



# Cultural Infrastructure: Select Annotated Bibliography

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# Introduction

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## About this Annotated Bibliography

The term ‘cultural infrastructure’ is increasingly used in policy discourses. For example, the state governments of New South Wales and Western Australia have both recently released cultural strategy documents framed in terms of cultural infrastructure. In their frameworks, cultural infrastructure is taken to be physical spaces where culture is produced and consumed—museums, archives, galleries, libraries, theatres, cinemas, studios, creative retail, outdoor venues and rehearsal spaces, as well as digital spaces that support access to culture (see State of Western Australia 2020; NSW Government 2019). This ‘hard’ infrastructure, however, also involves components of ‘soft’ infrastructure—relations, engagements, knowledges, affects, practices and a range of actors and stakeholders operating in the cultural and creative industries. In many urban and regional settings, provision and support of cultural infrastructure is predicated on its capacity to stimulate economic activity, cultivate desirable city branding and enhance the well-being of local communities.

Despite its emerging importance in policy frameworks, the concept of cultural infrastructure remains undertheorised in scholarly work. Responding to this gap, the Institute for Culture and Society’s Cultural Infrastructure Research Program aims to develop critical understandings of cultural infrastructure. In May 2021, we commissioned program member Dr Phillip Mar to undertake a literature review on concepts of infrastructure. After its completion in June 2021, the review was circulated to our membership. Over the next several months, we held virtual roundtables where members responded to the literature review based on their diverse disciplinary perspectives. Roundtables focused on the relations between hard and soft infrastructure; thinking beyond economic and policy-focused understandings of cultural infrastructure; how the (in)visibility of infrastructure intersects with social hierarchies and inequalities; and issues of temporality, scale, speed, affect and care. It became clear that the literature review was an invaluable resource for thinking through concepts of infrastructure that may be of use across the range of research work being undertaken by the Institute for Culture and Society. It should be publicly accessible as a contribution to surveying and engaging with a rapidly expanding field of cultural knowledge.

This literature review is organised into two key sections, ‘Concepts of Infrastructure’ and ‘Annotated Bibliography’, with the former providing a summary of the key definitions, issues and debates explored in the body of literature that is canvassed in the latter section. The second section is divided thematically into sub-sections, and, for ease of use, some entries appear in more than one sub-section. It is important to note that Abstracts and Descriptions in most cases are as they appear either on publishers’ websites or in the publications themselves.

## About the Cultural Infrastructure Research Program

The Cultural Infrastructure Research Program (co-led by Professor Deborah Stevenson and Dr Zelmarie Cantillon) conducts cutting-edge, interdisciplinary research into the cultural institutions and practices that shape the expression and experience of everyday lives and cultures and contribute to the social, cultural, and economic vitality of cities and regions. These are the built and imaginative places for the production and consumption of culture. Mindful of the complexity and unevenness of cultural infrastructure, the program probes its contours at different levels of operation and governance, and in contexts ranging from the local to the global. Key research

concerns include cultural policy, placemaking, urban cultures, cultural work, the creative industries, museums and heritage, material culture, the arts, sport, entertainment and leisure.

This program is innovative in its merging of policy-relevant and critical research and the incorporation, under the rubric of ‘cultural infrastructure’, of diverse cultural institutions and practices such as heritage, the arts and sport. It brings both qualitative and quantitative research methods to bear on these important subjects while some researchers have a particular interest in applying the techniques of cultural mapping and data visualisation to penetrate the texture and complexity of cultural infrastructure. Research team members frequently work in partnerships with both the public and private sectors, including local municipalities, state government bodies, commercial and not-for-profit cultural organisations.

Important research currently underway examines options for conserving heritage sites in rapidly developing parts of Asia, including Mongolia and China, transnational approaches to interpreting migrant heritage, and a study of heritage making by recent migrants from China and India in Parramatta. Other work probes civic engagement among diverse cultural communities, the planning, provision and uses of urban cultural infrastructure, the complexity of cultural work in Greater Metropolitan Sydney (especially in the West) and a major study of the social and cultural dynamics of cultural taste across contemporary Australia.

### **How to cite this work**

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# Concepts of infrastructure: A brief investigation

*Phillip Mar* (May–June 2021)

This report and literature review has been prepared for the Cultural Infrastructure Research Program at the Institute for Culture and Society. It offers an overview of theoretical conceptions of infrastructure to inform further research, particularly in cultural fields.

## The word ‘infrastructure’

Infrastructure is a modern idea, first emerging as a term in French civil engineering. The earliest records for infrastructure are from 1875 in French and 1927 in English (Oxford English Dictionary 2021).

Infrastructure was first ‘an organizational and accounting term used to distinguish the construction work that was literally conducted *beneath* unlaid tracks (roadbeds) or was otherwise organizationally *prior* to them (surveys, plans, bridges [etc.])’, in contradistinction to the superstructure situated above or constructed after the tracks (Carse 2017: 29, italics in original).

What does this word suggest? *Infra*, meaning below, beneath, sometimes inferior, plus *structure*. Infrastructure must be *of* something. Infrastructure is not itself a structure; it differs from a structure or network in implying relations of depth or hierarchy. Infrastructure can also be a singular noun for a collection of integrated parts (Carse 2017: 27). Infrastructure must be embedded in relations.

Infrastructure gradually became a common term in engineering, planning and economics, but only emerged as a significant concept in social sciences and humanities in the past 25 years. Since the 1990s there has been a proliferation of academic usages of the concept. Illustrating the problem of infrastructure’s diversity of conceptualisations, Larkin (2013: 338) reflected on the dilemmas of infrastructure theory:

Because the basic object of infrastructure is so diverse and can be analyzed in so many different ways, the choice of methodology is a theoretical question. Are infrastructures technological systems, and the way to understand them a process of analyzing networked machines? Are they financial instruments, practices of accounting and budgets, or management structures and organizational techniques? Are they biological, embodied in the physicality of men who use their size, mass, and attitude to attract bids on a Chicago trading floor (Zaloom 2003, 2006)? Or are they social, composed of practices of visiting, drinking tea, and greeting, investments into sociality that can pay off by creating a web of connections that can be relied on for all sorts of social, economic, and political work (Elyachar 2010, 2011; Simone 1998, 2001, 2004)?

## Theories

Infrastructure began to enter social and cultural thinking with sociological work on emerging scientific and digital technologies by Susan Leigh Star, Geoffrey Bowker and others. This influential work would affect subsequent studies, particularly Susan Leigh Star’s (1999) definition of infrastructure as ‘a system of substrates’ (380) that is ‘by definition invisible, part of the background for other kinds of work ... sunk into and inside of other structures, social arrangements, and technologies’ (381). But these substrates—such as pipes and wires—are also ‘part of human organization’ if seen through an ‘infrastructure inversion’ (Bowker 1994, a foregrounding of elements not normally attended to, drawing attention to the sociotechnical elements of large-scale systems.

At roughly the same time, infrastructure emerged as a theoretical category in disciplines such as anthropology, geography and urban studies. The following broad definition provided by Stephen Collier and Aihwa Ong (2003) for a multidisciplinary workshop on infrastructures illustrates the elasticity of extensions that the concept could undergo as a term for facilitating some linkage between technological, material and social entities. They explain that infrastructure:

designates specific institutional, material, or social conditions through which the functioning of a certain technology, ethical regime, form of regulation, or mode of communication is either enabled or impeded. It inscribes the space and form of limited, finite, and localizable relationships and effects that occupy a certain space and that concretely link—or distinguish and divide—various objects, spaces, techniques, individuals, and social groups. An infrastructure allows these elements to come into communication but does not necessarily organize them in terms of a common structural or logical principle. Technologies and infrastructures shape spatial forms, but they also shape problems. (Collier and Ong 2003: 423)

A more recent definition is more contained:

[I]nfrastructures are extended material assemblages that generate effects and structure social relations, either through engineered (i.e. planned and purposely crafted) or non-engineered (i.e. unplanned and emergent) activities. Seen thus, infrastructures are doubly relational due to their simultaneous internal multiplicity and their connective capacities *outwards*. (Harvey et al. 2017: 5, emphasis in original)

The authors warn that inquiry requires a ‘firm focus’ on the ‘infra’ qualities, their temporal and spatial reach and the complications of their ‘open-ended relational capacities’ (5). The layered quality of infrastructures means that they will likely be complexly entangled with other technologies and narratives (Marklund & Rudiger 2017: 15). These definitions point to the slipperiness of a concept that by definition requires careful analytical contextualisation.

## **Theoretical orientations and distinctions**

### ***Visible and invisible***

Star and her colleagues (Star 1999; Star & Ruhleder 1996) emphasised the invisibility and taken-for-grantedness of digital media infrastructures. It is only when they fail that they are noticed. This aspect of infrastructures has been taken on critically in other fields. For instance, Amin (2014), writing of informal settlements in Brazil, both supports and critiques this claim about the visibility of infrastructure. Infrastructure tends to become more invisible with the achievement of ‘well-functioning’ social arrangements, but structural precarity makes it visible.

Visibility and degrees of strategic engagement with infrastructures remains a key question. For instance, as digital technologies become increasingly pervasive and coextensive with everyday life, infrastructure becomes more ‘visible’ as people need to actively negotiate with technical infrastructure to make it work for particular uses (Dourish & Bell 2007). Infrastructures will vary according to their physical and cognitive relationship to human users, perhaps shifting between taken-for-grantedness and intervention. Specific rationalities and justifications will be generated in relation to infrastructural interventions.

### ***Hard and soft infrastructures***

Infrastructural relationships are commonly described as ‘hard’ or ‘soft’. This is a legacy of standard economic thinking, in which hard infrastructure was conceived as physical facilities while soft infrastructure names social aspects such as human capital or innovation. In earlier formulations,

soft infrastructure was conceived as the core institutional framework that underpins the operation of an economic, political or social system (Niskanen 1991). Soft infrastructure is frequently cast as an ‘enabler’ of hard infrastructure, soft infrastructure being defined as ‘institutional systems that facilitate the development and operation of hard infrastructure’ (Turner 2020: 11). There is necessarily a ‘dialectic of hard and soft infrastructure’, for instance where both converge as expertise. One wonders at the relevance of the hard/soft binary, given the shift to thinking about infrastructure in terms of sociotechnical assemblages that are intrinsically entangled.

