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Platforms, sex work and their interconnectedness

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Abstract

This paper examines the interconnectedness of sex work with the platform economy. It does this by mobilising two concepts from the platform economy literature: the *platform stack* (which captures the structure of platforms) and *interpenetration* (which describes the processes through which platforms intersect). Exploring the platforms stacks and interpenetration of platforms used by sex workers, the paper draws on a dataset of linked platforms used by 54 cam workers and documented observations of 55 different platforms. These platforms include those designed for sex workers as well as those with a more generalist function. In mapping this platform ecology, the paper highlights some of the opportunities, barriers and risks that platform interpenetration presents for sex workers.

Key words: sex industry, platform economy, platform stack, interpenetration

Introduction

Web-based platforms (hereafter platforms) – broadly defined as digital systems through which third parties can connect or interact (Srnicek, 2017a) – play a vital role in shaping the economic, social, cultural and political infrastructures around us. For customers (who purchase goods, services and content) and consumers (who consume it without purchasing), platforms provide access to various forms of media (SoundCloud); facilitate social and business networking (Twitter, LinkedIn); aggregate reviews (TripAdvisor); operate marketplaces (Etsy); and compare goods and services (Expedia, Comparethemarket). For producers and creators, platforms enable rapid access to customers and consumers, near and far.

While many sex workers, customers and consumers worldwide have limited or shared online access and many instances of sex work are not directly mediated by platforms, the importance of platforms within sex work seems to be growing. Platforms are increasingly involved, directly and indirectly, in the production, consumption,

mediation and exchange of many sexual services, as well as a vast array of free or purchasable sexual content. They provide (in many contexts) legal spaces of work and help to facilitate safety strategies for sex workers – for instance, enabling the vetting of customers (Clancy, 2020; Cowan *et al.*, 2021; Sanders *et al.*, 2018). In addition, sex workers utilize platforms to advertise and communicate with potential customers and consumers, take payment, and provide services or content.

Platforms facilitate four types of sex work which can be used in combination by sex workers. The first involves *in-person*, *direct sexual experiences* – such as paid-for-sex, fetish or BDSM sessions – where both provider and customer are physically co-present for the exchange having arranged the encounter online. The second involves *at-a-distance, indirect 'live' experiences* – such as web-camming, phone sex, instant messaging or teledildonics – where the internet is essential to the performance and consumption of the sexual experience (Cunningham *et al.,* 2018; Sanders *et al.*, 2018; Rand, 2019). The third category is *indirect purchasing or consumption of material,* which involves the use of platforms to purchase or consume sexual material without the live presence or engagement of the sex worker – such as watching pornography or viewing sexually explicit imagery. The fourth category is *asynchronous consumption and interaction*, which involves repeated interaction with sex workers and/or materials produced by sex workers through services such as OnlyFans, Patreon or behind paywalls on social media platforms such as Snapchat.

Despite their importance in the contemporary sex industry, platforms are underexamined and under-conceptualized in the sex work literature. One fruitful way of understanding the relationship between platforms and sex work is to draw on two concepts developed in the platform economy literature: (i) the platform stack, which is a framework for understanding platform structure, and (ii) interpenetration, which describes the processes through which platforms intersect (van Dijck, 2013; Swords, 2018). In this paper, we examine the platform landscape, concentrating on the stacks within, and interpenetration between, the different platforms that sex workers use – including platforms designed for sex workers as well as platforms with more generalist functions. In mapping the landscape, the paper demonstrates how the platform economy – and specifically the interconnectedness of platforms – presents opportunities, barriers and risks for sex workers (see also Blunt and Wolf, 2020; Blunt

et al., 2020; Sanders et al., 2018; Ryan, 2019). To do this, we draw on a dataset of linked platforms used by 54 cam workers, which is analysed alongside documented observations of 55 different platforms used by sex workers.

The platformization of sex work

If we frame sex work broadly as 'the exchange of sexual services, performances, or products for material compensation' (Weitzer, 2010: 1) – while recognizing that some sexual labour is consumed for free (e.g. freely accessible pornography) – we can identify an impressive array of academic literature examining sex work. An important theme in this literature is the use of the internet and digital technologies by sex workers and their allies. We turn to this theme now.

Sex work, the internet and digital technologies

Studies on sex work, the internet and digital technologies have drawn on a range of methods and a recurring focus of such studies has been on the use and management of online spaces and platforms by sex workers and customers. Online advertising by sex workers has been the subject of several studies. For example, Pruitt and Krull (2010) draw on content analysis to analyse female escorts' online adverts while Blevins and Holt (2009) analyse sex buyer web forums. In *Sexualities*, Vartabedian (2019) examines trans sex workers' advertisements and, more recently, Kingston and Smith (2020) published a large-scale quantitative analysis of an online escort directory, challenging what they argue to be hetero-sexist assumptions inherent in sex work discourse. Taking a broader focus, the *Beyond the Gaze* project explores the working practices of online sex workers in the UK (see Cunningham *et al.*, 2017; Sanders *et al.*, 2018; Campbell *et al.*, 2019). It reveals how online working can enable entrepreneurial practices including online brand development, innovative marketing strategies, safety and risk management practices, and access to peer-to-peer networks. The project revealed high levels of job satisfaction, but this featured alongside experiences of victimization (Sanders *et al.*, 2018). Data has also been published from the project on the policing of online sex work (Scoular *et al.*, 2019) and on the experiences of online customers (Sanders *et al.*, 2020).

