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Governance and Interdependence in Data-Driven Supply Chains

JENNIFER COBBE

8.1 Introduction

Recent years have seen fundamental changes in production and distribution of digital technologies.[1] In the past, software was distributed as a product, and customers bought licences to install it on their devices. Today, however, technologies are commonly distributed as *services*, where *providers* offer remote access to centralised hardware resources or software functionalities and perform the underlying computation – often called *cloud computing*.[2] This includes *user-facing* services (consumer and business platforms) and *infrastructural* services, which are predominantly business-to-business and support development of *applications* (apps, platforms, websites, devices, business and administrative processes, and more). Developers now often integrate several infrastructural services into complete applications, delegating control over the technologies underpinning those applications to their providers. Services may be strung together, with outputs from one forming the inputs to another.

As a result, applications now often involve data-driven *supply chains* of interconnected systems and actors, whose interaction produces outcomes and functionalities[3] (the 'supply chain' metaphor here following

[1] S Gürses and J van Hoboken, 'Privacy After the Agile Turn' in E Selinger, J Polonetsky and O Tene (eds), *The Cambridge Handbook of Consumer Privacy* (CUP 2017); J Cobbe, M Veale and J Singh 'Understanding Accountability in Algorithmic Supply Chains' (2023) *ACM Conference on Fairness, Accountability, and Transparency* (ACM FAccT '23); C Millard, *Cloud Computing Law* (2nd ed., OUP 2021) chs 3 and 4.

[2] Millard, *supra* note 1.

[3] Cobbe et al (2023), *supra* note 1; J Cobbe, C Norval and J Singh, 'What Lies Beneath; Transparency in Online Service Supply Chains' (2020) 5 *Journal of Cyber Policy* 65; J Cobbe and J Singh, 'Artificial Intelligence as a Service: Legal Responsibilities, Liabilities, and Policy Challenges' (2021) 42 *Computer Law & Security Review*; see also Millard, *supra* note 1, chs 3 and 4.

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previous work[4] and academic,[5] policy[6] and industry[7] usage). These supply chains are versatile and highly (re-)configurable, with transient interactions between an array of networked parties. Generally invisible to application users,[8] supply chains are key infrastructures in informational capitalism, characterised by the replacement of markets with platforms and production organised around the accumulation and processing of information.[9] They are therefore a primary means by which technology companies enclose social and economic life, extract value and concentrate power.[10]

In this chapter, I argue that understanding supply chains through the lens of interdependence helps explain how they serve as new sites of distributed governance in contemporary societies. The dependence of social and economic life on a few companies' services has brought much concern in academic and policy literature and in public debate. By

[4] J Singh, J Cobbe and C Norval, 'Decision Provenance: Harnessing Data Flow for Accountable Systems' (2019) 7 *IEEE Access*; Cobbe et al (2020), *supra* note 3; Cobbe and Singh (2021), *supra* note 3; J Cobbe and J Singh, 'Data Protection Doesn't Work: Oversight Failure in Data Processing Figurations' (Paper presented at the 2022 Privacy Law Scholars Conference, Northeastern University, Boston, MA 2022) available online at <https://bit.ly/4fDrnu5>; Cobbe et al (2023), *supra* note 1.

[5] See, for example, M Ohm et al, 'Backstabber's Knife Collection: A Review of Open Source Software Supply Chain Attacks' (Presentation at Detection of Intrusions and Malware, and Vulnerability Assessment: 17th International Conference, DIMVA 2020); D Gray Widder and D Nafus, 'Dislocated Accountabilities in the "AI Supply Chain": Modularity and Developers' Notions of Responsibility' (2023) 10 *Big Data & Society* 1.

[6] See, for example, National Cyber Security Centre, *Supply Chain Security Guidance* (2018) available online at <https://bit.ly/3AvFtyE>; Cybersecurity and Infrastructure Security Agency, *Securing the Software Supply Chain: Recommended Practices Guide for Developers* (2022) available online at <https://bit.ly/3YBXqn9>.

[7] See, for example, G Studebaker and P Natoli, 'Harness the Power of Data and AI in Your Life Science Supply Chain' (*Google Cloud*, 14 December 2022) available online at <https://bit.ly/4egqK8z>; Google Cloud, *Software Supply Chain Security* (2024) available online at <https://bit.ly/3UG9i6y>; A Diglio, 'The Journey to Secure the Software Supply Chain at Microsoft' (*Microsoft Developer Blogs*, 22 May 2023) available online at <https://bit.ly/40zPENf>.

[8] Cobbe et al (2020), *supra* note 3.

[9] JE Cohen, *Between Truth and Power: The Legal Constructions of Informational Capitalism* (OUP 2019).

[10] Cobbe et al (2023), *supra* note 1; D Gray Widder, S West and M Whittaker, 'Open (For Business): Big Tech, Concentrated Power, and the Political Economy of Open AI' (2023) available online at <https://bit.ly/3YTZRTs>; Cohen (n 9); M Moore and D Tambini (eds), *Digital Dominance: The Power of Google, Amazon, Facebook, and Apple* (OUP 2018); U Dolata, 'Apple, Amazon, Google, Facebook, Microsoft: Market Concentration – Competition – Innovation Strategies' (Stuttgarter Beiträge zur Organisations- und Innovationsforschung, SOI Discussion Paper, No. 2017–01 2017) available online at <https://bit.ly/3ChaCq3>.

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focusing on the dynamics of *inter*dependence, however, we can understand how providers' position and power in supply chains arises through relations heavily shaped by law and other factors, *and* how law and regulation might begin to rein in that power. In Section 8.2 I contextualise data-driven supply chains as key infrastructures in the political economy of informational capitalism. In Section 8.3 I explain how supply chains – shaped by law and other influences – produce power dynamics which privilege certain actors, as providers leverage asymmetric interdependencies to their benefit. In Section 8.4, I sketch some directions for governance of data-driven supply chains through law and regulation.

8.2 Data-Driven Supply Chains

A key dynamic in the transition to informational capitalism is *platformisation*:[11] the dematerialisation of markets and their replacement with platforms and algorithmic mediation.[12] Take a hypothetical (yet typical) mobile app, offering a platform for ordering food from restaurants for delivery. Historically, customers ordered directly from restaurants, who employed delivery riders (often on a casualised basis).[13] To build market position, the app vendor strategically leveraged their platform to destabilise, restructure, and intermediate those relations (in the context of broader social, political, and economic developments,[14] such as increasingly precarious labour following the 2008 financial crisis). Now, through the platform, restaurants advertise food, customers browse menus and place orders and the vendor assigns riders deliveries from many restaurants. The labour market for riders and the takeaway food market are thus both replaced by the vendor's platform. Accordingly, the vendor can dictate terms of access to the platform by others, engage algorithmic systems to replace market mechanisms (such as for determining prices for customers or payments to restaurants and riders), shape platform users' interactions to their benefit and extract value.

[11] JE Cohen, 'Law for the Platform Economy' (2017) 51 *UC Davis Law Review* 133; T Poell, D Niebord and J van Dijck, 'Platformisation' (2019) 8 *Internet Policy Review*; Cohen (2019), *supra* note 9.