These binary terms can be of use when they can usefully facilitate the articulation of relations between hard and soft elements. For example, in De Beukelaer’s (2019) study of a West African music scene and music distribution, hard infrastructure includes built venues (or spaces that can act as venues), regulatory environments, transport, street lighting and music education, while the soft infrastructure of music venues includes the capacities and efforts to create makeshift events in the context of decaying urban infrastructure.

In Bryson’s study of the relocation of a UK ballet company, which was also framed in terms of urban regeneration implications, hard cultural infrastructure was the provision of built facilities such as theatres, while soft cultural infrastructure included audience development, but also ‘concentrations of creativity and expertise’ (Bryson 2007: 98). For Bryson, hard and soft dimensions are interrelated and investment is required for both, but they need to be kept apart analytically.

Central to this relationship are the interactions that occur between soft and hard cultural infrastructural investments and, in particular, the tacit and codified knowledge that is acquired by dancers as well as dance audiences. Part of this analysis highlights the interplay that exists between local and national policies and the ways in which the local can mobilise elites, politicians, artists, and others to shape the artistic and cultural character of a city (Bryson 2007: 109).

Hard infrastructure is linked to capital investment and soft infrastructure to resource investment in tacit cultural knowledge and skills. This analysis deftly maintains the infrastructure discourse within an economic framework including state investments, while keeping focus on the ongoing reproduction and nurturing of cultural practices.

### ***Spatialised and spatialising infrastructures***

A strong theme in infrastructural conceptions is their inherently spatial dimension, as well as the potential of infrastructures to define and shape spatial relations. This can take place across many dimensions; infrastructural relations can both connect and divide people and places. For instance, Easterling (2014) contrasts digitalised infrastructural space with traditional architectural space, with which it has effectively merged. Buildings are no longer ‘singularly crafted enclosures, uniquely imagined by an architect, but reproducible products set within similar urban arrangements’ (11). This infrastructural space also includes ‘shared standards and ideas’, the ‘soupy matrix of details and repeatable formulas that generate most of the space in the world’ (11). Thus infrastructure is no longer a hidden substrate, as Star argued; infrastructure is more and more the ‘overt point of contact and access between us all—the rules governing the space of everyday life’ (11). If so, is it still infrastructure?

Rossiter (2016) is concerned with the way in which logistical media produces an emergent territoriality beyond the nation state as a bordered entity. This uncontained territoriality ‘consists of operational practices specific to infrastructural systems and technical devices, the effect of which produce territory as spatial arrangements and temporal dynamics that may contest or conflict with state-based claims to control over the bounded space of the nation and its sovereign extensions’ (143).



On an everyday experiential level, infrastructures provide a template for routine spatial practices; this is obviously the case with standardised public transport routes. But with emerging platform economies such as Uber, there is a ‘performativity of circulation’ inherent in platform ecosystems, which, ‘via the glowing rectangles held in many hands, extends from the social web to rescript geographies of everyday socio-spatial encounter’ (Barns 2019: 8).

Recent studies propose the notion of ‘inverse infrastructures’ that disrupt networks from below (Egyedi & Mehos 2012). This notion opposes centrally controlled infrastructures with inverse infrastructures that ‘develop independently and outside the realm of centralized control [and] are typically user driven and self-organized’ (Egyedi, Mehos & Vree 2012: 3). These may range from socially disruptive initiatives to complementary initiatives that are nested within surrounding systems (Egyedi 2012: 257). ‘Bottom-up’ infrastructural projects such as wireless community networks (Crabu & Magaouda 2018) entail research and collaboration localised outside conventional spaces of research and development, pointing to an ongoing respatialisation of infrastructure, also relevant to activities of other fields, including cultural activities.

### ***Infrastructures and temporality***

Temporality has long been a feature of infrastructure theory. From Star and Ruhleder’s (1996: 112) study of a collaborative scientific network, the view that ‘infrastructure is something that emerges for people in practice, connected to activities and structures’ has focused attention on the temporality of the emergence of infrastructures, raising the question ‘when is an infrastructure?’ Infrastructures condition routines and social tempi. There has been strong interest in participatory aspects of infrastructural creation, in commons and in cultural dimensions of infrastructures that grow and emerge over long time periods (Karasti et al. 2010; Karasti 2014; Berlant 2016; Marttila & Botero 2017; Karasti & Blomberg 2018).

While infrastructures tend to contribute to the acceleration of social life, Barlow and Drew (2021: 212) argue the need for slow infrastructures, in which there can be ‘an attunement to multi-species and more-than-human relations’. If slowness is associated with care, attention and reflection, slower processes may also be linked to slow (usually ‘soft’) infrastructures in fields such as cultural production that encompass the longer time required for creative work for audience development. Bryson (2007) contrasts the temporal differences of investment maturation for hard and soft infrastructures, the rapid onset of hard infrastructure (capital) investment compared to the longer time frames for soft (resource) investment.

### ***Digital and analogue***

There is a strange meshing and blurring in the theorisation of and research on infrastructures between digital and analogue technologies. Perhaps this is because much of the early work on infrastructure came from thinking about emerging computing systems and processes. Infrastructure studies still labours under the tension of conceptualising infrastructure in general and digital networked infrastructures in particular.

Rossiter (2016: 192) reminds us that infrastructure is grounded in *techné*, ‘where the human and technology are co-originary’. The analytical power of logistics is attributable to its *unconcern* with the dichotomy between human and machine, digital and analogue.

Nevertheless, there are conceptual tensions due to the trajectory of infrastructures’ theoretical development that need to be worked through. There has been criticism of the predominance of information and network perspectives that are not always the most apposite for the analysis of certain kinds of infrastructure. Mattern (2020: 139) notes the ‘longevity and limitations of city-as-computer scenarios’ while seeking to create ‘more generous, inclusive maps of urban information

ecologies’ and richer epistemologies ‘better attuned to the lifecycles of urban information resources—to their creation, curation, provision, preservation, and destruction—and to the assemblages of urban sites and subjects that make up a city’s intellectual ecologies’.

### ***Swelling and splintering of theories of infrastructure***

The expansion of infrastructure as a theoretical category is illustrated in the call for ‘expanding and renegotiating the roles of infrastructure not only as a technical, but also as a political, economic, social, and even aesthetic matter of concern for all’ (Ruby and Ruby 2017). As infrastructure thinking generates further layers and subliterations ‘infrastructure loses the “black-boxed” quality of a stable, ubiquitous, banal underpinning of everyday life the more it fragments and segments space’ (Johnson 2018: 75); this statement reflects the dilemmas of a field of inquiry that may be splintering and outgrowing its original insights.

Another conceptual branch is that of ‘affective infrastructures’. This concept was rather idealistically flagged by Lauren Berlant (2016), who advocated for affective infrastructures as accommodating multiplicity and desire moving beyond and countering relations of sovereignty. This concept can be found in areas such as health studies, heritage, sport, tourism and political science. For instance, see Heywood (2011) on affective infrastructures in sports training and coaching; Street (2012) on colonial hospital environments; Knox (2017) on political imaginaries; Knudsen and Kølvrå (2020) on heritage practices, Holloway (2010) on tourism (ghost tours) and Chambers (2018) on affective infrastructure in the Chinese Communist Party.

In the past decade, there has been a focus in the literature on knowledge infrastructures, initially an outgrowth of the participatory design literature in ICT and science studies (Stuedahl et al. 2016). The term ‘thinking infrastructures’ was proposed to ‘consider a broad range of phenomena that structure attention, shape decision-making and guide cognition such as rankings, ratings and algorithms’ (Bowker et al. 2019: 1). Thinking infrastructures are ‘investments in form’, that is, concepts, classifications, evaluations, etc. that can organise thinking and direct action across multiple spatial and temporal scales. Thinking infrastructures are focused not on the thoughts themselves but on the ‘technologies, epistemic cultures and social practices that make thought and thinking possible in the first place’ (2). Clear examples of thinking infrastructures are organising knowledge through search engines (what I did to create this literature review), contact tracing or governing markets through algorithm design.

Paul Edwards uses the notion of infrastructuration, tying infrastructure—as ‘complex, adaptive sociotechnical systems, made up of many interacting agents and components’ (Edwards 2019: 356)—to Giddens’s notion of structuration. Sociotechnical systems rely on routine, habit, procedural norms; infrastructures condition (and are conditioned by) agency and active participation in many ways. Hence, sociotechnical practices become life skills, which become embodied, embedded in labour processes, often routinised and quasimechanical. Infrastructures thus become ‘lifeworlds we inhabit’ (365). Here, infrastructure is aspiring to join the armoury of general theories of practice, agency, dispositif and so on. Is it still infrastructure then? Perhaps there is value in Harvey et al.’s (2017) advice to keep ‘what is infra’ at the centre of analysis.

It is evident from this brief foray into the conceptual polarities—and frequent tensions—in the literature that infrastructure conceptions have expanded both in reach and in their range of meanings. This has conceptual implications that need to be further addressed; the swelling and splintering of infrastructure theories may threaten its coherence. At the same, some of these emerging tendencies hold considerable promise in terms of their research potential.’

## **Infrastructure theory by broad thematic areas**

While infrastructure theories are multidisciplinary in their reach, there are clearly disciplinary differences in approach. Here we examine infrastructure theory in terms of loose disciplinary clusters of approaches to infrastructure, recognising the many crossovers that characterise the literature. The aim is to gain some idea of links between research themes and disciplinary developments and to provide points of comparison.

### ***Economics***

Infrastructure is most commonly understood as an economic category which equates infrastructure as a means of ‘noneconomic’ support for economic activity often associated with the ‘supply side’. In general, I have omitted discussing mainstream economic uses of the term, although it is important to note that this perspective suffuses work in many academic disciplines, particularly where there is a policy interface—for instance, urban planning or cultural policy.