The literature on sex work, the internet and digital technologies has diversified in recent years. Audacia Ray's (2007) *Naked on the Internet* is arguably foundational here; providing an experiential insight it considers (amongst other things) *internet sexploration* and diverse sexualities in the context of online cultures. More recently, digital tools used by sex worker support services have been examined in the human-computer interaction literature (see Strohmayer *et al.*, 2017, 2019), and technology as political protest has been considered in *Sexualities* (Middleweek, 2020). Research on webcam workers has considered the role of entrepreneurialism (van Doorn and Velthuis, 2018) and interactivity (Bleakley, 2014). Jones's (2020) *Camming: Money, Power and Pleasure in the Sex Industry*, meanwhile, explores issues of pleasure, danger and intersectionality, while Stuart (2016) recognizes the role of mainstream technologies in facilitating webcam work. Elsewhere, Ryan (2019) considers how male sex workers carefully curate escort and social media profiles to build identity and monetize their brand.

However, there has been little examination of platforms beyond their user interface – on the role of code, algorithms, infrastructure, digital tools, rules and regulations or how such things impact sex workers. There are a few recent exceptions, however, with two sex worker-led studies by the Hacking//Hustling collective being particularly noteworthy. The first assesses the impact of legislation on sex workers access to, and use of, platform spaces (Blunt and Wolf, 2020) and the second considers the impact of shadow banning[i] on sex workers (Blunt *et al.*, 2020). Complementing these, van Doorn and Velthuis (2018: 189) explore the interaction between the 'algorithmically configured state of uncertainty' and competition generated by webcam platform Chaturbate. They investigate how cam workers work within this socio-technological environment, showing how sex workers must negotiate platform infrastructures to be successful. More recently, Velthuis and van Doorn (2020) consider the impact of a ranking algorithm on performers. Expanding on these observations, in the next two sections we make the case that the concepts of the platform stack and interpenetration can help us to better understand the platformization of sex work and its impact on sex workers.

Platforms and the platform stack

A platform is a digital system which facilitates interaction between third parties (Srnicek, 2017a). When we look closer, however, platform functions become more specific, and conceptualization becomes more complex. There are many types of platform; describing every type is not helpful here (see, instead, Gillespie, 2018) but we can identify two broad types of relevance to our research: business-to-business and business-to-consumer.

Choudary (2015) identifies a technical architecture common to most consumer-focused platforms which is a useful model on which to build an understanding of the functioning of platforms. He visualizes the architecture as a *platform stack* which has three layers (see Figure 1). The first is the network/marketplace/community layer (network layer henceforth) where users interact with each other and whose interaction generates various types of value (e.g. monetary, brand, reputational, share). Value is created from, for example, financial transactions between users, views of adverts, or data about the interactions. The second is the infrastructure layer: 'the tools, services, and rules that enable the plug-and-play nature of a platform business' (Choudary, 2015: 61). Here we find socio-technical devices including code and algorithms as well as Terms and Conditions and user guidelines, which shape how a platform is used. The third is the data layer where data about users and their interactions is stored, and from which analysis takes place to shape the infrastructure layer and forms of interaction in the network layer. Analysis of the data layer is also used to improve the overall value and functionality of the platform. The size and importance of each layer varies between platforms depending on its function/aims.

As argued elsewhere (Langley and Leyshon, 2017a; Swords, 2018), the platform stack is a useful framework to structure a more detailed interrogation of platforms. When examining the *network layer*, for example, platforms can be viewed as intermediaries which enable and (re)produce multi-sided markets (Langley and Leyshon, 2017b; Swords, 2018). Analysis of network layers also reveals insights about the content of a platform and its users. From the outside, it is important that platforms are seen to have a thick network layer with many (and increasing numbers of) users, as this is where their value – both financial and discursive – is measured (Srnicek, 2017a). Having data on the amount, types (e.g. person to person) and forms (e.g. cam, chat) of interaction within the network layer is also important, as it indicates what

content and which users are allowed, sought after or excluded from a platform. Examination of the network layer, then, provides us with answers to 'what' style questions. For a deeper understanding of why and how a platform's network works the way it does, analysis of the infrastructure layer is required.

Network Layer
The visible surface of the platform stack where users interact e.g. sharing and liking media, buying/selling, communicating etc.

Infrastructure Layer
The location of code, algorithms and other socio-technical devices, as well as terms, conditions, community guidelines etc. which allow a platform to function.

Data Layer
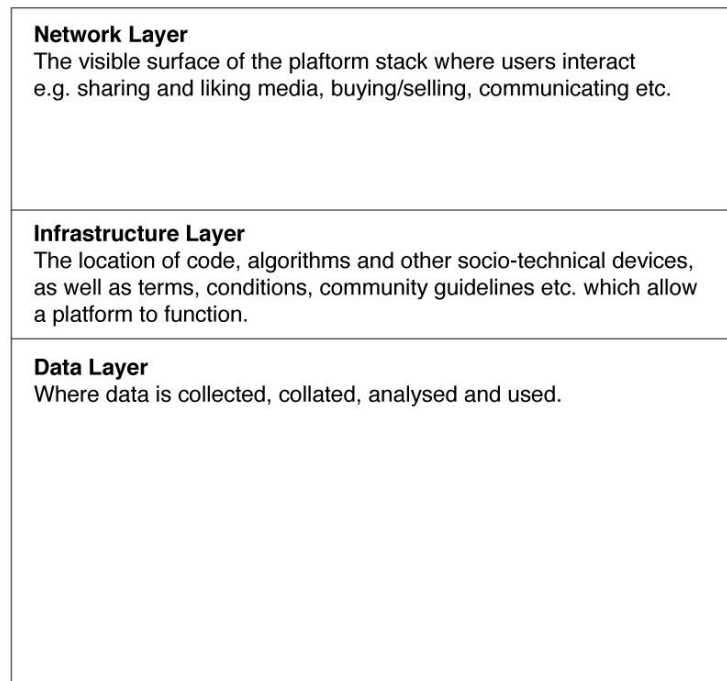Where data is collected, collated, analysed and used.