[12] Cohen (2017), *supra* note 11.

[13] Y Gabriel, 'Fast Food Enterprises' (2001) *International Encyclopedia of the Social & Behavioral Sciences* 5415.

[14] N Kacher and S Weiler, 'Inside the Rise of the Gig Economy' (REDI Report 2017) available online at <https://bit.ly/48KMLLB>.

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Each of these platformised activities relies on and in turn triggers data flows which enable their interactions: between devices used by restaurants, customers and riders; the vendor's servers; and other technical infrastructures. Through these, the vendor coordinates between customers, restaurants and riders to provide apparently seamless food delivery. Below the surface, these data flows work through the vendor's cloud provider's technical infrastructure – likely Amazon Web Services, Microsoft Azure or Google Cloud. The cloud provider also underpins various capabilities, such as database services to store information about restaurants and menus, or 'AI' services for personalised recommendations. The vendor also integrates other providers' services for payment processing (perhaps PayPal), security (Cloudflare), user authentication (using Apple,[15] Google[16] or Facebook),[17] content delivery (Akamai), tracking and analysing customers' activities (Google Analytics) and advertising (AdSense or Facebook APIs).

The app – seemingly one system controlled by one company – is thus in fact many systems controlled by multiple companies, together producing its functionalities: a supply chain abstracted into an interface providing a coherent experience. Each of the services forming the app's supply chain might rely on other services in turn, forming a network of interlocking supply chains stretching across societies, economies, and legal jurisdictions. Due to concentration in cloud markets, a few companies will control many services. Amazon (AWS), Microsoft (Azure) and Alphabet (Google Cloud) together account for around two-thirds of the global market,[18] alongside other important players like Meta, IBM and Cloudflare.

Restructuring social and economic relations around platforms thus often means restructuring around data-driven supply chains. Beyond mobile apps and food delivery platforms, supply chains work across all kinds of websites and apps, platformised social interactions, business, government and administrative processes, and anywhere else digital technologies exist. Supply chains are *data-driven* in several ways. First (Section 8.2.1), data's production, processing and flow links users, vendors and providers dynamically, enabling their more stable legal, technical

[15] Apple, 'The Fast, Easy Way to Sign in to Apps and Websites' (*Apple*) available online at <https://bit.ly/48ETN4y>.
[16] Google Identity, 'Authentication' (*Google*) available online at <https://bit.ly/3YUH7Dx>.
[17] Meta, 'Facebook Login' (*Facebook*) available online at <https://bit.ly/3AuOUOM>.
[18] F Richter, 'Amazon Maintains Lead in the Cloud Market' (*Statista*, 1 November 2024) available online at <https://bit.ly/3AuPhsE>.

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and economic relationships to produce application functionality. Second (Section 8.2.2), supply chains are key infrastructures for data production and in tracking and targeting. Third (Section 8.2.3), data's production, aggregation and use through supply chains is shaped by informational capitalism's logics and imperatives and data's importance and value.

8.2.1 Application Functionality Through Data-Driven Supply Chains

With a typical supply chain model, a *client* application (often accessed through a lower-powered device) makes requests to a *server* through an *Application Programming Interface* (API). The server – usually in a data centre – processes the request and responds with the result, which the client displays, uses for functionality, or inputs to another service for further processing. One actor (a *customer*) can control the client, while another (a *provider*) performs the computation. Data flow links actors' systems and enables the functionalities they produce. This allows expensive computing resources to be centralised, with costs spread across a provider's customer base and customers paying based on usage or subscription (or some combination thereof). Some providers' data centres work at *hyperscale*, where computing resources rapidly grow and shrink in response to demand.

Through this, hardware resources and software capabilities are modularised into plug-and-play services, with vendors coordinating their integration into a coherent application. This application may itself be a cloud service working as a component in other applications, with the vendor accordingly being a provider to their own customers. As supply chains comprise multiple applications and services with their own supply chains, coordinated by different actors, no single party has overall control. Moreover, each instance of a supply chain may differ in composition and structure: data's processing determines the direction of its subsequent flow through the chain (going to different actors depending on the result) and therefore the actors involved.[19] However, companies and organisations typically have ongoing legal, technical and economic relationships across chains. As such, while chains may differ with each instance, they broadly follow *patterns* reflecting these more persistent relationships, taking a particular pattern – or combination of patterns – each time. Supply chains thus involve services and

[19] Cobbe et al (2023), *supra* note 1.

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applications dynamically strung together and linked by data flows – each potentially with their own supply chain – which may support many types of service, application or functionality and serve multiple customers and purposes simultaneously.

8.2.2 Data-Driven Supply Chains and Data Production

Platformisation – as a process of platforms replacing markets – involves *capture* as described by Agre,[20] whereby human activities are (re-)configured to make them legible and trackable by and with computers.[21] As Poell et al argue, platform relations are 'organised through the systematic collection, algorithmic processing, monetisation, and circulation of data'.[22] This produces social and economic interactions represented, according to Cohen, by 'structured flows of data suitable for continuous collection and analysis at the platform level'.[23] Agre characterises[24] capture as a complex process by which activities are broken down into their component parts, reconceptualised to permit datafication and reconstructed accordingly to enable computerised control – allowing (as Cohen puts it) the platform to serve its own priorities.[25]

A key feature of informational capitalism is that data and other intangible informational resources are reconceptualised as property and commodified.[26] Indeed, the production and processing of data generates significant revenue for platform companies, while datasets are extensively traded between a vast array of data brokers and widely leveraged for profit. The datafication found in capture therefore operates as the 'principal logic of commodification' in informational

[20] P Agre, 'Surveillance and Capture: Two Models of Privacy' (1994) 10 *The Information Society* 101.
[21] Ibid; Cohen (2017), *supra* note 11; Gürses and van Hoboken, *supra* note 1.
[22] Poell et al, *supra* note 11.
[23] Cohen (2017), *supra* note 11.
[24] Agre, *supra* note 20.
[25] Cohen (2017), *supra* note 11.
[26] Cohen (2017) *supra* note 11; Cohen (2019), *supra* note 9; A Kapczynski, 'The Law of Informational Capitalism' (2020) *Yale Law Journal* 970, reflecting Polanyi's argument that industrial capitalism conceptualised land, labour, and money as 'fictitious' commodities (K Polanyi, *The Great Transformation: The Political and Economic Origins of our Times* (Farrar & Rheinhart 1944)). See also J Sadowski, 'When Data is Capital: Datafication, Accumulation, and Extraction' (2019) 6 *Big Data & Society*; R Vatanparast, 'The Code of Data Capital: A Distributional Analysis of Law in the Global Data Economy' (2021) *juridikum 1/2021* 98.

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capitalism,[27] whereby social and economic relations reconfigured around platforms are represented in data, commodified and put to work in platform business models. While, as Cohen argues, platforms represent points of 'friction' in networks[28] – in that social and economic relations must pass through them – capture thus permits friction*less* value extraction by platform providers.