There is, however, a humanistic strain of infrastructural critique amongst some economists. The Foundational Economy Collective are a group of economists wanting to renew the ‘foundational economy’ consisting of the goods and services making up the ‘broad infrastructure of safe and civilised life’ (Foundational Economy Collective 2018: 32–33), laid down in Britain in the late nineteenth century up to the thirty years following WW2 (33). The American economist Brett Frischmann argues that approaching infrastructures from the (social) demand side ‘facilitates a better understanding of how infrastructure resources generate value for society and how decisions regarding the allocation of access to such resources affect social welfare’ (Frischmann 2012: xii). Rather than looking at how much money there is, he adopts a future-oriented policy to invest in infrastructure based on its potential social value, which does not yet exist, but that will be generated in the future. Frischmann (2012: 112) advocates the economic advantage of the nondiscriminatory management of these infrastructures as commons, arguing that nonmarket management would be more flexible, fluid and adaptable, and more likely to deal with unforeseen and unpredictable shifts and changes.

### **Information communications and media**

Work on information and media infrastructures that emerged from the 1990s came from sociologists and science and technology scholars who examined the ‘mundane combinations of technological and social factors’ (Hesmondhalgh 2021: 133) in networked information systems as they were emerging. This work largely triggered interest in other fields, and for this reason it has been highly influential in the conceptualisation of infrastructure in fields beyond ICT and media.

Geoffrey Bowker (1994: 10) coined the phrase ‘infrastructural inversion’ to argue that ‘background infrastructural elements could be treated as “figure” or foreground’ in understanding the sociotechnical elements of large-scale systems. Susan Leigh Star (1999: 377) further developed the notion of infrastructure to include ‘boring things’ like wiring or industry standards in order to bring together social and technological dimensions inherent in specific practices.

The notion of infrastructure had been rarely used in social analysis before the 1990s, when Star and colleagues developed an influential account of information and media infrastructures as a sociotechnical substrate. Star (1999), in proposing an ‘ethnography of infrastructure’, described infrastructure as ‘a system of substrates’ that is ‘by definition invisible, part of the background for other kinds of work ... sunk into and inside of other structures, social arrangements, and technologies’ (380–381). Leigh Star proposes nine properties of infrastructures, summarised in this gloss:

embedded (i.e. ‘sunk into other structures’ ...); transparent (‘it does not need to be reinvented each time or assembled for each task’); offers temporal or spatial reach or scope; is learned by its users; is linked to conventions of practice (e.g. routines of electricity use); embodies standards; is built on an installed base of sunk capital; is fixed in modular increments, not built all at once or globally; and ... tends to become visible upon breakdown. (cited in Graham & Thrift 2007: 8)

Elsewhere, it was argued that infrastructure is not simply a ‘system of substrates’ in the way underground pipes are to sewerage, say. Rather, ‘infrastructure is something that emerges for people in practice, connected to activities and structures’ (Star & Ruhleder 1996: 112). In other words, infrastructure is situational as well as being ‘a fundamentally relational concept, becoming real infrastructure in relation to organized practices’ (Star 1999: 380). Since infrastructure is not simply a thing (or things), careful attention is needed in analysis to investigate the relational aspects. Hesmondhalgh (2021) has noted the often-vague assumptions around this relationality in much digital media infrastructure research, and the lack of causal analysis.

Because the early work on infrastructure was largely grounded in technological and scientific processes and partnerships (and a close relation to the developing science and technology studies and in part to actor–network theorists), there is a considerable literature on collaborative processes, some of it under the label of ‘participatory design’ (Karasti et al. 2010; Karasti 2014; Bødker et al. 2017; Karasti & Blomberg 2018). The more active gerundial term ‘infrastructuring’ has been applied to collaborative processes that develop ‘sociomaterial resources and experiences’ in collaborative ways. ‘Infrastructuring’ as a concept has also spread to research beyond technical and scientific worlds, such as citizen initiatives to make and repair things (Hector & Botero 2022).

In the past decade, there has been a strong emphasis on the interface of user experience and everyday practice. Communications infrastructure theory (CIT) builds on the ‘sociotechnical negotiations’ that the mechanisms of digital communication rely on. The internet is literally an immense actor-network with an ‘installed base of routers, users’ experience and practice, backbones, hosts, software, and specifications’ that is well-established and largely ‘irreversible’ (Monteiro 1998: 242). More recent research focuses on both the design of technical systems and the role of end users in the interface of everyday life (e.g., Jung & Kim 2018; Liu et al. 2018). As digital infrastructure becomes increasingly pervasive, it becomes coextensive with everyday life. Infrastructures can become more ‘visible’ as people need to negotiate them as we become more interdependent with them. Infrastructural experience is spatialised in many ways—for example, ‘infrastructures of naming, infrastructures of mobility, infrastructures of separation, infrastructures of interaction’ (Dourish & Bell 2007: 418). While infrastructures are often invisible and taken for granted, they also ‘offer themselves up to people for manipulation and interaction’ (428). The line between design and use can become blurred. For example, a recent paper on music algorithm designers observes that the ‘vernacular social theorizing’ of developers tangles with their technical work; they mimic the enthusiasm of the avid listener with a level of enthusiasm for music, which manifests as a willingness to expend effort in finding listening material (Seaver 2021: 773).

However, Hesmondhalgh (2021) warns of the possibilities of reification in this area, i.e., assuming that computer networks are automatically infrastructures without closely examining and questioning human–nonhuman relations and practices.

There is also a literature that places notions of digital infrastructure within a macrolevel social and political analysis. Graham and Marvin’s (2001: 9) *Splintering Urbanism* is grounded in a notion of ‘networked infrastructures’ enabled by digital media that are propelling the fragmenting of infrastructure through ‘privatised, customised infrastructure networks across transport, telecommunications, energy and water’. Infrastructure processes reproduce highly uneven sociospatial relations in urban spaces across the globe. Rossiter’s *Software, Infrastructure, Labor* (2016)

develops an extended media infrastructure theory encompassing labour, class, logistics and digital systems. The primary focus is on logistical infrastructure, which ‘enables the movement of labor, commodities, and data across global supply chains’ coordinated by software, codes, etc. (Rossiter 2016: xv). Communicative infrastructure enables sovereign media such as data centres and algorithmic softwares (e.g. HFT high frequency trading) that challenge states as sovereign entities. It is clear that this work on digital infrastructures spills over into spatial and urban analysis.

### ***Urban studies and spatial approaches***

Spatiality is implicit in the notion of infrastructure defined as a material substrate, as interrelation with other levels. Infrastructures are widely conceived as being generative of spaces as they evolve and change; hence, many studies incorporate the territorialising effects of infrastructure, whether state or private infrastructure, local or autonomous. Cities and urban spaces have been the principal focus of attention in studies of these spatial effects, for instance of the ‘privatised, customised infrastructure networks across transport telecommunications, energy and water ... interwoven with the changing material and socioeconomic and ecological development of cities and urban regions’ (Graham & Marvin 2001: 9; see Graham 2000). Architectural theorist Keller Easterling (2012, 2014) proposes the notion of ‘infrastructural space’, which extends—and perhaps surpasses—the notion of infrastructure as substrate. It ties in the generative spatiality (and temporality) of infrastructure activity, providing conditions for largely undisclosed activities Easterling characterises as ‘extrastatecraft’. Unlike the distinctive symbolic architectures of the modern era, contemporary ‘infrastructure spaces’ are suffused by infrastructural media including ‘pools of microwaves beaming from satellites and populations of atomized electronic devices that we hold in our hands’, ‘shared standards and ideas’, and data and algorithms that generate spaces as well as semiautonomous zones of infrastructural concentration (Easterling 2014: 11). New—often privatised—models of planning, governing and financing cities tend to privilege specific urban rather than national spaces (O’Neill 2010; Dodson 2017). Cities have been the focus of much thinking about cultural infrastructure and space, often tied to urban regeneration (see section on cultural infrastructure). There has also been a strong focus on how people experience space mediated by infrastructures; Dourish and Bell attempt to draw together the ‘practical organization of space (that is, how spatial arrangements provide an infrastructure for the ongoing achievement of concerted action) and the cultural organization of space (that is, how the organization of space becomes an infrastructure for the collective production and enactment of cultural meaning)’ (Dourish and Bell 2007: 415).

### ***Anthropology and ethnographic approaches***

Anthropological studies of infrastructure have tended to examine questions of access to basic requirements such as water supply as its main object, but also as human practices that kick in when states and markets fail in providing basic provision. When a tap doesn’t automatically provide water, infrastructure becomes visible and the object of social strategies. Anthropology in Africa has provided many insights into the practices of user provision. As Simone (2004: 407–408) puts it:

African cities are characterized by incessantly flexible, mobile, and provisional intersections of residents that operate without clearly delineated notions of how the city is to be inhabited and used. These intersections, particularly in the last two decades, have depended on the ability of residents to engage complex combinations of objects, spaces, persons, and practices. These conjunctions become an infrastructure—a platform providing for and reproducing life in the city.

Amin’s (2014) work on land occupations and informal settlements in Brazil points to the ‘reciprocities of infrastructure and sociality’ which may play out in different ways. Far from being

‘invisible’ processes of accessing, infrastructures have a role as a ‘social mnemonic’, when labour and intervention was necessary to make basic functions viable (Amin 2014: 151), especially in Brazil where a large proportion of housing has relied on autoconstruction. Shared activities of ‘occupation, self-organization, infrastructural improvisation, and counter-vernaculars of inhabitation and design’ all contribute to making the city plural, livable and lively (Amin 2014: 157).

Infrastructural assets in conditions of scarcity and instability generate opportunities for profit-making and parasitism. Brian Larkin’s (2015) work asserts that media piracy in Nigeria, which makes use of technologies of reproduction, is part of the ‘organizational architecture’ of globalisation, providing the infrastructure that allows media goods to circulate. The example of informal music distribution in Burkina Faso (De Beukelaer 2019) points to the messiness of many aspects of cultural infrastructure (both ‘hard’ and ‘soft’), its makeshift and constantly shifting nature, and the extent to which it is enmeshed with ‘digital modernity’ as well as relying on the material resources of scarce music venues.