Figure 1: The platform stack

Analysing the *infrastructure layer* is valuable as it sheds light on the organization operating the platform and the ways in which users' activities are enabled and constrained. This is important because although platforms might be presented as neutral by their creators and proponents, they are not – nor are the policies and socio-technical devices used to govern platforms (see also Blunt *et al.*, 2020). Gillespie has argued that platform companies like to promote themselves as apolitical actors and they cite legislation which enables companies to be legally defined as merely providing access to content (rather than publishers of it) and services (Gillespie, 2010; Gillespie, 2018; see also Flew *et al.*, 2019). For example, although platforms providing access to sexual content may be defined primarily as content providers or ad-hosters, some publish resources which (perhaps) indicate a position on sex work. The Vivastreet blog hosts sex positive articles (*Yoga poses for better sex*) and sex worker friendly posts

(*How to be safe as a sex worker*). Whereas other platforms such as PayPal use Terms and Conditions to exclude sex workers – often with implications for the welfare of sex workers (Cowen and Colosi, 2021; see also Blunt *et al.*, 2020; Blunt and Wolf, 2020). Other platforms simply advise users that they may encounter material 'which is offensive, harmful, inaccurate or otherwise inappropriate' (Twitter, 2020: n.p.). Alternatively, some platforms actively curate adult content – for instance, Discord has a not safe for work (NSFW) category.

In his analysis of platforms, Gillespie (2014: 169) asserts the importance of 'unpack[ing] the warm human and institutional choices that lie behind these cold mechanisms'. In the case of sex work, this is vital because while many platforms present opportunities for sex workers (e.g. accessing useful articles, providing marketing tools to engage potential customers), they also present barriers (e.g. being banned from using certain payment processors/accessing certain cloud spaces, shadow banning, excessive content moderation, de-platforming) and risks (e.g. shared account information between sex work dedicated and generalist platforms, profile information shared without consent, online victimization) (Blunt *et al.*, 2020; Blunt and Wolf, 2020). Organizations decide what to include in their Terms and Conditions, what media can and cannot be posted, and who can and cannot post. Staff act on Terms and Conditions and engage with socio-technical devices to process, restrict, curate and promote content (Medeiros, 2019; Rand, 2019). Here it is important to remember that a socio-technical device such as an algorithm is simply a sequence of instructions and choices. Humans have determined which instructions and choices to program into the algorithm in a particular order (Bucher, 2018; Smith, 2019). Therefore, much can be learned by examining platform infrastructures, the contexts (both internal and external to platform companies) which support them, and the role of humans in producing and reproducing these dimensions (see van Doorn and Velthuis, 2018; Velthuis and van Doorn, 2020).

Interrogation of the *data layer* is also important as the right kind of data – generated, processed and analysed in the right ways – is incredibly valuable (Gitelman and Jackson, 2013). Organizations create value from their data by, for example, selling it, using it to serve tailored advertising to users, and boasting about it to (potential) shareholders and markets. Internally, data analysis helps drive the development of the

infrastructure layer by providing insights about the network layer, and it is used in the delivery of platform functionality (e.g. offering recommendations and automated moderation). Analysing the data layer is hard, however, as access requires the cooperation of platform companies.