This involves complex patterns of data production and flow – not just around 'a platform', but between a variety of platforms and services controlled by multiple actors who may together produce an application, its functionalities and its effects, and through which significant data may be extracted. As such, supply chains are important infrastructures for data production, both for AI production and development[29] and for tracking, profiling and targeting. Data produced through supply chains feeds into social sorting systems for making decisions about people's lives in the private sector; and in eligibility assessments for welfare, housing or other public services. This is all enabled by supply chains stretching across societies: producing, transporting and processing data; linking actors and their systems; and giving effect to decisions, outcomes and functionalities.

In digital advertising, supply chains are extensive.[30] Trackers produce data[31] for profiling, bidding and targeting systems,[32] which is widely processed and traded.[33] Flows of data through these chains link audiences, advertisers, and many ad brokers, ad exchanges and data brokers. Advertising chains are often comingled with others – a mobile app might integrate trackers from multiple companies,[34] or use component services

[27] JE Cohen, 'The Regulatory State in the Information Age' (2016) 17 *Theoretical Inquiries in Law* 2534.

[28] Cohen (2019), *supra* note 9.

[29] Cobbe et al (2023), *supra* note 1.

[30] Information Commissioner's Office, *Update Report into Adtech and Real Time Bidding* (2019) available online at <https://bit.ly/4fbvain>; M Veale and F Zuiderveen Borgesius, 'Adtech and Real-Time Bidding under European Data Protection Law' (2022) 23 *German Law Journal* 226.

[31] R Binns et al, 'Third Party Tracking in the Mobile Ecosystem' (WebSci '18: 10th ACM Conference on Web Science, May 27–30 2018) available online at <https://bit.ly/4hzUMXO>; R Binns, 'Tracking on the Web, Mobile and the Internet-of-Things' (*arXiv:2201.10831* 2022) available online at <https://bit.ly/48FrC5j>.

[32] S Zuboff, 'Big Other: Surveillance Capitalism and the Prospects of an Information Civilization' (2015) 30 *Journal of Information Technology* 75; Informational Commissioner's Office, *supra* note 30; Veale and Borgesius, *supra* note 30.

[33] S Spiekermann, A Acquisti, R Böhme and K-L Hui, 'The Challenges of Personal Data Markets and Privacy' (2015) 25(2) *Electronic Markets* 161.

[34] Binns et al, *supra* note 31; Binns, *supra* note 31.

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which themselves integrate trackers, while displaying targeted advertising for revenue purposes. The technologies which underpin application functionality therefore often also produce data through tracking systems and spirit it away to targeting processes.

8.2.3 *Data-Driven Supply Chains and Informational Capitalism*

Supply chains thus have a dual role: working to produce application functionality, *and* to produce and extract data and enable targeting. Reorganising social and economic life around platforms and supply chains therefore means reorganising around infrastructures for data's production, aggregation and use. This data – relating both to the markets reconstituted around supply chains and to the interactions of individuals and groups – is subject to 'active appropriation strategies'[35] (as Cohen says) by providers seeking competitive advantage. Data-driven supply chains are therefore how various platforms are constructed, how certain platforms are strung together to construct others, *and* how much of social and economic life has been captured[36] by the logics and imperatives of profit extraction under informational capitalism.[37]

As such, supply chains are key infrastructures in informational economies. With the reorganisation of markets and social relations around platforms, and of platforms around supply chains, data and its flow plays an important structural role in addition to its propertisation and commodification.[38] Data's flow links actors to produce applications' functionalities and enables their platformised relations. Data's processing determines which actors take part in each instance. Given data's structural and economic importance, asymmetries in the ability to produce and productively use data affect the position and power of various actors. Those with greater capacity to construct platforms and provide services by doing so can position themselves advantageously, extract significant revenue and build significant power. As such, the relations constituted by and through supply chains are significant sites for governance in contemporary societies, as I now explore.

[35] Cohen (2017), *supra* note 11.
[36] Agre, *supra* note 29.
[37] Cohen (2017), *supra* note 11; Cohen (2019), *supra* note 9.
[38] Sadowski, *supra* note 26; Cohen (2017), *supra* note 11; Kapczynski, *supra* note 26; S Viljoen, 'A Relational Theory of Data Governance' (2021) *Yale Law Journal* 370; Vatanparast, *supra* note 26.

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8.3 Governance *in* Data-driven Supply Chains

Governance has been conceptualised as involving complex sets of relations between state and non-state actors,[39] where power flows through shifting arrays of organisations and networks and through a variety of institutions and techniques.[40] This produces a diffusion of power across societies through complex processes which regulate and manage people's activities and relations. Reorganising social and economic life around data-driven supply chains involves such a diffusion, with the asymmetric interdependencies in these chains producing multipolar power dynamics which favour actors controlling particular technologies. Here, I explain how data-driven supply chains distribute operation and control of services and applications among several actors (Section 8.3.1), producing complex, dynamic interdependencies between them (Section 8.3.2). Next (Section 8.3.3), I examine how *asymmetries* in distributions of operation and control produce (often sizeable) asymmetries in these interdependencies, and are themselves heavily influenced by commercial, legal, technical, and other factors. Then (Section 8.3.4), I explain how asymmetries in interdependence afford asymmetric power dynamics allowing providers to reinforce the conditions which produce them to maintain and amplify that power. In all, I argue, through the asymmetric interdependencies which constitute them, supply chains are now key sites of distributed governance reaching deep into social and economic life.

8.3.1 Operation and Control of Technology

Distribution of modularised computing resources through services and their integration into applications involves legal, technical and economic relationships through which control over various aspects of technologies is assigned between multiple actors. In integrating services into applications, developers *delegate* control over certain aspects of their application to providers. The corollary is that providers delegate limited and conditional control of certain aspects of *their* systems to customers or end-users,[41] while *retaining* control of other aspects of that technology (delegated to them from the customer's perspective). This would be impossible without

[39] N Rose, *Powers of Freedom: Reframing Political Thought* (CUP 1999).
[40] Ibid; P Miller and N Rose, *Governing the Present: Administering Economic, Social and Personal Life* (Polity 2008).
[41] Cobbe et al (2023), *supra* note 1.

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data's flow linking geographically dislocated actors and enabling control to be split between and exercised separately by them.

A key feature of data-driven supply chains is therefore that different people simultaneously *operate* or *control* various aspects of the same systems, allowing them to provide some service, undertake some computation, supply some functionality or produce some application. This is enabled by modularisation of computing resources and underpins their distribution through APIs. 'Operate' here means running computing infrastructures an actor owns, under their retained control or another party's delegated control. 'Control' means deciding questions around systems' design and development, who they are used by, in what way, for what purposes and so on. Some such questions relate to a technology's *essential* aspects, going to the system's core function.[42] These are generally uniform across instances, as variation would affect the service's core features, with providers retaining control for technical and commercial reasons. Other aspects are *incidental*,[43] not relating to core functions and could vary between instances (particularly as supply chains unfold dynamically across various patterns). These may be delegated or retained.