### ***Sociology and social theory***

Apart from sociologists of digital media and of science and technology, there has been a surprising dearth of theoretical initiative about infrastructure within sociology. Graham and Marvin (2001) made the charge that sociology generally missed the nonstatic nature of new infrastructures because it is wedded to old models of cities and communications, although Manuel Castells’s work on network societies was a key source for his work.

For Craig Calhoun (2002) infrastructure is ‘a society’s fundamental material and cultural systems, such as communication, transportation, and education – especially those material and cultural attributes necessary for future social and economic development’ – a rather static conception of infrastructure. Calhoun (2009) considered that developing communications and information infrastructures continue an established role of providing necessary structures and processes for modernity, i.e. where social order can be distanced from direct rule. Sociology had perhaps overrated the importance of production technologies; Calhoun considered that infrastructural technologies such as computing are ‘at least as important’ as structures of industrial production in generating social change (2009: 208).

One exception to this lack of attention to infrastructure is political sociologist Michael Mann’s (1984, 2008) notion of infrastructural power, which, although it was devised for gauging the comparative forms of the power of states, is suggestive of ways in which counterinfrastructures are developed in civil society. Mann’s notion of infrastructural power was defined—in contradistinction to despotic power—as the capacity of states to penetrate civil society. Here, infrastructure refers to internal political infrastructures within sovereign territories. States may be weak in despotic power but stronger in infrastructural power, typically in democracies, multiparty states or where a ‘governed interdependency’ has been achieved, such as in the case of post-WW2 East Asian Tiger states, where negotiations between government and civil society groups were able to coordinate a blending of public and private resources to pursue developmental goals. In Mann’s (2008: 358) schema, infrastructural power is only one form of state power, alongside ideological power—control over meaning systems; economic power—the extraction, transformation, distribution and consumption of the resources; and military power—the social organisation of violence. These forms of power also have their own infrastructures, i.e., ‘routinized media through which information and commands are transmitted’ (Mann 2008: 358); often media will be shared or overlapping between forms of power, such as roads, education systems and computer networks.

Sociological thinking also draws on an older conception of social infrastructure as a basis for shared sociality. Klinenberg (2018: 6; see also Latham & Layton 2019) defines social infrastructure as ‘the physical places and organizations that shape the way people interact’. When the social

infrastructure is robust, it fosters contact, mutual support and collaboration; when integrated, it inhibits social activity, leaving families and individuals to fend for themselves. Unlike ‘social capital’ (à la Robert Putnam), social infrastructure relies on things and conditions that support communal life, and whether these resources are sufficiently dispersed and accessible within urban space. This line of inquiry connects to urbanist writers such as Jane Jacobs and Richard Sennett interested in spatial arrangements, such as streetlife, that support sociality.

### ***History and/of infrastructures***

Historical studies are useful in embedding our understandings of infrastructural development in time, its role in constituting modernity, and the role of material infrastructures in the organisation of state power, including colonial states (see Bennett & Joyce 2010). How were differing kinds of infrastructure ‘bundled’? Built infrastructures could physically link places and territories; also the state could symbolically mark its presence through ‘territorial infrastructures, military weaponry, agency archives, and post offices [that] give it a palpable presence and identifying features’ (Joyce & Mukerji 2017: 2). Knowledge infrastructures embodied in maps, surveys and testimonies were co-constitutive with territorial power, creating dual sites and practices of power in courts and archives. Knowledge infrastructures could be used ‘to control the patrimonial patterns of existing elites, and the legal bases of elite power’ (Joyce & Mukerji 2017: 9).

For Marklund and Rüdiger (2017: 9), a materialist focus on things such as telegraph wires, cables or transmitter keys also entails ‘a history of spaces, geopolitics, institutions and human actors—from telegraphers, clerks and engineers to national governments and customers’. At the same time, inanimate objects such as switchboards can acquire a kind of agency, a life of their own (Marklund & Rüdiger 2017: 12). A use-oriented approach to the history of infrastructure should capture this complexity, recognising that agency is not necessarily tied to subjects’ conscious actions. Historians must also grasp the temporal dimension, relating the complexity of infrastructures to specific historical contexts—for instance, the relation of railways and telecommunications to the chain of events leading to WW1. Crucial to this history is the duration of infrastructures, their ageing, decay or eclipse.

### ***Infrastructural governance and policy***

Theorisation of infrastructures has to some extent converged with governmental discourses and practices since the 1990s, which is when infrastructure began to feature in policy discourse in relation to emerging technologies; for instance, the US ‘national information infrastructure’ referred to services and standards that could be developed using the internet (Hesmondhalgh 2021: 133). Government concern with the security of infrastructure is illustrated by the widespread adoption of ‘critical infrastructures’ inventories and policies since the mid-1990s. National critical infrastructure protection programs have existed in the US since the Clinton administration and are now almost universal for nation states, underpinning governments’ heightened concerns over infrastructural security from terrorism, cyberattack, ecological or natural disaster, and so on. Critical infrastructures (CIS) rarely include social or cultural infrastructure. Nevertheless, government policies and inventories do not evidence much nuance and understanding of the interrelatedness of critical infrastructures (Gallais & Filiol 2017). Interdependencies among CISs ‘increase the potential for cascading failures and amplify the impact of both large and small scale initial failures into events of catastrophic proportions’ (Ouyang 2014: 43). Analysis of the modelling and monitoring of critical infrastructure systems and their interdependencies has itself become a field of study (Ouyang 2014), a kind of mirroring of the analyses of some of the larger-scale infrastructure theorising mentioned above.

Aside from this, infrastructure has become a leading governance and policy term—in recent years, government infrastructure agencies increasingly take a leading role in urban, regional, national and international policy agenda-setting and budgeting. Australia was something of a leader in this with the founding in 2007 of Infrastructure Australia, which aimed at ‘providing a national policy perspective on infrastructure planning and financing, including harmonisation of business case models and a priority infrastructure list’ (Dodson 2017: 88). Dodson (2017: 87) places such developments within the context of a ‘global infrastructural turn’, a ‘coordinated effort to stimulate infrastructure development at the national and global level via an array of international frameworks’. Infrastructure governance at various scales—urban, national and global—demands research attention, including infrastructure discourse, infrastructure instrumentalities and infrastructure politics (Dodson 2017).

### ***Environmental/Anthropocene infrastructures***

In recent years infrastructure conceptions have been extended to critical theorising on environmental crises and the Anthropocene. According to Wakefield (2018: 1), ‘infrastructure has become perhaps the political question of the Anthropocene’. Her review of the theoretical literature reveals two distinct but related paradigms of liberal governmentality and infrastructure, the first grounded in the modern project of ‘mastery and order’ and the second in ‘resilience, ruins, and survival’ (Wakefield 2018: 2). This has prompted a further infrastructure ‘inversion’ or reconfiguration, whereby natural and biotic infrastructures become a more important infrastructural ‘base’. For Hetherington (2019: 8), the Anthropocene leads to a further infrastructure inversion—following Bowker—in which ‘infrastructural inversion is itself inverted, and in which the political stakes of material structures and historical analyses fold into each other’. Human infrastructures are supplanted (analytically) by the environmental substrates that are produced as unintended consequences of human intervention. Under Anthropocene conditions, nature is compromised; there is no ‘pure’ ecological infrastructure, only environments layered by human interventions.

### **Cultural infrastructure**

Analysts of art and culture have been relatively conservative in using newer conceptions of infrastructure, often drawing on standard economic approaches. This is perhaps because notions of cultural infrastructure already existed, and also because there was initially little focus by theorists of sociotechnical infrastructures on broader cultural spheres. Also, arts and cultural analysis concerned with infrastructure or resources is often linked to policy perspectives, where economic conceptions of infrastructure are more common. Often, cultural infrastructure tends to refer to something like ‘the ensemble of institutions offering cultural services and products (museums, theaters, cinemas, etc.)’ (Pirvu & Goldbach 2017)—that is, focused on consumption and supply mainly within high-culture markets.

Even where there is a policy focus on creative production, there is often a thin conception of infrastructure as places in a built landscape. The Mayor of London’s Cultural Infrastructure Plan (2019) tells us that ‘When we talk about “cultural infrastructure” we mean the buildings, structures and places where culture is consumed: Places where culture is experienced, participated in, showcased, exhibited or sold ... or where culture is produced: Places of creative production, where creative work is made’.

The emphasis here is on places and buildings viewed simply as containers of cultural activity. In this understanding, there is little sense of material substrates/conditions, relational processes and collaborative networks that have been at the core of discussions above. For instance, such an account of cultural infrastructure will be blind to the ways in which cultural infrastructure can



segment cities, creating images of “more or less creative” places, industries and people’ (Brennan-Horley & Gibston 2009: 2596 cited in Bell & Orozco 2021: 93).

The term cultural infrastructure usually signals the insertion of culture into policy or planning models, often involving ‘predefined ideas about what culture should be’ (Bingham-Hall 2020: 56). In these framings, cultural activity is rarely ‘for itself’, but rather is in the service of another agenda: urban regeneration, health impacts, social capital, and so on. The discursive dependency of culture on development or planning is, in itself, a good subject for an infrastructural analysis.

Analysis of cultural infrastructure has commonly focused on urban settings. Culture and cities have been consistently tied together analytically in both anthropological work in African and Latin American cities and in work on networked infrastructures. (Nevertheless, the differing socioeconomic contexts of studies – e.g., whether they focus on infrastructuring in Silicon Valley labs or Brazilian favelas – should be of clear relevance for cultural analysis.) Failures or inadequacy of infrastructural provision can necessitate improvised solutions, such as the messy and improvised linking of music venues and music distribution in Ghana and Burkina Faso (De Beukelaer 2019). People become infrastructural agents in conditions of failure or lack; these situations seem familiar enough in ‘Western’ urban contexts where ‘outlaw’ practices from street art to self-organised art spaces can generate infrastructures and gain a degree of legitimacy.