Interpenetration: Beyond the platform stack

Examining the interplay of layers in the platform stack reveals important insights into platform design and the human decision-making behind it, but we also need to think beyond the platform stack. This involves recognizing that platforms are part of an ecosystem and intersect, often in complex ways. We can understand the overlap of platforms through the concept of *interpenetration* (van Dijck, 2013). This is illustrated in Figure 2. Interpenetration draws attention to the ways in which platforms are connected in two ways. First, platforms are connected through technical linkages – for example, via code, APIs (application programme interfaces), cloud services, server infrastructure and domain registrations – through which interoperability is possible and the internet can function. This infrastructure facilitates further interpenetration as platforms link to one other through plugins that allow code and media from one platform to be embedded in another. This may be via hyperlinks, shortcuts and templates for sharing connections to specific parts of a platform via another, or shared support systems which facilitate payments, tracking and profiles. For example, the 'tweet' buttons on adult video websites producing formatted content and links for Twitter accounts. Second, platforms are connected through shared operational logics: ways of working, conventions and norms which align them. For example, common approaches to functionality and design which reduce barriers to use (van Dijck, 2013); similar approaches to problem solving (Gillespie, 2018); concomitant business, investment and reward models (van Dijck *et al.*, 2018; Srnicek, 2017b); similar employment practices; shared legal approaches; and lobbying (Balkin, 2014). In addition, Swords (2018: 526) argues that interpenetration happens in different ways across different layers of the platform stack, thus '[n]ot all platforms are created, nor behave, equally'. We need, therefore, to examine power relationships between platform interconnectivity, and the impact this can subsequently have on platform users.
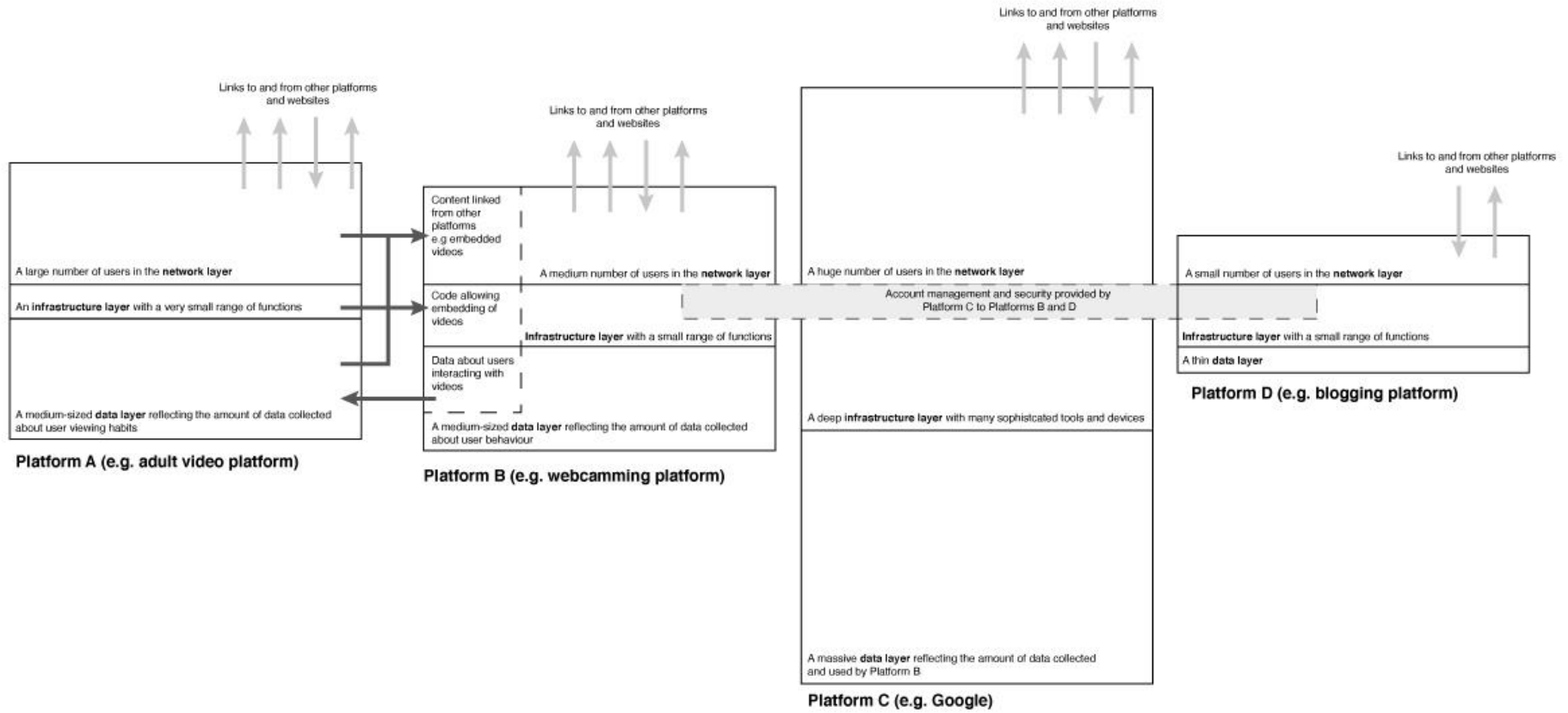
Figure 2: An example of interpenetration across platforms

Another way of thinking beyond the platform stack is by considering how and why people use or do not use platforms. This involves focusing on users' interaction with platforms, the layers therein, other platform users and how they negotiate interpenetration with platform ecosystems. This is particularly important when platforms are used for activity at the edge of legality or where content is deemed controversial by some parties. Legal constraints and a platform's response to them will enable and constrain certain activities, with differential penalties applied to 'misuse'.

Platform interpenetration

To apply the concept of interpenetration to sex work, we collated data from 54 cam worker profiles who had placed in the top-25 monthly rank in at least one month in a three month period during 2019 on a popular webcamming platform[ii]. This sample, while not representative, provided an illustrative cross-section of the most active cam workers working online, on that platform at that time. We collected data on the number and types of platforms linked from these profiles which led us to further platforms listed in Table 3. Although we did not collect it, other information was available on profiles (e.g. age and location). This was frequently missing or in accurate (e.g. some people included fictional locations and ages over 100). The project had ethical approval from Northumbria University. We did not collect any profile/personal/identifying or sensitive information; we only collected data pertaining to platform links. Cam worker performances were not observed during data collection.

Observations of any links from profiles from this secondary set of platforms were subsequently made. This dataset, and existing knowledge of the online sex work ecosystem, was used to identify and analyse the network layer of 55 sex-focused and generalist platforms used by sex workers. We considered multiple variables including log in options, the type and functions of platforms, app availability, options for interaction, sharing options (e.g. via social media), monetization, Terms and Conditions, cross-platform links and the types of service and content available.

This section uses the data collected to do three things: (1) it identifies the types of platforms used by sex workers; (2) it begins to map interpenetration across the network layers of these platforms; and (3) it considers the implications of interpenetration and outlines some of the opportunities, barriers and risks this presents for sex workers.

Sex work and platform types

As Sanders *et al.* (2018) have demonstrated, sex workers in the course of their work often use platforms that are dedicated to sexual services as well as platforms that are not dedicated to sexual services. We shall refer to these as dedicated and generalist platforms respectively. Table 1 draws heavily on Sanders *et al.* (2018) in outlining the types of dedicated platforms that are frequently used by sex workers. These platform types range from webcam platforms to customer review forums. They play an important role in the sex industry as they are platforms where sex workers and customers/consumers meet, access material and purchase/provide services; they are designed and used for this specific purpose.