There is therefore an *exchange of control* of certain aspects of technologies between actors and a potentially complex *distribution of responsibility*[44] for them (in that multiple actors are factually responsible in different ways for different practical aspects of their production, deployment and use). Application vendors may sub-delegate some of the control delegated to them by providers while retaining aspects of that control themselves (the degree of delegated control often diminishing with each step in a chain). For example, the food delivery app vendor may allow restaurants to personalise menus to end-users with a recommender service from the vendor's cloud provider, thereby sub-delegating some control over that underlying technology to restaurants. Yet they may retain some (delegated) control over other aspects of the recommender service, allowing it to be integrated with other platform features

[42] 'Essential' here deriving from the concept of 'essential properties' in analytic metaphysics, referring to features that an entity *must* have, as opposed to those which they *could* have but may lack (see, for example, D Bennett, 'Essential Properties' (1969) 15 *The Journal of Philosophy* 487; T Robertson Ishii and P Atkins, 'Essential vs. Accidental Properties' in EN Zalta and U Nodelman (eds), *The Stanford Encyclopedia of Philosophy* (2023) available online at <https://bit.ly/4ejYCkQ>).

[43] In analytic metaphysics these would be called 'accidental properties'. I use 'incidental' to avoid any implication that they exist – or control over them by any actor arises – 'by accident'.

[44] Cobbe et al (2023), *supra* note 1.

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(particularly if those aspects of the recommender service go to the platform's core intermediary function and are therefore essential). Operators may have their own providers, contributing to development or operation of their technologies, with exchanges of control up and down the chain.

Exchanges of control necessarily vary: different things are essential – and control over them typically retained – to different services and applications. Providers may also retain control over incidental aspects relating to data production and policy enforcement (for example) to minimise their potential legal and commercial risks and maximise their benefit from the platform. Moreover, different *kinds* of service or application – with different core functions – necessitate different retention and delegation. In Software as a Service (for example), where customers access whole user-facing applications remotely, delegated control is more limited. In Infrastructure as a Service, however, where customers can install and run software they choose on lower-level computing resources, delegated control is necessarily greater and retained control correspondingly less. In AI services, providers retain significant control over producing and operating their system while delegating much of its deployment and use to customers.[45]

Digital technologies thus often involve complex patterns of operation and (sub-)delegation of control which produce supply chains. For example, the storage provider Dropbox used AWS's infrastructural services to host customer data.[46] Dropbox necessarily delegated control over some incidental aspects of their application to AWS, who operated the underlying technology. AWS delegated to Dropbox control of other aspects of that technology (incidental to an infrastructure service): what kind of information is stored, on whose behalf, and when and how it is retrieved. Dropbox, in turn, sub-delegated some control to their customers (such as the specific information stored). However, other aspects of the control AWS delegated to Dropbox form essential aspects of a storage service, going to its core function, and Dropbox therefore retained them (such as around *which* customer's data is stored, with what access controls, and mechanisms for storage and retrieval). Through this, both AWS and Dropbox retained control over different aspects of the same

[45] Ibid; Cobbe and Singh (2021), *supra* note 3.

[46] R Jennings, 'Dropbox Mostly Quits Amazon Cloud, Takes Back 500 PB of Data' (*ComputerWorld*, 15 March 2016) available online at <https://bit.ly/3NTxRcr>; R Miller, 'Why Dropbox Decided to Drop AWS and Build Its Own Infrastructure and Network' (*TechCrunch*, 15 September 2017) available online at <https://bit.ly/48zunFz>.

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technologies which were essential to their respective services, while delegating control over other aspects of those and other technologies to each other and to the end-users.

8.3.2 *Exchange of Control and Interdependence*

Interdependence is thus a key dynamic in data-driven supply chains. Through retention and (sub-)delegation of control, each actor does something which triggers, enables, or underpins others' activities. As such, each actor depends on others[47] in ways which reflect and shape patterns of operation and control: giving inputs, undertaking computation, applying outputs, providing services which support and enable their activities, and much more.

With the hypothetical food delivery app, for example, each actor does things which others depend on – through the supply chain – enabled by data flows between them. Cloud providers operate technical infrastructure underpinning the platform, controlling retained aspects of their service but otherwise acting under control delegated to the vendor, who pays service fees. The vendor controls essential aspects of their platform to intermediate between restaurants, customers and riders (such as for assigning deliveries to riders), as well as over incidental aspects which shape their relations, while customers and restaurants pay fees. Riders control some aspects of the platform relating to them – accepting or declining jobs and so on – and deliver food from restaurants to customers, in return for fees from vendors. Other supporting providers contribute to various aspects of the platform (around payments, security, content delivery and others). This involves a constellation of actors, where data's production in client devices, processing in servers and flow through supply chain components underpins exchanges of control which link them dynamically into a fluctuating web of interdependent relations and enables their various activities and interactions.

Yet providers' role in supply chains – and therefore their business model and market position – depends on others as much as anyone else's. Discussions around digital technologies sometimes overlook this fundamental *inter*dependence, framing people, organisations or societies as dependent on providers. Yet without others doing things which use their services, providers would play no role in a supply chain; indeed, without others' activities, there would be no supply chain to be part of at all.

[47] Cobbe et al (2023), *supra* note 1; Cobbe and Singh (2022), *supra* note 4.

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Moreover, supply chains' dual purposes – also producing data for development processes[48] or advertising-based revenue streams[49] – means production and ongoing development of the technologies through which providers partake in chains depends in part on others in them, as does their income. Choices which enable providers' activities are of course conditioned both by their capture of markets and by dynamics which tend towards supply chain consolidation around certain players (and which providers proactively pursue). But the fact remains that providers' position is constituted by and sustains only through *mutually* dependent relations.

8.3.3 *Structuring Patterns of Interdependence*

Supply chain interdependencies are, however, asymmetric in ways which reflect asymmetries in patterns of operation and control. Patterns of *operation* are often asymmetric both within and across chains, shaped by differences in technical and financial resourcing and by commercial, legal, and political economic influences. Services and applications rely on data production and processing, for example, yet operating computing infrastructures to produce and productively use data may require significant financial and technical resources – consequently, global markets for infrastructural computing services are particularly (and increasingly) concentrated around three companies.[50] Law is important in constituting both capitalism[51] (generally) and informational capitalism[52] (specifically) – enabling platformisation,[53] supporting surveillance business models[54] and shaping technological development.[55] Intellectual property laws protect closed-source, proprietary

[48] Cobbe and Singh (2021), *supra* note 3.
[49] Zuboff, *supra* note 32; Sadowski, *supra* note 26.
[50] Amazon, Microsoft and Google together comprising around 66 per cent of the global market as of January 2024: Richter, *supra* note 18.
[51] K Pistor, *The Code of Capital: How the Law Creates Wealth and Inequality* (Princeton University Press 2019); G Baars, *The Corporation, Law and Capitalism* (Brill 2019); H Brabazon (ed), *Neoliberal Legality: Understanding the Role of Law in the Neoliberal Project* (Routledge 2016); R Mangabeira Unger, *The Critical Legal Studies Movement* (Harvard University Press 1986).
[52] Cohen (2019), *supra* note 9; Kapczynski, *supra* note 26; Viljoen, *supra* note 38; Vatanparast, *supra* note 26.
[53] Cohen (2019), *supra* note 9.
[54] Ibid; Kapczynski, *supra* note 26.
[55] S Deakin and C Markou, 'The Law-Technology Cycle and the Future of Work' (University of Cambridge Faculty of Law Research Paper No. 32/2018 2018).