Cultural analysis has also drawn on insights about ‘infrastructuring’, strategic agency and intervention in hybrid systems comprising media, material and practices within information technologies (Karasti 2014). For instance, Macchia et al. (2014: 229) extends infrastructuring to ‘the interrelation among actors, practices, museums as institutions, and artefacts that mediated and influence the actions and the activities in museums’. Other writers go further in critiquing the analysis of cultural infrastructures based on concepts derived from information networks. Sharon Mattern (2020: 134) advocates for moving beyond “information” and its “processing” in creating more generous, inclusive maps of urban information ecologies’. She wants to foreground an ‘infrastructural intelligence’ that can face up to ‘precarious infrastructural, environmental, political, and ethical futures’, as the project of ‘making infrastructures visible or otherwise sense-able or experiential’ has been to make those systems ‘become sensible, comprehensible—and perhaps even manipulable and hackable’ while rejecting some the more reifying and functionalist elements of ‘infrastructural representation’ (Mattern 2016). The institution of the library is an exemplary infrastructural site: often a bustling hub of interaction and inquiry, pointing to the need for closer attention to information resources, ‘their creation, curation, provision, preservation, and destruction—and to the assemblages of urban sites and subjects that make up our cities’ intellectual ecologies’ (Mattern 2020).

Some recent research on urban creative cultural infrastructure has employed more sophisticated thinking about infrastructures for cultural production. *Making Cultural Infrastructure* (Bingham-Hall & Kaasa 2017) grounds the understanding of creative production in a closer interrogation of material conditions of production such as the architectural and ecological qualities of spaces, their messiness and the proximity to others working, based on practitioners’ accounts. These were examined in relation to differing kinds of creative work—performative, material and virtual. Insights about these conditions were used to prompt new approaches by architects and to build ‘a language for cultural infrastructure’, including more detailed articulations of value, the stability of infrastructures, determinacy (purpose-built or adapted) and visibility (profile, publicness) (Bingham-Hall & Kaasa 2017: 9). This attempt to thicken understandings of the specificity of cultural infrastructure focusing on the ‘active processes by which [culture] is made’ aims to move beyond ‘the need to determine what culture looks like as an aspect of urban space’ (Bingham-Hall & Kaasa 2017: 63). An article by Bingham-Hall (2020: 56) on the overlay of cultural and transport (railway) infrastructures exemplifies an infrastructural take on understanding the ‘enabling

conditions for culture's production, without needing to predefine what culture is' by 'always looking underneath, behind, and around in order to find out what makes things work'.

Nevertheless, the primacy of this emphasis on culture as working within urban spaces suggests limitations in the conceptualisation of cultural infrastructures. There is room for broader considerations of culture using an infrastructural paradigm drawing on scholarship attuned to the aesthetic dimension as well as the material and social dimensions. For instance, Pipinis's (2017) thesis 'Art as Infrastructure' constructs a plausible synthesis of theories that might contribute to an adequate approach to art *as* infrastructure (as opposed to the infrastructures *of* art). Pipinis (2017: 19) draws on Larkins's notion of infrastructure moving 'goods, ideas, waste, power, people, and finance'. In positioning his approach between materialist and more abstract functions of art, Pipinis (2017: 18) draws together:

Gell's view on art as an 'unrecognized technical system' for social reproduction, Morphy's acknowledgment of art as sufficiently distinct category for people to allocate objects to, Svašek's processual view on 'aestheticisation' of objects as art, Schneider's endorsement for studies of agency of art through interdisciplinary approaches, Becker's mapping of social embeddedness of artistic production and Bourriaud's definition of art as a discursively formed set of objects and techniques for production of relations.

Pipinis (2017: 18) also takes into account 'art's social functions pointing, inter alia, towards identity marking, cross-generational knowledge transfer, social reproduction, stabilization of collectives, expressions of power and authority, innovations etc.'. This example suggests the need for greater depth in analysing infrastructures of socioaesthetic practices and how they can themselves form infrastructures for broader cultural and social spheres.

An example of culture and art providing infrastructure for business cultures is Turner's (2009) paper on the Burning Man festival, 'a key cultural infrastructure for the Bay Area's new media industries', at Google:

[E]lements of the Burning Man world—including the building of a sociotechnical commons, participation in project-based artistic labor and the fusion of social and professional interaction—help to shape and legitimate the collaborative manufacturing processes driving the growth of Google and other firms. (Turner 2009: 73)

Infrastructures have rarely been examined in relation to popular cultures. Chattopadhyay's (2012) study of popular cultures in Indian cities examines street cricket and how it is conditioned by the materiality of the urban environment, the rough surfaces of streets and home-made bats. The street is not simply an 'underlying' environment for human activity: it must first be occupied, arranged and planned. The street is a 'conjunctural construct that begins with people and habitation' (Chattopadhyay 2012: 120).

Cultural heritage is concerned with re-presenting material cultures and historical knowledge to contemporary publics. Infrastructures in a heritage context help in the mediation of heritage objects and contemporary publics. Stuedahl et al. (2016) discusses attempts to develop knowledge infrastructures with the aim of opening cultural heritage institutions for public access and involvement in Norway and Sweden as part of governments seeking to involve citizens in more participatory digital public infrastructures. Marttiila and Botero (2017) also focus on information systems as infrastructural initiatives aimed at contributing, from different angles, to wider public access to and appropriation of the European digital cultural heritage in ways that allow collaboration of diverse user groups and contribute to a cultural commons. Knudsen and Kølvrå (2020) provide an account of heritage performances in Nantes, once the largest slave port in France, in which "mechanical" infrastructures such as harbour cranes become affective infrastructures, in giving voice to subjectivities formerly marginal or invisible.

Infrastructure has itself become an artistic subject. Mendelsohn (2014) discusses two dissimilar American artists, Matthew Barney and Edward Burtynsky, who both share an ‘ecological vision tied to an interest in infrastructure, monument, ritual, and deep historical time’, while Parke (2015) focuses on Chinese artists with a concern for migrant workers as human infrastructure. Middlebrook (2015) describes Rachel Whitehead’s *Water Tower*, a constantly altered work focused on networks within the built environment under continual modification.

Judging from the above examples, there are many inconsistencies in the way cultural infrastructures are conceived. Policy and planning conceptions of cultural infrastructure tend to reify cultural infrastructure usually as ‘hard’ assets (usually buildings) that embody cultural access, without specifying how it is infrastructural: what it supports, how it engages with the ‘soft’ cultural knowledges and expertise, who it is for (its audiences and those who don’t come), how it interacts with other kinds of infrastructure. These ‘hard’ assets are often seen as achieved outcomes, eliding the ‘soft’ cultural and organisational processes required to animate them over time. Bryson (2007) stresses the importance of integrating both while pointing to the differing temporality of hard and soft cultural investments, namely capital investment for hard infrastructure and ongoing resource investment in ‘soft’ cultural capacities. Other responses to infrastructure questions in cultural policy and governance include Bingham-Hall and Kaasa’s (2017) and Mattern’s (2016) attempts to fill in the complex webs of cultural agency, imagination and flows of things that make a place cultural. Infrastructural agency extends beyond the spaces of formal and regulated cultural provision supporting cultural needs that are unmet by markets and state (De Beukelaer 2019) with potential to create self-organised ‘inverse infrastructures’ (Egyedi & Mehos 2012) that complement formal cultural markets or institutions to create alternatives. There is clearly considerable potential to deepen and sharpen analyses of art and culture and its relation to other structures.

## **Concluding on infrastructure theory**

This review of the infrastructure literature was undertaken to enhance research approaches to cultural infrastructure through an interrogation of the broader theory of infrastructures. The above review of infrastructure theory and approaches shows a field of theorising that is clearly differentiated by disciplinary and intellectual backgrounds and differing research focuses. Differing disciplinary and theoretical ‘world views’ have been overlaid onto the conceptions of infrastructure. These can be of value in extending analysis beyond disciplinary or conceptual ‘silos’. Despite the diversity of approaches, there seems to be a common starting point in the work of Star, and Bowker (and various colleagues)—for many, the ‘classic’ articulation of this literature—who offered the notion of infrastructure as invisible substrate, as underlying conditions necessary for specific cultural practices and cultural forms of life, generally taken for granted unless situations become obviously dysfunctional. Ongoing considerations of what to focus on as infrastructure, what is significant among the many possible elements ‘underlying’ a given object of research—which as we have seen can vary in physical scale from a building or neighbourhood to a global digital network—shift depending on the perceptions of a researcher or analyst deciding on which ‘infrastructural inversion’ (Bowker 1994) is of most relevance. The establishment of a particular inversion in a given figure-ground structure brings particular elements to analytical attention. In time the analytical choice of certain infrastructural elements contributes to what is ‘figured’ or foregrounded in particular research areas, leading to the somewhat fractured picture of infrastructure conceptions described in this review. There can even be a ‘flipping’ between what is considered figure and ground, for instance in the way the notion of the Anthropocene led to an ‘inversion’ of thinking around the nature of ecological infrastructures (see Hetherington 2019: 8). These remarks should not be understood to question the realism of infrastructure research—but the perception of them is important, particularly where research approaches rub up against established ideas of infrastructure in policy and governmental fields. The point is that infrastructural theory is inherently political and value laden.

An obvious contrast is with the superstructure metaphor in Marxist thinking. Drawing on a (slightly older) term denoting things above the level of foundations such as the roadway of a bridge (Oxford English Dictionary Online 2021), superstructure was used by Marx to indicate what is not fundamental in arguing that the material realities of an economic base conditioned the ‘whole immense superstructure’ including legal and political structures ‘to which there correspond definite forms of social consciousness’ (Marx 1859/1976). In the base/superstructure model this base is invisible, ideologically hidden behind social and cultural superstructures. But this classical Marxist binary tended to marginalise much cultural and social action, removing it from material reality in a most inflexible and undialectical way.