Table 2 highlights the types of generalist platforms often used by sex workers. Here it pinpoints some types identified by Sanders *et al.* (2018) as well as some that we have added (the latter are highlighted in Table 2 with an asterisk). In sum, there are a multitude of generalist platform types used by sex workers and other digital labourers. These include, for example, social media apps (e.g. Twitter), blog and website hosting platforms (e.g. WordPress, Squarespace) and software platforms that provide tools to create photosets and videos (e.g. Adobe Creative Cloud). Importantly, some platform technology – particularly the generalist type – can be embedded across platforms. So, it might be that sex workers access several platforms, via a singular login (e.g. using a Google account to log into MyFreeCams and OnlyFans). Another example are third party payment processors which can be embedded into webcam or multi-service adult entertainment platforms.

Platform type	Function
Agency websites	Managed by third-party agencies to facilitate in-person sex work.
Content delivery platforms	Hosts and sells user-generated adult content online.
Customer review forums	Allows customers to 'post messages about their experiences of buying sexual services (normally in-person)' and sex workers to market services (Sanders *et al.*, 2018: 34).
Escort directories/ advertising platforms	Allows 'sex workers who offer in-person direct sex work to create profiles to advertise their services' (Sanders *et al.*, 2018: 25).
Individual sex worker websites	Used by individual sex workers who work independently to market services.
Multi-service adult entertainment platforms	Offers 'a range of different sex work services within the one site' (Sanders *et al.*, 2018: 29).
Webcam platforms	Facilitates webcam shows and provides an interface between webcam workers and customers.

Table 1: Platforms that are dedicated to sexual services
Source: adapted from Sanders *et al.* (2018)

Platform type	Function
Classified websites	Allows 'individuals to post user generated advertisements for a range of goods and services' (Sanders *et al.*, 2018: 37).
Dating and hook-up platforms with commercial advertising	Facilitates people to connect for 'personal relationships and unpaid sexual encounters' while also providing 'designated commercial advertising space where sex workers can openly advertise their services' (Sanders *et al.*, 2018: 31).
Dating and hook-up platforms without commercial advertising	Facilitates people to connect for 'personal relationships and unpaid sexual encounters' *without* providing 'designated commercial advertising space where sex workers can openly advertise their services' (Sanders *et al.*, 2018: 31).
E-commerce platforms	Provides technology enabling producers to create an online shop/business and sell goods (e.g. Shopify).
Funding/crowd patronage platforms	Facilitates payments from 'patrons' to artists and content creators (e.g. Patreon, OnlyFans, Memberful).
Link aggregators	Aggregates links to multiple platforms in one place (e.g. WatchmyFeed, LinkTree).
Online retail platform	Allows third parties to sell products online (e.g. Amazon).
Social media platforms/apps	Allows users to communicate through (micro-) blogging, messages, sharing media and following people's feeds (e.g. Twitter, Instagram).
Payment processors	Facilitates payments between producer and consumer (e.g. PayPal, Stripe, Epoch).
Social media platforms/apps	Allows users to communicate through (micro-) blogging, messages, sharing media and following people's feeds (e.g. Twitter, Instagram).
Software platforms	Provides software services to users usually through subscriptions (e.g. Adobe Creative Cloud).
Streaming platforms	Allows video and audio streaming often with viewer interaction (e.g. Twitch, YouTube, Discord).
Web hosting platforms	Provides online space and tools for people to design and run a website (e.g. Squarespace, Wordpress, Blogger).

Table 2: Generalist platforms used by sex workers

A vast array of platforms are used in the sex industry. This presents opportunities for sex workers such as access to large customer markets, opportunities for home-working, building brand recognition and a dedicated fan base, and access to peer support. It also presents challenges including the negotiation of terms and conditions, which are often aligned with legislation and criminal law in places where platforms are based and operate. Given sex work is often positioned as a moral issue, the perceived risk of having sex workers and their customers as users of platforms also plays a part here; many platforms either overtly (via Terms and Conditions) or more covertly

(through shadow banning, exclusion via algorithms or other means) exclude, or at the very least, reduce the visibility of sex workers on platforms (Blunt *et al.*, 2020; Smith, 2019). In this context, platform companies, their workers and financial backers weigh up the potential risks of explicit content being generated and shared in platform spaces. All these factors limit what platform technologies can and cannot be used for. Sex workers must therefore negotiate barriers across and within platforms, as they build sociality and manage their professional identity/identities (see also Ryan, 2019). Limited access to some intermediaries (e.g. payment processors and cloud storage for adult content) creates barriers. Risks are also generated when personal identity information is shared to verify accounts or when there are shared log ins for sex work dedicated and generalist platforms; hence there is potential for victimization such as doxing and stalking. Sex workers have also reported shadow banning, being de-platformed (removed from platform spaces) and being victimized through punitive content moderation practices (Blunt *et al.*, 2020). This can be a significant challenge because, as we demonstrate below, the interpenetration of platforms between multiple layers is complex and can involve invisible linkages between platforms. This can potentially lead to personal data being shared either unintentionally or without the informed consent of users (Blunt *et al.*, 2020).

Network layer interpenetration

Now that we have outlined the types of platforms that sex workers engage with, it is possible to trace interpenetration between platforms (whether they are sex work dedicated or generalist). We begin by highlighting how links between the network layers of platforms create interconnections. While these interlinkages are common, they are important to highlight as they indicate interpenetration down through the platform stack. When analysing cam worker profiles on an anonymised platform, it was apparent that a range of cross-platform connections were present (as shown in Table 3). Of the 54 profiles examined, only six had no links to other platforms. The remaining 48 profiles features links to 14 other platforms while also providing email addresses and links back to the original cam platform's media sharing system.