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systems.[56] Intermediary liability protections reduce legal risks of operating services at scale[57] (which might otherwise be insurmountable) by limiting claims for customers' or users' activities.

Providers may adopt strategies to reinforce and amplify asymmetries in operation – hoarding patents and other intellectual property; lobbying to create or exacerbate regulatory barriers to entry; or (relatedly) lobbying around licensing, labour or data protection law (for example). Providers typically pursue vertical and horizontal integration, seeking to maximise economies of scale and reduce the extent to which their own platforms and services rely on infrastructure operated by others (some providers, such as Google, Amazon and Microsoft, have achieved high levels of integration). Moreover, providers may incentivise customers to use several of their services rather than those of competitors, centralising applications around their technologies and amplifying asymmetries in operation[58] (as a provider can operate not just *some* technologies underlying an application, but potentially many).

Patterns of *control* are typically asymmetric in ways shaped by patterns of operation. Indeed, providers can leverage asymmetries in operation towards asymmetric patterns of control: more vertically integrated providers – operating much of the infrastructure for their services – can delegate to fewer of their own providers (for example). Yet patterns of operation do not *determine* exchanges of control. Rather, control within and across chains is also shaped by legal and political economic context, by technical necessity (delegating control to individual customers of aspects of services which are uniform across instances would not necessarily work), and by providers' commercial interests in retaining control over both essential and incidental aspects. Indeed, providers may delegate the minimum control needed to allow customers to use their service, retaining as much as possible for themselves. While legal, technical, economic relationships between actors in captured markets are configured in many ways around providers' interests, patterns of control thus arise from interactions of all sorts of influences, shaping relations and exchanges between providers, vendors, suppliers, customers and others.

Law, for instance, structures patterns of control in a general sense, shaping and underpinning the relations through which providers' market position arises. For example, delivery riders' legal classification as

[56] Cohen (2019), *supra* note 9.
[57] D Keller, 'The Right Tools: Europe's Intermediary Liability Laws and the EU 2016 General Data Protection Regulation' (2018) 33(1) *Berkeley Technology Law Journal* 297.
[58] Cobbe and Singh (2021), *supra* note 3.

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workers, employees or self-employed affects their individual and collective protections and rights against the vendor and the degree of control they may have over certain aspects of the platform[59] (and may prompt reform to address social and legal implications of new ways of working).[60] Restrictions on industrial action and collective bargaining affect riders' abilities to act together to protect their rights and interests by limiting the vendor's control over aspects of the platform which shape their work and interactions with customers and restaurants.[61] Data protection and privacy laws shape the processes of capture and of data's production, processing and flow (with the commodification and economic value of data – a key reason why differential abilities to produce and productively use data matter in structuring supply chains – itself being legally constructed).[62] These data protection and privacy laws typically rely on the principle of *individual* control by data subjects,[63] limiting opportunities to challenge systemic problems or represent collective interests.[64] Regulatory compliance obligations may present barriers to new market entrants, and lax competition enforcement combined with providers' financial resources often allows them to buy out potential competitors.

Law thus affords conditions for patterns of operation and control and shapes interdependencies across societies. Asymmetries in these produce asymmetries in supply chain interdependencies, which are often *heavily* unequal both within and across chains. Within chains, individual customers (or users) generally depend much more on a provider's services – potentially underpinning essential aspects of the application's core function – than the provider depends on their custom. Across chains, due to market concentration, many customers may depend a great deal on

[59] A Aloisi, 'Commoditized Workers: Case Study Research on Labor Law Issues Arising from a Set of on-Demand/Gig Economy Platforms' (2016) 37(3) *Comparative Labor Law & Policy Journal*; J Kaltner, 'Employment Status of Uber and Lyft Drivers: Unsettlingly Settled' (2018) 29 *Hastings Women's Law Journal* 29.

[60] T Burke, 'World-Leading Legislation to Protect Gig Workers' (*Ministers of the Employment and Workplace Relations Media Centre,* 31 August 2023) available online at <https://bit.ly/4ehjtW6>.

[61] H Johnston and C Land-Kazlauskas, 'Organising On-Demand: Representation, Voice, and Collective Bargaining in the Gig Economy' (Conditions of Work and Employment Series No. 94, 2019) *International Labour Organization*; Aloisi, *supra* note 59.

[62] Cohen (2019), *supra* note 9; Kapczynski, *supra* note 26; Vatanparast, *supra* note 26.

[63] O Lynskey, *The Foundations of EU Data Protection Law* (OUP 2016); BJ Koops, 'The Trouble with European Data Protection Law' (2014) 4 *International Data Privacy Law* 250; Cobbe and Singh (2022), *supra* note 4.

[64] Cobbe and Singh (2022), *supra* note 4.

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a single provider, who seemingly barely depends on the others individually.[65] Individual delivery riders may depend on the food app vendor for much of their income, whereas each rider plays a relatively minor role in the vendor's service (which may have many potential riders). Yet often-overlooked collective dimensions matter: if riders unionise or otherwise act collectively, the vendor's dependence on riders *as a whole*, rather than individually, quickly becomes apparent.

8.3.4 Regulatory Power

Asymmetries in supply chain interdependencies arising from asymmetric patterns of operation and control produce, shape and intensify power dynamics within and across chains which are also asymmetric (often greatly). These asymmetries potentially allow providers to make access to technologies which are essential to applications in many markets and sectors conditional on acceptance of certain requirements.[66] Indeed, Cohen argues that platforms' legal and technical protocols perform a 'double function': 'affording access but also points of contact for exercises of technological and political authority'.[67] Through these points of contact, providers aim to extend their power up and down chains in attempts to maintain their position, minimise legal and other risks and responsibilities and maximise their commercial benefit.

For example, the vendor's control of aspects of the food delivery platform which are *essential* to its core function of intermediating between restaurants, customers and riders – itself conditioned by law and by the vendor's relationships with providers who operate or control underlying technologies – produces key asymmetries in their collective interdependence which favour the vendor. This allows the vendor to insist on retaining *incidental* aspects of the platform which amplify asymmetries in interdependence with and between platform users and perform some governance function – algorithmically shaping interactions between restaurants, customers and riders, producing and extracting data for targeting and enforcing policies – thereby permitting

[65] Ibid; Cobbe et al (2023), *supra* note 1; N Elias, *What Is Sociology* (Columbia University Press 1978); N Elias, *The Civilizing Process: Sociogenetic and Psychogenetic Investigations* (2nd ed., Wiley-Blackwell 2000).

[66] Cohen (2017), *supra* note 11; for Cohen, this second function of platform protocols was lacked by the 'fictionalised construct of the market', and 'comprehensively reshapes the conditions of economic exchange'.

[67] Ibid.