By contrast, in infrastructural analysis, the underlying material objects are not conceived as a ‘base’ in a general, societal or abstract sense but only as things drawn on in practices and processes in a specific analytic instance. This specificity—in my view—is what makes it valuable for research or evaluation. While infrastructure could form part of broader theory of how capitalism, the state or media operates historically, it seems well suited as an indexical concept pointing to and examining actions and possibilities *in situ*. On this point, I would agree with the advice to keep ‘what is infra’ at the centre of analysis (Harvey et al. 2017). Conceived this way, infrastructure provides a way of articulating ‘with what?’ in an analysis of agency and process within specific environments for action. Infrastructure as a concept firstly entails interdependence; it provides means of analysing interdependencies by considering how well an environment supports or ‘affords’ particular animals and living processes. The notion of affordance, what an environment ‘provides or furnishes’ (Gibson 1979: 119), derives from ecological psychology and provides a useful analogy to infrastructure. Gibson defined an affordance as a ‘value-rich ecological object’ (119) for a living entity interacting with an environment. A flight of stairs offers a different affordance to a toddler as to an adult human, which would again differ for an adult in a wheelchair. I make the analogy between infrastructure and affordances because a relation with infrastructure is a living one rather than a static or ‘mechanical’ one amenable to a functional accounting. While infrastructures may be taken for granted, they are also encountered as possibilities depending on the needs and capacities of agents to take advantage of them. They are also objects of values and norms; these values and norms are also taken on by analysts, as illustrated by the various ‘inversions’ discussed above.

This is a point of difference to theoretical approaches with which infrastructure theory has some kinship, such as assemblage theory, which also attempts to examine the logics of cofunctioning networks of material things, aesthetic choices, documents, discourses or whatever. Assemblage approaches privilege unstable ‘relations of exteriority’ rather than structures or institutions, elements of symbiotic connection between components which may be otherwise quite unrelated, maintaining their ‘singularity’ and disavowing causal relations (DeLanda 2006; Deleuze & Parnet 1987: 69). While assemblage theory can be useful, for instance in tracing the complex connections of collaborative projects that cross a myriad of scales and registers, it may also be methodologically unwieldy, suggesting a multiplicity of interfaces, while often lacking the means to investigate their significance for actants (Mar and Anderson 2010: 48).

By contrast, infrastructure theory should support complex analysis grounded by cultural practices; it points to nested relations of structure and causality, however open-ended or apparently indeterminant. Hesmondhalgh (2021) rightly bemoans the frequent failure of research on infrastructures to demonstrate causal relations, but this is hardly a reason not to pursue stronger analysis. Infrastructure thinking is as much a heuristic device as a theory in itself, pointing to possibilities to investigate accompanying conditions, things, knowledges and relations enabling specific practices. Its aim should be to sharpen understandings of cultural practices to generate more details of processual accounts. Infrastructural analyses and theoretical articulations over some twenty-five years provide a host of parameters or dimensions of relationships—material and immaterial—to explore in relation to cultural activities and phenomena. Revisiting some of these

dimensions, we can construct an initial array of research questions to probe infrastructural relationships to a specific cultural process:

- What things (material or immaterial) are required to support specific practices? What do these infrastructures enable?
- What capacities are required to make use of this infrastructure?
- What forms of knowledge, expertise, calculation, judgement are infrastructural in this case?
- What are the spatial characteristics of infrastructures? (location, scale, type of network or assemblage)
- What are the temporal aspects of infrastructures? How they condition or fit with the tempo of processes?
- Are these infrastructures relatively stable and fixed or precarious and changeable?
- Standardisation and regulation—what rules or procedures (formal or informal) shape access to particular infrastructure?
- Is the infrastructure invisible/taken for granted or is action required to access it?
- Are there relatively autonomous ‘inverse infrastructures’ or activities that piggyback on other infrastructures?
- Can we map the layering of infrastructures? (synergies with other resources, technologies, narratives or regulation)

Such instrumental or toolkit questions may be of value for an initial foray into significant infrastructural relationships for analysis, but they do not supply a rationale for analysis. Infrastructure theories do not specify a normative framework or a set of problematics, although there can be no escaping the need to articulate where one is coming from in research making use of the concept of infrastructure.

# Annotated bibliography

*Phillip Mar*

This Annotated bibliography has been prepared for the Cultural Infrastructure Research Program at the Institute for Culture and Society, Western Sydney University. It looks at infrastructure theories arising in social sciences and humanities in the past twenty-five years; it does not seek to examine the whole literature on economic infrastructures. The aim is to gain an overview on theoretical conceptions of infrastructure with the aim of providing ideas for further research, particularly in cultural fields. Not all, or even most, of the articles are purely theoretical in nature—indeed, infrastructure seems to be an inherently contextual concept; the focus is on the use of the infrastructure concept in the research.

The literature review is divided according to broad disciplinary categories. Many articles straddle these themes and could have been placed in more than one category.

## Some general overviews of theories of infrastructure

**Amin, A. (2014). Lively infrastructure. *Theory, Culture & Society* 31(7–8): 137–161. doi:10.1177/0263276414548490**

**Abstract:** This paper examines the social life and sociality of urban infrastructure. Drawing on a case study of land occupations and informal settlements in the city of Belo Horizonte in Brazil, where the staples of life such as water, electricity, shelter and sanitation are co-constructed by the poor, the paper argues that infrastructures—visible and invisible—are deeply implicated in not only the making and unmaking of individual lives, but also in the experience of community, solidarity and struggle for recognition. Infrastructure is proposed as a gathering force and political intermediary of considerable significance in shaping the rights of the poor to the city and their capacity to claim those rights.

**Notes:** Includes a summary of the anthropological theory of infrastructure, and some points of difference, e.g., the visibility of infrastructure in developing spaces as against the infrastructural invisibility in Star's US-centred account. Infrastructure would tend to become more invisible with the achievement of 'well-functioning' social arrangements: the precarity of arrangements may make infrastructures visible. Some characteristics of infrastructural practice in favelas include the 'infrastructural being' of property ownership and the 'reciprocities of infrastructure and sociality', which may play out in different ways. Ironically, these elements are inscribed in the apparently 'invisible' access to infrastructural goods. Infrastructure has a role as a social mnemonic, when labour and intervention were necessary to make basic functions viable (151), especially in Brazil, where a large proportion of housing has relied on autoconstruction.

There is a normative dimension here in favour of collaborative aspirations to the commons. Amin argues for the 'liveliness' of engagement with infrastructure, because it is contested: 'the liveliness of infrastructure involves more than its character as the object of community struggle, in the form of mundane socio-technicalities that are fundamental in shaping wellbeing, sociality, and organization, and in ways that often inflect the politics of the "foreground" in unexpected ways' (156). These can be of 'self-organization, infrastructural improvisation, and counter-vernaculars of inhabitation and design', which are all ways of 'making life liveable, the city a plural ontology, and power more decentred' (157).

**Anand, N., A. Gupta, & H. Appel (Eds.). (2018). *The Promise of Infrastructure*. Durham: Duke University Press. doi:10.1215/9781478002031**

**Description:** Attending to the everyday lives of infrastructure across four continents, the contributors to *The Promise of Infrastructure* demonstrate how infrastructure such as roads, power

lines, and water pipes offer a productive site for generating new ways to theorize time, politics, and promise.

**Berlant, L. (2016). The commons: Infrastructures for troubling times. *Environment and Planning D: Society & Space* 34(3): 393–419. doi:10.1177/0263775816645989**

Notes: 'Infrastructure is not identical to system or structure, as we currently see them, because infrastructure is defined by the movement or patterning of social form. It is the living mediation of what organizes life: the lifeworld of structure' (393). But this immanence of social form comes from failure of state/market infrastructures. There is a blurring, a double meaning of infrastructure as objective/subjective.

Berlant sees contemporary culture as embodying alienation as a kind of spectacle: 'what used to be called alienation, a structure that felt alienated, is experienced at once as sensual saturation and physical exhaustion', while work is experienced as 'perpetual and impossible' (409). For Berlant, infrastructure names an attempt to reconstruct 'the commons', what should be available to us all. A 'pedagogy of unlearning' should 'build affective infrastructures that admit the work of desire as the work of an aspirational ambivalence' (414).

**Carse, A. (2017). Keyword: Infrastructure. How a humble French engineering term changed the modern world. In P. Harvey, C. B. Jensen, & A. Morita (Eds.), *Infrastructures and Social Complexity: A Companion* (pp. 27–39). Abingdon, Oxon; New York: Routledge. doi:10.4324/9781315622880**

Notes: Combines etymology and social contexts to elucidate how the meaning of infrastructure has changed and what it might come to mean. Etymology: Infrastructure is a modern word, emerging in the 1880s as a term in French civil engineering; infrastructure was originally 'an organizational and accounting term used to distinguish the construction work that was literally conducted *beneath* unlaaid tracks (roadbeds) or was otherwise organizationally *prior* to them (surveys, plans, bridges', etc., in contradistinction to the superstructure situated above or constructed after the tracks (29). *Infra-* means below, beneath, sometimes inferior. Infrastructure differs from structure or network in proposing relations of depth or hierarchy. Also, infrastructure is a singular noun for a collection of integrated parts (27).

**Collier, S. J., & A. Ong (2003). *Oikos/ anthropos: Rationality, technology, infrastructure. Current Anthropology* 44(3): 421–426. doi:10.1086/374902**

Notes: This is a summary of a workshop on rationality, technology and infrastructure. A definition of infrastructure is provided: it 'designates specific institutional, material, or social conditions through which the functioning of a certain technology, ethical regime, form of regulation, or mode of communication is either enabled or impeded. It inscribes the space and form of limited, finite, and localizable relationships and effects that occupy a certain space and that concretely link—or distinguish and divide—various objects, spaces, techniques, individuals, and social groups. An infrastructure allows these elements to come into communication but does not necessarily organize them in terms of a common structural or logical principle. Technologies and infrastructures shape spatial forms, but they also shape problems' (423).