Platform	N	%
Twitter	34	63
Platform's own media sharing system	33	61
Amazon	17	32
Instagram	15	28
Snapchat	11	20
No links to other platforms	6	11
YouTube	4	7
OnlyFans	3	6
Personal website	3	6
Email	2	4
Bras N Things	1	2
Discord	1	2
Platform's own social platform	1	2
Reddit	1	2
Tumblr	1	2
Wicked Weasel	1	2
Wordpress	1	2

Table 3: Links to platforms from cam worker profiles

Tracing this further, of the 34 linked Twitter accounts, all but one of these provided links to other services, the most popular of which were: the original platform (15), OnlyFans (12), the original platform's media sharing system (9), Instagram (5), allmylinks.com (5) and their own websites (4). This demonstrates a second level of connections and, while we did not undertake further tracing schematically, exploring profiles and links to and from connected platforms revealed the additional platforms included in Table 1. This illustrates the complexity of interpenetration across these platforms. Indeed, some cam workers use link aggregator sites – such as WatchMyFeed and LinkTree – to demonstrate the range of platforms they use. Link aggregator sites are also useful as they allow people to bypass the limited space to post links and any other restrictions the platform might have on what can and cannot be posted on profile pages. However, platforms are trying to restrict this. Sex workers using TikTok reported that their profiles were being removed even though they are complying with TikTok's rules. They instead believe they were being punished for their Linktree linking to platforms used by sex workers (Corbett, 2020). Therefore, although many sex workers access and use mainstream sites, their profiles are often (and arbitrarily) removed without warning. This can also lead to sex workers using platforms which are less desirable, have predatory practices, and lack security/customer service.

The range of platforms evident in the data used also speaks to the mix of social, non-sexual labour performed alongside the provision of sexual services and content. Cam workers are using the sociality afforded by platforms to build personas and brands to engage consumers on a level beyond sexual content which could provide not only additional avenues for income, but also the opportunity for more resilient business models. However, as well as negotiating multiple Terms and Conditions, interpenetration also means that multiple platforms hold personal data and account information which may have been originally intended for a different, single platform. For example, it is possible to link OnlyFans with a Spotify account. Therefore, workers must navigate Terms and Conditions, the complexities and additional labour of managing sex worker personas across complex and interlinked digital ecosystems. This creates a risk that professional and personal identities are publicly exposed which can lead to doxing, outing stalking and violence. It has been reported that in some cases where people have been banned from platforms for sex work, they have subsequently been unable to log into linked non-sex work related accounts on other platforms (Blunt and Wolf, 2020). Furthermore, facial recognition technologies are being used by programs such as Spotlight to identify victims of child trafficking online. They scrape millions of images from platforms including sex worker advertisements and make the scraped data available to other non-sex work related platforms (e.g. Facebook, Twitter, Snapchat) wherein sex worker profiles can be identified (and are sometimes removed) (Taylor, 2019). In addition, some have voiced concerns that the same information is being shared with law enforcement agencies; this has been described as 'terrifying' for sex workers (Taylor, 2019, n.p.). Therefore, sex workers not only face being shadow banned or removed from platforms, they also risk criminalisation from law enforcement.

Infrastructure layer: Interpenetration of shared operational logics

The number and type of interconnections across a platform's network layers indicates further interpenetration at other levels of the stack. Interpenetration between infrastructure layers, however, is more complex than adding links to profiles. As discussed above, this kind of interpenetration is enabled through shared operational logics – defined as similar approaches to functionality, business models, employment practices, legal approaches and lobbying – and more technically focused

interoperability (shared technologies which allow the internet to function). There is only so much variation that can happen at the technical level, otherwise platforms would not be compatible with more fundamental internet protocols. Operational logics, in contrast, stem from how a company is organized and run. This, in turn, relates to the geographical context in which they operate and, therefore, leads to differential outcomes for users.

In relation to shared operational logics, the legal systems that companies must comply with and the interpretation thereof is instructive here. The legal context, in combination with a company's orientation as a sex work dedicated or generalist platform, and their position on sex work (if they explicitly have one) shapes the Terms and Conditions of a platform and therefore what content can and cannot be posted. For example, there has been a dramatic shift in which online spaces sex workers can use in the United States, following the introduction of The Allow States and Victims to Fight Online Sex Trafficking Act (FOSTA) in 2018, known widely as FOSTA-SESTA. FOSTA-SESTA has a broad-brush approach, expanding existing laws including the SAVE Act (2014) which made it illegal to financially gain or distribute advertising for commercial sex acts (Sanders 2018). To quote the Act itself, FOSTA-SESTA targets websites 'with the intent to promote or facilitate the prostitution of another person.' The wide net of FOSTA-SESTA means that many types of sex work are targeted including both direct and indirect sexual services, alongside existing sexual content such as legal pornography (Clancy, 2020; Romano, 2018). It can be applied to platforms where organizations did not know sex work was happening – such as ad posting sites – and it can also be applied retroactively or in circumstances where there is no evidence of coercion or trafficking (stopsesta.org). As Clancy (2020: n.p.) notes, there is the conflation of 'consensual sex work with human trafficking by design'.