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them to structure those relations to maximise their commercial benefit from the platform's core function of intermediation. A cloud provider may insist on retaining control over incidental aspects of services to restrict purposes or contexts of use to reduce legal or reputational risk, or which limit integration with competitors' services.

Sizeable asymmetries in interdependence afford certain providers *regulatory power* in their relations with others:[68] the capacity to durably affect or constrain their behaviour. This regulatory power is not held by one actor exclusively, but is multipolar: cloud providers may have some regulatory power in their relations with the food app vendor, for example, while the vendor has some regulatory power in their relations with restaurants and riders (itself conditioned by the cloud provider's regulatory power in their relations with the vendor). Yet the power dynamics between the app vendor and a delivery rider, for example, result also from the relations between riders themselves and whether they act individually or collectively. Power dynamics in data-driven supply chains therefore arise relationally but *multilaterally* through the interactions of the many actors therein (conditioned by the legal, social, technological and market factors which shape those relations). Providers may exploit their regulatory power in efforts to build, maintain, and amplify further legal and technological asymmetries both within and across chains, shaping the activities of individual customers and users and power dynamics in captured markets to their advantage. Although regulatory power is multipolar, asymmetries in supply chains thus produce asymmetries in that power which offer opportunities for extensive private ordering by providers.

The services model – affording the ability to dictate terms and alter, withdraw or cancel services at will – itself offers providers opportunities to retain some control over deployment of their technologies in customers' applications in ways which would have been impossible with traditional software licensing via physical media.[69] A primary mechanism for this is standard form, take-it-or-leave-it contractual Terms of Service.[70]

[68] S Delacroix, 'Beware of "Algorithmic Regulation"' (2019) available online at <https://bit.ly/4fyYTS9>.

[69] Cobbe et al (2023), *supra* note 1.

[70] L Belli and J Venturini, 'Private Ordering and the Rise of Terms of Service as Cyber-Regulation' (2016) 5 *Internet Policy Review*; D Kamarinou, C Millard, and W Kuan Hon, 'Privacy in the Clouds: An Empirical Study of the Terms of Service and Privacy Policies of 20 Cloud Service Providers' (Queen Mary School of Law Legal Studies Research Paper No. 209/2015 2015); JD Michels, C Millard and F Turton, 'Standard Contracts for Cloud Services' in C Millard (ed), *Cloud Computing Law* (2nd ed., OUP

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These establish legal relationships which underpin technical and economic relationships and through which customers and users exchange control in particular ways (in the context of commercial, technical, legal and other influences setting a general structure to them). At the same time, however, providers also impose terms for exchange of control which seek to minimise legal costs, risks, responsibilities and accountabilities by passing them to others.[71] As such, they are influenced by (for instance) intermediary liability, intellectual property, data protection and employment laws, but they also make normative claims about those laws' meanings in the context of their relations with customers and users and – as a result – shape their effects to providers' advantage.

Employment status for delivery riders (for example) depends on broader legal context, but the food app vendor can construct their Terms of Service (and their practices and the platform's operation) towards one classification or another. In other cases, providers' Terms may make intellectual property law claims to restrict access to their proprietary technologies and foreclose efforts to better understand how those technologies work, while claiming rights to use others' intellectual property to train models and improve services.[72] Providers may similarly seek to legitimate their practices in data protection law, claiming questionable legal bases for data processing and rights to use data for development, service improvement, and tracking and targeting[73] (obtaining data being an important aspect of platforms' competitive strategies[74] and producing data being a key function of supply chains). Providers may claim to be processors in data protection law,[75] seeking to place primary compliance and regulatory responsibilities for their data practices onto customers (aided by data protection law's binary distinction between controllers and processors).[76] Terms may also disclaim liability for things not covered by intermediary liability protections, even where problems originate in technologies providers operate or where they retain

2021); F Turton et al, 'Privacy in the Clouds, Revisited: An Analysis of the Privacy Policies of 40 Cloud Computing Services' (Queen Mary Law Research Paper No. 354/2021 2021).

71 Cobbe et al (2023), *supra* note 1; T Bucher, 'Objects of Intense Feeling: The Case of the Twitter API' (2013) *Computational Culture: A Journal of Software Studies* 3; Kamarinou, Millard and Kuan Hon, *supra* note 70; Michels, Millard and Turton, *supra* note 70; Turton et al, *supra* note 70.

72 Millard (ed), *supra* note 70; Cobbe and Singh (2021), *supra* note 3.

73 Cobbe and Singh (2021), *supra* note 3.

74 Cohen (2017), *supra* note 11.

75 Turton et al, *supra* note 70; Cobbe and Singh (2021), *supra* note 3.

76 Cobbe and Singh (2022), *supra* note 4.

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control.[77] Moreover, Terms may contain choice of law or arbitration clauses to resolve disputes over meaning in favourable jurisdictions or away from formal legal processes.

In effect, through their Terms of Service, providers use various areas of law as both swords and shields in the relations through which their position and power arises, structuring their legal relationships with – and the activities of – other supply chain actors. Providers seek maximum retained control over their technologies (depending on the type of service) as far down chains as possible – and maximum benefit from that control – while externalising costs or responsibilities which might otherwise come with it (often attaching in these agreements to the more limited control delegated to others). Through this, enabled by simultaneous control by separate actors of different aspects of the same systems, legal rights and benefits around operation and control (on the one hand) are decoupled from legal risks, responsibilities and obligations (on the other) and arranged in ways which maintain and amplify technological and legal asymmetries to providers' benefit.

The regulatory effects of software[78] are also leveraged by providers in the design of platforms and services to prevent or afford[79] different activities by users in line with platform policies. In other cases, providers may retain control over incidental aspects of technologies allowing them to enforce policies and restrictions to limit customers' delegated control through APIs, the design of services, or other means. The recommender service provider which underpins personalisation in the food delivery app (for example) may delegate control over the system such that the vendor can integrate it into the platform, while (for policy purposes) retaining control allowing them to limit the kinds of content restaurants input for that personalisation. A content delivery network provider may delegate control to allow customers to use that service to underpin applications of many kinds, while also retaining rights to refuse content they find objectionable or commercially difficult. If the content network provider is several steps up or down a chain from the point where content is 'submitted', those rights will necessarily be extended through those steps (i.e. the

[77] Cobbe et al (2023), *supra* note 1.

[78] J Grimmelmann, 'Regulation by Software' (2005) 114 *Yale Law Journal* 1719; L Lessig, *Code: And Other Laws of Cyberspace* (Basic Books 1999).

[79] D Norman, *The Design of Everyday Things* (2nd ed., MIT Press 2013); J Gibson, *The Ecological Approach to Visual Perception* (Classic ed., Psychology Press 2015); J Davis, *How Artifacts Afford: The Power and Politics of Everyday Things* (MIT Press 2020).

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provider extends retained control up the chain to govern the activities of actors they do not have a direct relationship with). A facial recognition service provider may use automated checks to restrict why and where customers can deploy that service. Such mechanisms may extend an application's supply chain – the recommender service provider may use *another* provider's content moderation service to check inputs for compliance, for instance (involving another exchange of control between the recommender service provider and the moderation service provider).

