflection on the digital's cultural and socio-ecological impact. Frictionless technologies are designed to suggest pure immediacy—a digital world moving at the 'speed of now' (Facebook IQ, 2017)—and, by implication, to recede from conscious perception. This situation is achieved not only by endowing digital designs and practices with an aesthetic of seamlessness, but also through a process of digital acceleration. Indeed, frictionless technologies are often perceived as frictionless because they function in (micro)temporal regimes that

1 For an in-depth exploration of the connections between frictionlessness and surveillance/platform capitalism, see Kemper, 2024.

both elude and elide human perception and cognition (Hayles, 2017). Bringing Gates's dream of automated markets to its logical conclusion, the smart sensors and predictive algorithms that comprise the world of frictionlessness are leveraged to know and anticipate our desires *before we do*. Increasingly, the everyday life hosted through automation is one that is interspersed with media operations of which no direct human experience is possible, shaping what Geoffrey C. Bowker calls 'life at the femtosecond' (2021).

Yet why would this dual process of obfuscation and acceleration be problematic? We suggest that, with the elimination of friction, the space for critical reflection and deliberation is diminished, even though this space is necessary for constructing a sustainable future. One of Bernard Stiegler's contributions to media theory is that, in phrasing his philosophy of technology in pharmacological terms (designating technology as always both poison and cure), he concretised how a technology's impact coincides with the forms of care this technology itself is likely to attract: 'The *pharmakon* is at once what *enables* care to be taken and that of *which* care must be taken—in the sense that it is necessary *to pay attention*: its power is *curative to the immeasurable extent* that it is also *destructive*' (Stiegler, 2013: 4, emphasis original; see also Kemper, 2022). Technology, in order to facilitate a world that is caring, must itself become an object of care and conscious investment. Technology, in other words, should bolster forms of perception that make us think and reflect on its ramifications. However, in eradicating all friction from the interface and in consigning technological tasks to microtemporal agents, the qualities of human deliberation and decision-making are preformatted and delegated to systems that function largely autonomously. This is not to peddle a narrative of human obsolescence, but to recognise that frictionlessness operates as a protocol steering what N. Katherine Hayles calls today's 'cognitive assemblages', or networks of humans and technical actors that are capable of cognitive and autonomous acts (2017). Frictionlessness expands these assemblages and binds them to commercial aims, geared toward the generation of (surveillance) capital and the stimulation of consumerism; for instance, Amazon's persistent focus on designing technologies that expedite and automate users' commercial desires shapes a vision of technology that primarily invokes constant and instantaneous consumption. Such systems are expressly designed to reduce the capacity of humans to intervene, to pay *care*ful attention to technology's nature and design.

Ultimately, when frictionlessness is glorified as a design principle of interaction, what Stiegler terms the 'time of the question' (2013: 101) is reduced and helps Silicon Valley to lock down the future through pre-emption. The data economy on which frictionlessness is premised restructures the relation between past, present, and future, and the role of human experience within it. In erecting a realm of seamless connectivity, immediate information, and tailored recommendations, frictionlessness seeks to render behaviour optimally controllable; the friction-free capitalism envisioned by Gates is friction-free precisely because uncertainty and ambiguity have been minimised. As philosopher Yuk Hui suggests, for the user of contemporary technology, the

digital future becomes one that is 'imposed on [one] and proceeds ahead of [one]' (2021: 80)—in anticipating our desires and pre-emptively feeding them back to us, the devices that Silicon Valley designs confine the future. Hui contends that, to prevent a deterministic automated future in which all things have been calculated beforehand, 'it is necessary to open new directions for the development of digital technology in order to imagine a future with technical diversities' (p. 83). This first concern of a frictionless design philosophy is thus that it draws together things in the world so that a capitalist future shaped by technology corporations appears to not only be desirable, but unquestionable as well.

The second concern of the design philosophy of frictionlessness is that it is materially and ecologically destructive. As a reminder, the tenets of the philosophy and the user experiences it enables tend to foster a cultural association of automation and human–technology interaction with an immateriality that has no earthly demands. This is far from reality. For one, because material friction forms a necessary part of all supply chains; the free-floating realm of digitally purchased goods that Silicon Valley conjures is tied to a material network of ports, carrier routes, and distribution centres whose contingencies persistently threaten to shatter illusions of the unimpeded flow of goods (Alimahomed-Wilson and Ness, 2018). Moreover, the material costs of computation itself have been well documented and continue to escalate (Cubitt, 2017; Parks and Starosielski, 2015; Brevini, 2021). Most ostensibly, these technologies are dependent on the gruelling labour of legions of miners around the globe—excavating, for example, the tantalum on which the AI sector is built (Dauvergne, 2020: 93–95)—and therefore on the 'radical depletion of non-renewable resources' (Crawford, 2021: 31).

Relatedly, data centres serve as the all-too-material lifeblood of frictionlessness and automation. Despite metaphors of 'cloud' computing tapping into a cultural history of imagining clouds as weightless and transcendent knowers of 'all time and all space' (Mosco, 2014: 207), these centres are fundamentally material and energy intensive. Composed of endless, monolithic rows of servers, they consume immense amounts of electricity and water to imperceptibly host digital communications and activities (Hogan, 2018), making them contemporary analogues for 'the factories of an earlier era' (Mosco, 2014: 37). Additionally, frictionlessness puts pressure on and—despite all suggestions that automation will do away with work—increases a planetary workforce. From the commercial content moderators cleaning Facebook timelines (Roberts, 2019) to the Amazon warehouse workers toiling around the clock to sustain the breakneck pace of instant commerce (Delfanti, 2021), the privilege of frictionless experience rests on the shoulders of many workers. While charting the full material impacts of the digital goes beyond the scope of this chapter, these examples highlight the diverse ways in which the 'automated dreamworld' of frictionlessness is 'more fantasy than reality' (Jones, 2021: 2). Indeed, friction is regularly relocated into asymmetries of power and environmental harms within frictionless systems, rather than being eradicated by design.