**Harvey, P., C. B. Jensen, & A. Morita (2017). Introduction: infrastructural complications. In P. Harvey, C. B. Jensen, & A. Morita (Eds.), *Infrastructures and Social Complexity: A Companion* (pp. 1–22). Abingdon, Oxon; New York: Routledge**

Notes: Combines etymology and social contexts to elucidate what infrastructure might mean. *infra*—beneath or below + *structure*—it differs from structure or network in proposing relations of depth or hierarchy. Also, infrastructure is a singular noun for a collection of integrated parts (Carse 27). The theoretical overview describes the 'inversions' that have taken place in conceptualising infrastructures, the complication and experimentation with the term. In the

process we have conceptions of infrastructure that are ‘quite different from the idealized notion of seamlessly integrated systems that facilitate smooth flows of people, goods, or services if not for some unusual obstruction.’ (13)

**Hesmondhalgh, D. (2021). The infrastructural turn in media and internet research. In P. McDonald (Ed.), *The Routledge Companion to Media Industries* (pp. 132–142). London; New York: Routledge. doi:10.4324/9780429275340-13**

Abstract: In this chapter I discuss some of the benefits for media and internet research brought about by the turns to infrastructure and distribution, notably a welcome concern with the mundanity and ordinariness of existing systems rather than optimistic speculation about future impacts, and an invigorating interest in questions of representation and meaning in relation to often taken-for-granted technologies. But I also discuss some of the problems surrounding the infrastructural turn in media and internet research: a tendency i to use the term ‘infrastructure’ in such a variety of ways that it risks losing its analytical value; an uncertain engagement with ideas of materiality and ‘relationality’; and a tendency towards banality and vagueness (using dubious defenses of vagueness itself). I close by reflecting on how the problems identified seem to have led to a neglect of other traditions of research, such as political economy of media, that might provide insights into the workings of media infrastructures as traditionally understood, but in a call for synthesis, I also point to those other traditions have also failed to pay due attention to the best contributions of recent media infrastructural studies.

Notes: A useful overview and critique of the literature within media studies and ICT.

**Hetherington, K. (Ed.) (2019). *Infrastructure, Environment, and Life in the Anthropocene*. Durham: Duke University Press. doi:10.1215/9781478002567**

Description: The contributors chart the shifting conceptions of environment, infrastructure, and both human and nonhuman life in the face of widespread uncertainty about the planet’s future. *Infrastructure, Environment, and Life in the Anthropocene* explores life in the age of climate change through a series of infrastructural puzzles—sites at which it has become impossible to disentangle the natural from the built environment. With topics ranging from breakwaters built of oysters, underground rivers made by leaky pipes, and architecture gone weedy to neighborhoods partially submerged by rising tides, the contributors explore situations that destabilize the concepts we once relied on to address environmental challenges. They take up the challenge that the Anthropocene poses both to life on the planet and to our social-scientific understanding of it by showing how past conceptions of environment and progress have become unmoored and what this means for how we imagine the future.

Notes: The onset (or the awareness) of the Anthropocene leads to a further infrastructural inversion—following Bowker—in which ‘infrastructural inversion is itself inverted, and in which the political stakes of material structures and historical analyses fold into each other’ (8). Hence human infrastructures are supplanted (analytically) by the environmental substates that are produced as unintended consequences of human intervention. Each of the book’s chapters ‘describes a moment in which some set of relations switches from environment to infrastructure’ (11). Because ‘environment’ and ‘infrastructure’ have some shared attributes—context, spatial extension, surrounding conditions, interrelationship—there is analytical potential for work between the two.

**Larkin, B. (2013). The politics and poetics of infrastructure. *Annual Review of Anthropology* 42(1): 327–343. doi:10.1146/annurev-anthro-092412-155522**

Abstract: Infrastructures are material forms that allow for the possibility of exchange over space. They are the physical networks through which goods, ideas, waste, power, people, and finance are trafficked. In this article I trace the range of anthropological literature that seeks to theorize



infrastructure by drawing on biopolitics, science and technology studies, and theories of technopolitics. I also examine other dimensions of infrastructures that release different meanings and structure politics in various ways: through the aesthetic and the sensorial, desire and promise.

Notes: An influential overview of the field. Larkin's opening definition of infrastructures: 'Infrastructures are built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space. As physical forms they shape the nature of a network, the speed and direction of its movement, its temporalities, and its vulnerability to breakdown. They comprise the architecture for circulation, literally providing the undergirding of modern societies, and they generate the ambient environment of everyday life' (328).

The review doesn't really examine the questions it raises at the end about whether infrastructures are primarily technical or social, regulatory procedures (like accounting) or management structures or productive knowledges, biological or mechanical. But the article presages the development of a poetics around infrastructural thinking. By poetics Larkin means where 'form is loosened from technical function' (335), taking on added significance, whether it is in state infrastructures supporting a national image or the meanings in a disconnected pipe in Aboriginal housing. The visibility and taken-for-grantedness of infrastructure is both a politics and a poetics.

**Marklund, A., & M. Rüdiger (2017). Historicizing infrastructure: After the Material Turn. In A. Marklund & M. Rüdiger (Eds.), *Historicizing Infrastructure* (pp. 5–20). Aalborg, DK: Aalborg University Press.**

Notes: This introduction gives a useful rundown of various conceptions of infrastructure from the perspective of historians of infrastructure. They link the interest in infrastructures to the turn to materiality (see Bennett & Joyce 2010). The focus on things (wires, cables, transmitter keys) also entails 'a history of spaces, geopolitics, institutions and human actors, their usages and social practices, knowledge and training'. This connects with actor–network theory, whereby inanimate objects and networks are rendered agency. A use-oriented approach to the history of infrastructure should capture this complexity, recognising that agency is not necessarily tied to subjects' conscious actions. Historians must also grasp the temporal dimension, relating the complexity of infrastructures to specific historical contexts, for instance the relation of railways and telecommunications to the chain of events leading to WW1. Also crucial to history is the duration of infrastructures, their ageing or eclipse. Another key aspect of infrastructure theory is its emphasis on the layered quality of infrastructures that are complexly related to other technologies and narratives, raising questions like 'where are the critical joints and junctures where one type of infrastructure ceases to operate and another one takes over?' (15).

## **ICT and media infrastructures**

**Barns, S. (2019). Negotiating the platform pivot: From participatory digital ecosystems to infrastructures of everyday life. *Geography Compass* 13(9), e12464, 13 pp. doi:10.1111/gec3.12464**

Abstract: The influence of global digital platforms today has brought attention to their growing significance as critical infrastructures of urban societies. This paper addresses the different ways that platforms are coming into focus, evidenced by growing literatures on platform capitalism, the platform society, platform surveillance, and platform urbanism. Navigating this platform pivot, I discuss the way platform influence is predominantly linked to processes of data-driven commodification and value extraction, as demonstrated by the global growth of major platforms such as Google, Facebook, Uber, and Amazon. But at the level of the everyday, platform influence also shapes socio-spatial experience through intentional design tactics designed to facilitate highly participatory ecosystems of interaction. I argue that by instituting relational dynamics between code, commerce, and corporeality, platforms remediate the 'technological everyday' in powerful

ways. This perspective points to the need for diverse epistemologies through which to critically reflect on the geographical implications of this pivot towards platforms.

Notes: Plantin et al. (2018: 307) called for the development of a ‘theoretical bifocal’ that cross-articulates different historical perspectives developed across platform studies on the one hand and infrastructure studies on the other. ‘Drawing on insights from infrastructure studies has allowed platform theorists to consider the influence of platforms in terms of what Bowker and Star have called the ‘scaffolding in the conduct of modern life; the largely unseen social and technological forces governing public action’ (Barns 2019: 3/13). These also interact with urban spaces in what Barns calls ‘platform urbanism’.

Platforms are ‘participatory ecosystems’. Social media platforms use their users to extend the platform: ‘[T]he role of the API [application program interface] is described as shifting the locus of platform innovation from inside a company or firm to its broader, external ecosystem. So, unlike traditional vertically integrated firms, platforms deliberately position themselves to be extended and elaborated from *outside*, by other actors’ (4/13). By facilitating value-sharing between platform participants, platform ecosystems have been described as “sharing economies”, a discursive positioning platform companies to their own advantage’ (5/13), for instance Airbnb.

This results in new kinds of markets, but ‘[u]nlike traditional kinds of markets, the inherent programmability of the API as a central infrastructure for platform-based value-sharing achieves two important outcomes. In the first instance, it allows the nature of the platform to constantly morph and evolve through the interactions of its users. The functionality of platform infrastructure is only “open” insofar as it is designed to enable others to add value. An active ecosystem of users and producers, software developers, and marketers, all governed by the terms of engagement set out by the platform and its API, generates beneficial network effects for all participants’ (5/13). Active value-sharing platforms such as Uber reconfigure governance such as transportation systems where new information and communications systems are developed and deployed directly to consumers. This digital circulation of value is meshed with everyday practices and performance:

a ‘performativity of circulation’ ... can be seen as inherent to platform ecosystems, which now, via the glowing rectangles held in many hands, extends from the social web to rescript geographies of everyday socio-spatial encounter. This performativity is not incidental: platforms continually reinforce the intentional interdependencies between the personal and the algorithmic, the transactional and the cognitive, through intermediations that deliberately restructure the corporeal nature of attention just as significantly as they co-ordinate and corral the distribution of information. (8/13)

‘Human performativity is linked to intentionality, reflexivity and sense-making, to embodiment, repetition and transgression. The technological, on the other hand, refers to deterministic operations without semiotic or affective qualities. This neat separation of human agency and nonhuman “procedurality” has become untenable. Human bodies and technological apparatuses enter instead into a relation of performativity’. There is a refinement of socio-spatial thinking into forms of technoaugmentation, for instance Instagram’s role in the reflexive mapping of places, in which ‘[p]latforms embed infrastructures of participation not simply through invisible code but also through conditions of highly personal, performative engagement’ (9/13).