Asymmetries in supply chain interdependencies thus provide conditions by which certain actors shape others' activities to their benefit. Through these strategies, providers' regulatory power affects what customers can do for *their* customers and end-users in turn and therefore exchanges of control within and across chains more generally. Asymmetric patterns of ownership and control, constructed by and combined with asymmetries in legal rights and obligations, thus contribute to structuring supply chains in ways that allow providers to reinforce and amplify those asymmetries and further consolidate capture of markets and social relations. These dynamics unfold in contexts where various influences shape and amplify asymmetries in interdependence and balances of power dynamically in ways which were not inevitable and are not unchangeable. Providers' position and regulatory power in data-driven supply chains is therefore not a technological phenomenon, but a socio-legal one which can – in principle – be conditioned, contested, and dismantled.

8.4 Governance *of* Data-Driven Supply Chains

Understanding data-driven supply chains through interdependence offers opportunities to pursue public policy goals in law and regulation. Governance scholars have observed trends since the 1970s whereby centralised government is replaced by regulatory agencies and hands-off interventions to manage various aspects of societies and protect people from risks from the activities of corporations and organisations.[80] In the EU (particularly important given the global influence of the EU's regulatory system),[81] the rise of this regulatory state produced a business-friendly

[80] J Francis, *The Politics of Regulation: A Comparative Perspective* (Wiley-Blackwell 1993); Rose, *supra* note 39; M Moran, 'The Rise of the Regulatory State in Britain' (2001) 54 *Parliamentary Affairs*; Miller and Rose, *supra* note 40.

[81] A Bradford, *The Brussels Effect: How the European Union Rules the World* (OUP 2020).

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system of regulation by 'steering' economic activity through broad rules developed in consultation with affected interests.[82] These changes brought actors across societies within the processes of their own governance,[83] through arms-length, risk-based mechanisms which place much responsibility on the regulated themselves.

The emergence of informational economies and the plasticity of digital technologies – accompanied by narratives of deregulation and privatising governance – have challenged the regulatory state:[84] platforms combine and operate across markets, undermining conventional understandings of market power,[85] for example, while systemic harms from aggregated data processing or systems deployed uniformly across many users are not easily addressed by individualist regulatory frameworks.[86] The EU[87] has addressed supply chain models without confronting their interdependence dynamics or tackling their core conditions: in terms of managing risk (in data protection law,[88] the Digital Markets Act[89] and the AI Act),[90] individual control (data protection[91] and ePrivacy law),[92] providing protections to providers

[82] M Moran, 'The Rise of the Regulatory State' in D Coen, W Grant and G Wilson (eds), *The Oxford Handbook of Business and Government* (OUP 2010).

[83] P Miller and N Rose, 'Governing Economic Life' (1990) 19 *Economy and Society* 1; N Rose and P Miller, 'Political Power Beyond the State: Problematics of Government' (1992) 43 *British Journal of Sociology*; Rose, *supra* note 39.

[84] Cohen (2016), *supra* note 27; Cohen (2019), *supra* note 9, ch 6.

[85] Cohen (2016), *supra* note 27; L Khan, 'Sources of Tech Platform Power' (2018) 2 *Georgetown Law Technology Review* 325.

[86] J Cobbe and J Singh, 'Regulating Recommending: Motivations, Considerations, and Principles' (2019) 10(3) *European Journal of Law and Technology* 1; Viljoen, *supra* note 38; Cobbe and Singh (2022), *supra* note 4.

[87] Similar frameworks exist in other jurisdictions – the Consumer Data Right in Australia, for instance, is broadly similar to rights to access, portability and rectification in EU data protection law and reflects the logic of individual control.

[88] Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [2016] OJ L119/1 ('GDPR'), arts 24, 25, 32, 35, 36.

[89] Regulation (EU) 2022/1925 on contestable and fair markets in the digital sector and amending Directives (EU) 2019/1937 and (EU) 2020/1828 [2022] OJ L 265/1 ('Digital Markets Act'), section 5.

[90] Proposal for a Regulation laying down harmonised rules on artificial intelligence and amending certain Union legislative acts (COM/2021/206 final) ('Artificial Intelligence Act').

[91] GDPR, arts 12–22.

[92] Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector [2002] OJ L 201/37 ('ePrivacy Directive'), art 5.

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(E-Commerce[93] and the Digital Services Act),[94] and addressing some implications of organising social and economic life in this way (Digital Markets Act,[95] Platform to Business Regulation,[96] Platform Work Directive).[97] This has enabled and legitimated many of the practices of providers under an increasingly elaborate array of regulators and quasi-public bodies.

Yet the points where providers' position and power depend on others offer opportunities for legal and regulatory governance mechanisms. By understanding how providers' position and power arises through interdependent relations structured by commercial, technical, legal and political economic influences in supply chain contexts, governance mechanisms can seek to arrange those influences and contexts to change their consequences and outcomes. I now sketch some high-level directions for addressing the asymmetries in patterns of operation and control (Section 8.4.1) and in legal rights and obligations (Section 8.4.2) which produce providers' regulatory power. Law cannot solve all problems (indeed, it perhaps cannot solve even the problems it causes), so non-legal responses to data-driven supply chains are also needed. However, careful changes in law in line with these suggestions may – in principle – bring durable and substantial change.

8.4.1 Asymmetries in Operation and Control

Asymmetric interdependencies – reflecting asymmetries in operation and control – provide underlying conditions for providers' regulatory power *in* supply chains; they should therefore be core considerations for governance *of* supply chains. Providers' control over *essential* aspects affords asymmetric interdependencies, allowing providers to insist on retaining control over *incidental* aspects, shape others' activities to their benefit, and impose conditions of access which reinforce and amplify

[93] Directive 2000/31/EC on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market [2000] OJ L 178/1 ('E-Commerce Directive'), arts 12–15.

[94] Regulation (EU) 2022/2065 on a Single Market for Digital Services and amending Directive 2000/31/EC [2022] OJ L 277/1 ('Digital Services Act'), chapter 2.

[95] Digital Markets Act, chapter 3.

[96] Regulation (EU) 2019/1150 on promoting fairness and transparency for business users of online intermediation services [2019] OJ L 186/57 ('Platform to Business Regulation').

[97] Proposal for a Directive on improving working conditions in platform work (COM/2021/762 final) ('Platform Work Directive').

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asymmetries. As such, a key regulatory goal should be arranging patterns of control to address asymmetries in interdependence: which aspects of what kinds of service are retained by and delegated to whom; who controls essential aspects relating to core functions and who controls others. Where platforms algorithmically intermediate markets, for instance, providers typically retain significant control for technical and commercial reasons. This might instead be distributed as appropriate between the actors who actually constitute those markets to mitigate or eliminate the provider's regulatory power and balance interdependencies between them. Where conflicts between different interests arise – for example, where incidental aspects of a platform affect both riders and restaurants and could therefore be controlled by either – control should be assigned according to the goal of balancing interdependencies. What is appropriate differs between markets and sectors, and between services with different core functions, so (re-)distributing control requires a specific understanding of services and of the social and economic relations around them.