These costs, however, seldom come up when designers proselytise about frictionless digital interactions. We earlier recalled Amazon's Ruhi Sarikaya's account of how Alexa is designed to remove 'friction in [. . .] customer's interaction with the physical and digital world' (2018), but this account neglects to mention how this reduction of friction is realised only through immense expenditures of energy, the excavation of finite resources, and the exploitation of marginalised labourers (Crawford and Joler, 2018). In a similar fashion, the 'zero friction future' that Zuckerberg and his ilk promise requires a vast material infrastructure of extraction to operate, a fact that is obviously glossed over in their press releases, advertorials, and marketing campaigns. These divergent examples demonstrate that Silicon Valley's reduction of friction in human–technology interaction tends to rely on an intensification of frictions elsewhere in the system of planetary computation. In this sense, frictionlessness operates in a similar fashion as globalisation does in Tsing's valuable account of friction (2005); like globalisation, frictionlessness is presented as a smooth, effortless process, even though it is directly supported by exploitative and extractive encounters.

It is true that technological practices have always come with steep material demands—it is not as if the analogue technologies of yesteryear arrived through immaculate production processes and supply chains. However, frictionlessness, more than preceding design philosophies, is functionally dependent on pushing these material conditions to—and beyond—their limit; the strange quality of frictionlessness is that it both exacerbates processes of material extraction *and* increasingly hides these from the user's view by staging interactions with technology that appear progressively dematerialised. The term friction refers precisely to the loosening of user perception from the underlying demands of the engaged technology—users are supposed to have their consciousness unburdened as invisible hosts of algorithmic systems take care of their desires. Yet, to maintain and expand such automated assemblages, the earth needs to be scoured for more minerals, energy, and bodies to exploit. Accordingly, one may formulate a tentative rule of digital culture within its frictionless mode: a frictionless user experience, designed to automate away the supposed frustrations of everyday life and the limits to consumption, is generally facilitated directly by the production of friction elsewhere. As the preceding examples demonstrated, frictionlessness forms a poisonous philosophy, where the vision of a frictionless future is sustained only through ecological exploitation, extraction, and the destruction of invaluable habitats and livelihoods.

6 Conclusion: Reclaiming Friction

In light of the above, what would be the value of highlighting friction in human–technology interaction? What could be the pedagogical value of imagining and designing systems that do not primarily seek to disappear beneath shimmering facades of optimisation, connectivity, and user-friendliness? In a sense, to ask these questions is to

invoke a kindred position to Zuboff's call to 'be the friction' (2019: 520). However, whereas Zuboff urges us to become the sand in the machine, refusing assimilation into a global web of surveillance and control, we shift attention from the human to the technological as an agent of friction. What does it mean to highlight the value of technologies that do not retreat into the periphery—that announce their materiality in stark and stubborn ways? In the resistance that is generated when technical objects and human beings interact, spaces of possibility bloom. Friction constitutes a generative force. Certainly, it may give way to frustration—forming a cruel negation of our internalised demand for speed and immediacy (Paasonen, 2021: 35)—but it can equally breed moments of contemplation (Kemper, 2024). For instance, (post)phenomenology, glitch theory and infrastructure studies have long relied on the contention that technological breakdown confronts humans with the material reality of technology, possibly inducing a different (perhaps more care-infused) attitude toward the technology in question.

This is not to say that friction is by definition desirable, but that the category of friction—indicating perceptible moments of resistance, instability, or incompatibility that allow for critical reflection on the specific forms interaction assumes—should remain a fixture in any automated future that is worth wanting. Friction is always situational and contextual, and there are certainly cases where smooth interaction is desirable or even indispensable. In principle, however, frictions in human–technology interaction are productive events of contemplation and decision-making. Clearly, friction is not something that Silicon Valley's moguls will voluntarily design into their devices, and for all claims about 'greening' and streamlining its technologies, the material impact of Silicon Valley's design philosophy continues to grow. This means that there are other ways in which a more friction-sensitive vision of automation needs to be demanded, such as rallying for more democratic forms of governance, organising worker protests, formulating stricter environmental regulations, and expanding the range of public discussions concerning technology. Such responses should be driven by the recognition that friction (when it happens, how it happens, and to whom) is now the main stage of contestation over the future. Do we want an automated future where frictionless comfort is intimately tied up with material destruction and the obfuscation of technological processes, or do we want an automated future that is more attuned to the constant necessity to negotiate the general concerns of planetary wellbeing with the specific concerns of human civilisation?

Emphasising friction as a counterweight to the destructive philosophy of frictionlessness potentially helps to both elucidate the latter's deeply material nature and to retain a sense of human agency in the face of Silicon Valley's designs. Seen in this light, the act of reclaiming friction might become one of the urgently needed tactics for (re)humanising automation; a powerful gesture that responds to the call of more just and sustainable futures.

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