Prior to FOSTA-SESTA in the US, platforms and Internet Service Providers were not held legally responsible for content posted by users and third parties, as they were protected under Section 230 of the 1996 Communications Decency Act. The impact however has been significant. Craigslist, for example, removed its free 'personals' listings in the US stating that they 'can't take such risk without jeopardizing all our other services' (quoted in Sanders, 2018, n.p.); and there were reports that work material (videos, clips, images etc.) disappeared from sex workers' Google

Drives in the wake of the law without warning (Cole, 2018; Sanders, 2018). This wholesale censorship has had a significant detrimental impact on sex workers' ability to generate money, maintain relationships with customers, carry out safety screening (with online 'bad-date' lists potentially falling under the auspice of FOSTA-SESTA) and network online with peers (Blunt and Wolf, 2020). However, the exclusion of sex workers from mainstream technologies is not uncommon. PayPal is known for refusing service to sex workers (Alptraum, 2016), and recently stopped all payments to performers on Pornhub citing that business payments were made without their permission (White, 2019). Similarly, in 2020 Visa, Mastercard and Discover all stopped payments to Pornhub when in order to investigate allegations of the site hosting videos depicting child abuse and rape. Payments to sex workers stopped overnight, leaving many without income, and without any time to prepare for stoppage of funds (Fabbri, 2020).

Sex workers are working to resist such exclusionary socio-technologies. One example of this is the Hacking//Hustling collective, who work 'at the intersection of tech and social justice to interrupt state surveillance and violence facilitated by technology' (Hacking//Hustling, n.d.: n.p.). While platforms that sex workers use are entangled with Big Tech, sex workers have developed workarounds in order to continue to make a living. They are often adept at navigating laws, and the subsequent changes to Terms and Conditions they force platforms to make. Cam workers, for instance, sell access to restricted social media or exclusive content using various workarounds, and in so doing generate new products for paying customers. This generates income, while helping them navigate the Terms and Conditions of different platforms. Content shared behind paywalls, for example, may be allowed to be more explicit. In other cases, posting material via private channels can allow sex workers to avoid human and socio-technical moderators. This comes with a risk, however, as breaching the Terms and Conditions of a platform, or interpenetrated platforms, could lead to more severe penalties.

There is always a labour cost to negotiating the technologies associated with different platforms. Sites are designed to facilitate interpenetration at the network layer but in the infrastructure layer, alignment is not always possible or desirable. Therefore, although interpenetration enables the requisite affective labour to develop brands,

persona and relationships with customers – for example, sociality through integrated Spotify playlists and the ability to purchase gifts from specialist retailers such as Wicked Weasel, which are integrated via processes of interpenetration – this also entails additional labour (Sanders *et al.*, 2018). Considering that workers may have multiple accounts on a single platform – e.g. multiple Twitter handles – as well as accounts across various platforms, this cost is not insignificant. This is illustrated by the experiences of a participant quoted in van Doorn and Velthuis (2018: 185) when discussing developing an effective 'hustle' on Chaturbate: '[i]t takes hours and hours to perfect the hustle, it takes countless hours of trial and error'. Developing branding, personas and associated business practices or hustles on a single platform not only takes up time, it is a significantly more complicated task when doing so across multiple platforms (perhaps with multiple or associated accounts) with varied Terms and Conditions, which may or may not also involve different modalities of currency and/or worker payment structures (Rand, 2019). Moreover, sex workers are often banned from platforms. This means they frequently lose huge customer/fan bases as well as the labour performed to generate them overnight (Corbett, 2020). Blunt and Wolf (2020) reported that 33% of the internet-based sex workers in their study had been banned from using a payment processor, additionally many of these had their monies seized in the process (see also Blunt *et al.*, 2020).

Infrastructure layer: Technical Interpenetration

We turn now to the ways in which technical interpenetration shapes the activities that companies allow on their platforms. Here, examining the functionality bought in is illuminating. It is a common strategy of platform companies to outsource functions of their services which are not core to their expertise or business model. By harnessing products offered by other backend-oriented platforms who provide specialist infrastructure, the costs and resources required to run platforms can be reduced. Using third parties for payment processing and account security are the most common ways of doing this, and by integrating these functions into the infrastructure layer, connections are formed to other platforms through suppliers.

Large technology companies that have millions of users with accounts offer other companies the option of integrating these accounts with their platforms. For

example, OnlyFans allows customers to sign up and login using their Twitter or Google credentials. This outsources account security to Twitter or Google and makes network interpenetration more efficient with easily shareable and formatted links. OnlyFans profiles can also be linked to Spotify accounts, integrating another form of platform and allowing sex workers to add a dimension to the sociality they generate by sharing playlists. Facebook accounts can be used for Tinder, Instagram, eBay and Spotify. MyFreeCams and xHamster – the former a cam and dating platform, the latter an adult video hosting platform – allow users to sign up with their Google accounts as does Blogger, a Google-owned website creation platform. Google also provides IT infrastructure and account management to universities (including one where one of the co-authors of this paper works). We can see here how sex work and generalist platforms become connected through technical interpenetration in different ways: Twitter and OnlyFans directly; Blogger and universities with xHamster and MyFreeCams via Google; Facebook and OnlyFans via Spotify.

Similar forms of technical interpenetration through use of third-party payment processors can be identified. Many of the largest payment providers are reluctant to allow sex-oriented platforms to use their services, and so a series of smaller operators have emerged. These include Epoch, CosmoPayment and Paxum, who offer specialist services designed specifically for the sex industry; notably though. platforms which specialize in providing services to sex workers often take a large percentage cut (Clancy, 2020). There are generalist e-commerce platforms that have been adopted by independent cam workers who sell directly to customers, rather than using intermediaries such as ManyVids. But as ever, there are Terms and Conditions to negotiate, meaning such platforms may not be an option for all sex workers. Other payment processors are connected through generalist platforms. One example is Patreon, a platform facilitating crowd-patronage, who uses Stripe, a major payment processor used by various platforms including Shopify, Lyft and OpenTable. Another example is the use by Adobe Creative Cloud (a platform that allows performers to create content) of Braintree (a company similar to Stripe), which is a subsidiary of PayPal and used by Uber, StubHub and Dropbox. These examples, again, illustrate how sex work dedicated and generalist platforms become connected through technical interpenetration with third-party infrastructure providers.