Importantly, *individualised* control has limitations, not least because of any remaining asymmetries between providers and individual customers or end-users. Moreover, features of services which are uniform across instances – such as essential aspects of systems going to their core function – may not be individually variable for technical reasons. Legal and regulatory governance mechanisms may therefore seek *collective* control of some or all such aspects. For the food delivery app, for example, this could be mutualised, cooperative, or other collective control over certain essential aspects of the platform's intermediation function by particular groups with concentrated interests[98] – such as delivery riders – or of incidental aspects which perform some governance function. Collective control over essential aspects could rebalance core interdependencies, which between providers and customers *as a whole* are perhaps not so asymmetric. This can be combined with other strategies aimed at incidental aspects of services: for instance, delivery riders as a whole might collectively control the food app's essential aspects even while particular riders and restaurants have more individualised control over incidental aspects relating to their activities through the platform. More generally, legal restrictions which prevent certain actors from

[98] MA Pollack, 'Representing Diffuse Interests in EC Policy-Making' (1997) 4 *Journal of European Public Policy* 572.

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acting collectively,[99] or frameworks such as data protection which focus on individual control and limit opportunities for collective intervention or redress,[100] should be revisited with a view to balancing interdependencies in this way.

Collective control over essential aspects of infrastructural services is difficult given the diverse and diffuse[101] interests of customers across markets and sectors accessing the same general-purpose technologies. Moreover, there may be multiple 'steps' up and down chains from the point of infrastructural services, which makes distributing control to customers, end-users, or others difficult. However, addressing asymmetries in interdependence fundamentally involves reducing the relative importance of any single actor's retained control. As such, meaningful representation or protection for groups of shared interest – such as data subjects' shared interest in the protection of their personal data,[102] or content creator's shared interest in protecting their intellectual property from appropriation into AI production – to collectively control or contest retained aspects of providers' services may help. Law may also seek to restrict infrastructural providers' ability to leverage control of essential aspects of services into retaining control of incidental aspects which amplify asymmetries in interdependence and afford regulatory power. This could involve reducing providers' discretion in insisting on particular exchanges of control with customers, by identifying the essential aspects of different kinds of service (based in the core function they perform), regulating the conditions for providers' retention of those aspects, and passing control over others to customers where possible. Again, this requires specific understandings of particular kinds of service, which will fulfil different core functions.

Mitigating asymmetries in *operation* (or their effects) at infrastructural level may be possible through interventions to reduce the relative importance of operating particular technologies and create space for alternatives, such as requiring open sourcing of proprietary systems[103]

[99] Such as restrictions on trade union organising or collective bargaining.
[100] Cobbe and Singh (2022), *supra* note 4.
[101] Pollack, *supra* note 98.
[102] Cobbe and Singh (2022), *supra* note 4.
[103] Though note the limitations of this in relation to AI services discussed by Widder, West and Whittaker, *supra* note 10.

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or interoperability[104] between platforms.[105] Enforced separations between infrastructural and user-facing services (challenging vertical integration), or requiring providers to divest certain services, limit reuse of data in development across services,[106] or limit reuse of models or systems across services (challenging horizontal integration) may also help. Some of these interventions have been proposed or sought in certain jurisdictions.

8.4.2 Asymmetries in Legal Rights and Obligations

Asymmetric patterns of operation and control do not fully explain governance in supply chains, however. Various other influences and supply chain dynamics shape and amplify asymmetries in interdependence, including laws which afford providers' position in patterns of control. Moreover, providers' regulatory power works in part through certain legal arrangements with others – their Terms of Service strategically interpret and make normative claims about relevant laws and legal frameworks to their advantage. Addressing regulatory power therefore requires addressing asymmetries in legal rights and obligations which influence supply chain interdependencies and exchanges of control in complex ways, reinforcing and amplifying technological and other asymmetries.

As described above, providers' Terms work with various frameworks to decouple legal rights and benefits around operation and control of technologies from legal risks and responsibilities, arranging them to instead maximise providers' commercial benefit and externalise liabilities and accountabilities to the limited control delegated to customers. A key goal for legal and regulatory frameworks in structuring interdependencies between actors is therefore to reliably align legal risk and responsibility with operation and control[107] – particularly for infrastructural services where re-distributing control is difficult. This means assigning roles, responsibilities, rights, obligations and accountabilities to reflect factual

[104] I Brown, 'Interoperability as a Tool for Competition Regulation' (*Open Forum Academy* November 2020) available online at <https://bit.ly/4huSJEt>. However, note that interoperability may in some cases bring anti-competitive effects: M Bourreau and J Kraemer, 'Interoperability in Digital Markets: Boon or Bane for Market Contestability?' (15th Digital Economics Conference 2023) available online at <https://bit.ly/3Ci5phS>.

[105] As, it should be noted, the Digital Markets Act seeks to do for messaging services (art 7).

[106] Again, as found in the Digital Markets Act (art 5), which does not apply to these infrastructural services (arts 2–3).

[107] Cobbe et al (2023), *supra* note 1.

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distributions of control over both essential and incidental aspects of technologies in accurate, sufficiently nuanced, and clearly specified ways[108] – to ensure that providers who benefit from services used across societies and economies bear the appropriate costs, that *legal* responsibilities around production and operation go to those who are *factually* responsible for them, and that customers' and end-users' rights and interests further down chains are properly protected. Addressing providers' ability to unilaterally determine Terms of Service violations at their discretion, remove customers' access at will, and limit avenues for challenge or redress may also help reduce the relative importance of providers' retained control.

8.5 Conclusions

The last fifteen years have seen transformations in production and distribution of digital technologies. The data-driven supply chains which now underpin social and economic life are characterised by unequal interdependencies between a range of actors, tied together by data, who together produce functionalities and outcomes in applications. Through these supply chains – key infrastructures for the production and processing of data across societies – the logics of informational capitalism reach deep into social and economic life. Asymmetries in supply chain interdependencies (constructed in part through laws and legal frameworks which shape patterns of operation and control of technologies) afford regulatory power to certain players, offering opportunities to shape supply chains – and therefore the social and economic relations now formed around them – to their benefit. Through this, relatively few providers have amassed significant power and extract significant revenue.

Viewing data-driven supply chains through the lens of interdependence allows us to understand both how they form through legally structured exchanges of control, and how the unequal balances of power within and across them come about. We can see that control of particular technologies is afforded by legal and other factors and does not by itself explain providers' position and regulatory power, which relies in part on leveraging asymmetries in legal rights and obligations to structure their relations with others in ways that reinforce and amplify other

[108] Unlike in, for example, EU data protection law – see ibid; Cobbe and Singh (2022), *supra* note 4.

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asymmetries. As providers' power arises through relations governed by law, we can see that law is not simply a tool for regulating supply chains, but a fundamental force in producing and structuring them. Understanding supply chains in this way also opens up avenues for legal and regulatory governance mechanisms aimed at supply chains. The lens of interdependence therefore offers opportunities to excavate the commercial, technological, legal and political economic foundations which afford providers' position and regulatory power, to address systemic problems in digital markets, *and* to begin to unpick the conditions which help produce them.

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