There can, however, be knock-on effects from this type of interpenetration. For example, even when a platform allows certain activities, if a third-party supplier has different Terms and Conditions, or if they are applied in stricter ways, users are impacted. This was the case in 2014 when PayPal withdrew its service to Patreon because some artist-creators used the crowd-patronage platform for explicit/sexual content (Swords, 2018). It resulted in many users being unable to access existing pledges or accept new ones and it is not the only example over the last few years (Stryker, 2014). Being aware of changes to Terms and Conditions, and when and where they might apply, adds additional workload for sex workers as well as the risk of potential loss of earnings. The interpenetration of payment processers across multiple platforms used by sex workers, again, exacerbates these problems, particularly where a platform's Terms and Conditions differ to a payment processor's as in the case of Patreon and PayPal. Although the issue was eventually resolved, the subsequent effect has been twofold: (i) sex workers have been reluctant to use platforms which use PayPal, and (ii) platforms like Patreon have stricter guidance on regulating explicit/sexual content. It is documented that sex workers are commonly discriminated against by payment processors, with accounts often being closed or stopped without warning which can result in performers losing significant chunks of income (Blunt and Wolf, 2020; Clancy, 2020). The example of Patreon/PayPal demonstrates how interpenetration means operational logics increasingly overlap and sometimes align, but at other times they do not. It also means the navigation of Terms and Conditions becomes more complex when activity is deemed at the edge of legality or is perceived as controversial by some parties.

Conclusion

This article has brought two sets of literature together, one on online sex work and another on the platform economy. In doing so, it has demonstrated that two concepts from the platform economy literature are valuable for understanding the interconnectedness of sex work and the platform economy. First, the *platform stack* allows us to understand different functions of platforms by considering their 'stack' which is comprised of three connected layers: the network layer (where users interact), the infrastructure layer (where socio-technical devices, services and rules reside) and

the data layer (where data about users and their interactions is stored). Second, we explored *interpenetration*, which describes the processes through which individual platforms intersect and overlap with each other via complex, technical linkages and shared operational logics, as part of a broader, digital ecosystem.

We have demonstrated that there is a significant degree of interpenetration between many of the platforms that sex workers use. Such interpenetration brings opportunities for sex workers operating online – for example, a space of legal work, enhanced sociality, opportunity to develop persona and brand, advanced technological tools to create profiles and professional branding, development of varied business models, access to useful articles/resources and spaces for peer support, and community building (Sanders *et al.*, 2018; Ryan 2019; SAMIEYW, 2019). Platform technologies also provide many options for public and private sharing of content. They also supply systems that can be circumnavigated and, to some extent, 'gamed' to workers' advantage, although this can translate as (often unpaid and time consuming) labour for sex workers (van Doorn and Velthuis, 2018).

The literature has documented in detail the risks of violence and financial insecurity faced by sex workers working online (see for example Blunt and Wolf, 2020; Blunt et al., 2020). It is noteworthy that interpenetration can contribute to the varied barriers and risks experienced by sex workers. For example, all platforms have terms and conditions to be negotiated and these are commonly guided by the legislative framework in which the platform exists and operates. We gave the example of FOSTA-SESTA impacting platform availability/accessibility to sex workers. When viewed through the lens of interpenetration, who has access to different types of platform technology becomes complicated, as although sex workers may be able to access and use certain aspects of a platform, there may other aspects of platform technology which they are excluded from, as the Google Drive/Patreon/PayPal examples highlight (Blunt *et al.*, 2020; Smith, 2019). In addition, technical interpenetration can create further risks, as platforms outsource account management, meaning that professional and personal identities could be linked via platform technology. As detailed above, there are also reports that platforms in collaboration with private surveillance companies are sharing escort adverts with other platforms without consent (Blunt *et al.*, 2020). The risks of managing professional profiles and identity online requires

further research to be fully understood but this blending of identity is likely to be worrying for sex workers seeking to keep their work identity private and completely separate from personal identity.

Returning to the key concepts of interpenetration and the platform stack, there are many questions that should be addressed. For example, how are the experiences of the consumers and customers using sex work dedicated platforms shaped by the platform stack and interpenetration? What are the implications of interpenetration for account and worker safety? How is data shared, managed and stored and how can sex workers protect themselves and their personal data? How do sex work dedicated platforms curate the layers across the stack? How are value judgements about content quantified? Furthermore, what effect has COVID-19 had on sex work platforms and their usage? Brouwers and Herrmann's (2020) article provide important insights into how adult service websites responded to sex workers during the pandemic; but this last question remains very important given a significant number of people are turning to platform-based labour. For example, in December 2020 the chief executive officer of OnlyFans, Tim Stokely, claimed that up to 500,000 new users are signing up every day (Shaw, 2020). Such questions can inform a future research agenda, one in which experiential participants and researchers should be front and centre, given it is sex workers themselves who use and negotiate platform technology in their working lives.

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[i] Shadow banning is the act of the blocking, partial blocking or concealment of online posts or content without the knowledge of the user posting them.
[ii] The identity of this platform has been anonymized in the paper.