**Beer, D. (2013). *Popular Culture and New Media: The Politics of Circulation*. London: Palgrave Macmillan. doi:10.1057/9781137270061**

Description: Popular culture and new media are deeply interwoven, yet they are often thought of as separate spheres. This book explores the material and everyday intersections between popular culture and new media. Using a range of interdisciplinary resources the chapters open up a series of hidden dimensions—including objects and infrastructures, archives, algorithms, data play and

the body—that force us to rethink our understanding of culture as it is today. Through an exploration of its intersections with new media, this book reveals the centrality of data circulations in the formation, organization and relations of popular culture. It shows how digital data accumulate as a result of our routine engagements with culture. It then examines the ways that these data fold-back into culture through algorithmic process, through play and through mediated bodily experiences. The book asks how we might conceptualize and understand culture as it continues to be reshaped by these recursive circulations of data.

**Bødker, S., C. Dindler, & O. S. Iversen (2017). Tying knots: Participatory infrastructuring at work. *Computer Supported Cooperative Work* 26(1–2): 245–273. doi:10.1007/s10606-017-9268-y**

**Abstract:** Today, most design projects are infrastructuring projects, because they build on technologies, competencies and practices that already exist. While infrastructuring was originally seen as being full of conflicts and contradictions with what is already present, we find that many contemporary reports seem to mainly address participatory infrastructuring as horizontal co-design and local, mutual learning processes in which people attempt to make the most out of available technology. In this paper we expand our view of design activities in three dimensions: First, how participatory processes play out vertically in different political and practical arenas; second, on the back stage of design, the messy activities that occur before, between and after the participatory workshops. And third, on their reach; how they tie into existing networks across organizations, and how agency and initiatives become dispersed within these networks. To illustrate and discuss the process of participatory infrastructuring we use a case study from an educational context. This particular project contains a diverse set of design activities at many organizational levels revolving around technology, decision-making, competence-building, commitment and policy-making. The project highlights these complexities, and our discussions lead to a vocabulary for participatory infrastructuring that focuses on knotworking, rather than structure, and on both horizontal and vertical reach and sustainability. This vocabulary is grounded in the meeting of the literature on infrastructuring, participatory design, and activity theory, and leads to a revised understanding of, for example, learning and conflicts in participatory infrastructuring.

**Notes:** The authors develop a notion of ‘participatory infrastructuring’ that acknowledges the wider negotiations required in many infrastructuring projects. Infrastructuring is defined as ‘a particular mode or practice of PD [participatory design] that develops and provides sociomaterial resources and experiences’ (247). Infrastructuring involves connecting with existing knowledge structures and experiences and the physical and digital infrastructures; it bridges educational facilities and technologies. But participatory infrastructuring also involves other networking activity, for instance activating networks of a range of stakeholders and other ‘backstage’ negotiation that helps to embed projects in other infrastructures. This often involves ‘messy’ negotiations with stakeholders with different interests and perspectives.

Some new conceptions are introduced—knotworks, relational agency and symbiotic agreement—to account for the complex negotiation that is often required in infrastructuring projects. “Knotworks” is derived from Engeström’s characterization of social production as a form of production where traditional notions of centers of control and mechanisms of coordination do not hold’ (251). Knotworks emerge from temporary constellations of actors, often with contrasting backgrounds and agendas. Relational agency refers to the capacities of actors to work in diverse contexts, aligning their own knowledges and perspectives with those of others as they work together to ‘expand their understanding and opportunities for action in relation to the situation at hand’ (252). Symbiotic agreements refer to ‘the strategic nature of these relationships and how people work on a shared object of activity but from different perspectives and with different outcomes in mind’ (267).

**Crabu, S., & P. Magaudo (2018). Bottom-up infrastructures: Aligning politics and technology in building a wireless community network. *Computer Supported Cooperative Work* 27(2): 149–176. doi:10.1007/s10606-017-9301-1**

Abstract: Contemporary innovation in infrastructures is increasingly characterized by a close relationship between experts and lay people. This phenomenon has attracted the attention from a wide range of disciplines, including computer-supported cooperative work (CSCW), science and technology studies (S&TS), organization studies and participatory design (PD). Connecting to this broad area of research, the article presents a qualitative case study concerning the building and maintenance of a grassroots, bottom-up information infrastructure in Italy, defined as wireless community network (WCN). Methodologically, the research is based on qualitative interviews with participants to the WCN, ethnographic observations and document analysis. The aim of the article is to understand the alignment between the technical work implied in building this bottom-up infrastructure and the political and cultural frameworks that move people to participate to this project. Relying on the field of science & technology studies, and in particular on the notions of ‘inverse infrastructure’ and ‘research in the wild’, we disclose the WCN’s peculiar innovation trajectory, localized outside conventional spaces of research and development. Overall, the presentation of the qualitative and ethnographic data allows to point out a more general reflection on bottom-up infrastructures and to enrich the academic debate concerning bottom-up infrastructuring work and other similar typologies of collaborative design projects in the domain of infrastructures.

Notes: A study of a wireless community network, where an active ‘infrastructuring’ is proposed. This recognises the ‘the growing importance of the multidimensional interaction between civic engagement and technical, political, and material instances in the development of a bottom-up information infrastructure’ (169). These collaborations can affect structural relations of collaborating entities—the ‘co-evolution of heterogeneous entities represents a disrupting force, able to transform conventional patterns of collaboration for the development and maintenance of information infrastructures’ (170).

**DeNardis, L. (2012). Hidden levers of Internet control: An infrastructure-based theory of Internet governance. *Information, Communication & Society* 15(5): 720–738. doi:10.1080/1369118X.2012.659199**

Abstract: Battles over the control of information online are often fought at the level of Internet infrastructure. Forces of globalization and technological change have diminished the capacity of sovereign nation states and media content producers to directly control information flows. This loss of control over content and the failure of laws and markets to regain this control have redirected political and economic battles into the realm of infrastructure and, in particular, technologies of Internet governance. These arrangements of technical architecture are also arrangements of power. This shift of power to infrastructure is drawing renewed attention to the politics of Internet architecture and the legitimacy of the coordinating institutions and private ordering that create and administer these infrastructures. It also raises questions related to freedom of expression in the context of this increasing turn to infrastructure to control information. This article explores the relationship between governance and infrastructure, focusing on three specific examples of how battles over content have shifted into the realm of this Internet governance infrastructure: the use of the Internet’s domain name system for intellectual property rights enforcement; the use of ‘kill-switch’ approaches to restrict the flow of information; and the termination of infrastructure services to WikiLeaks. The article concludes with some thoughts about the implications of this infrastructure-mediated governance for economic and expressive liberties.

**Dotson, T. (2017). *Technically Together: Reconstructing Community in a Networked World*. Cambridge, MA; London: The MIT Press.**

Description: If social interaction by social media has become ‘the modern front porch’ (as one sociologist argues), offering richer and more various contexts for community and personal connection, why do we often feel lonelier after checking Facebook? For one thing, as Taylor Dotson writes in *Technically Together*, ‘Try getting a Facebook status update to help move a couch or stay for dinner.’ Dotson argues that the experts who assure us that ‘networked individualism’ will only bring us closer together seem to be urging citizens to adapt their social expectations to the current limits of technology and discouraging them from considering how technologies could be refashioned to enable other ways of relating and belonging. Dotson characterizes different instantiations of community as ‘thick’ or ‘thin’, depending on the facets and manifestations of togetherness that they encompass. Individuating social networks are a form of community, he explains, but relatively thin in regard to several dimensions of communality. Dotson points out that current technological practices are not foreordained but supported by policies, economic arrangements, and entrenched patterns of thought. He examines a range of systems, organizations, and infrastructures—from suburban sprawl and smartphones to energy grids and ‘cry-it-out’ sleep training for infants—and considers whether they contribute to the atomization of social life or to togetherness and community vibrancy. Dotson argues that technology could support multifaceted communities if citizens stopped accepting the technological status quo and instead demanded more from their ever-present devices.

**Dourish, P., & G. Bell (2007). The infrastructure of experience and the experience of infrastructure: Meaning and structure in everyday encounters with space. *Environment and Planning B: Planning & Design* 34(3): 414–430. doi:10.1068/b32035t**

Abstract: Although the current developments in ubiquitous and pervasive computing are driven largely by technological opportunities, they have radical implications not just for technology design but also for the ways in which we experience and interact with computation. In particular, the move of computation ‘off the desktop’ and into the world, whether embedded in the environment around us or carried or worn on our bodies, suggests that computation is beginning to manifest itself in new ways as an aspect of the everyday environment. One particularly interesting issue in this transformation is the move from a concern with virtual spaces to a concern with physical ones. Basically, once computation moves off the desktop, computer science suddenly has to be concerned with where it might have gone. Whereas computer science and human–computer interaction have previously been concerned with disembodied cognition, they must now look more directly at embodied action and bodily encounters between people and technology. In this paper, we explore some of the implications of the development of ubiquitous computing for encounters with space. We look on space here as infrastructure—not just a technological infrastructure, but an infrastructure through which we experience the world. Drawing on studies of both the practical organization of space and the cultural organization of space, we begin to explore the ways in which ubiquitous computing may condition, and be conditioned by, the social organization of everyday space.

Notes: ‘The authors ‘approach these problems by focusing, in turn, on the practical organization of space (that is, how spatial arrangements provide an infrastructure for the ongoing achievement of concerted action) and the cultural organization of space (that is, how the organization of space becomes an infrastructure for the collective production and enactment of cultural meaning’ (415).

They cite Star, who details nine properties of infrastructure: ‘embedded (it is “sunk into” other structures, social arrangements, and technologies); transparency in use; reach or scope (going beyond a single event or site); being learned as part of membership in a community of practice; being linked to conventions of practice; embodying standards; dependency on an installed base; visibility upon breakdown; and being fixed incrementally rather than globally’ (416).

As digital infrastructures become increasingly pervasive, they become more coextensive with everyday life. Infrastructure becomes more ‘visible’ as people need to negotiate it as we become

more dependent on it in everyday life. Infrastructural experience is spatial—for example, ‘infrastructures of naming, infrastructures of mobility, infrastructures of separation, infrastructures of interaction’ (418). While infrastructures are often invisible and taken for granted, they also ‘offer themselves up to people for manipulation and interaction’ (428).

**Edwards, P. N., S. J. Jackson, G. C. Bowker, & C. P. Knobel (2007, January). *Understanding Infrastructure: Dynamics, Tension, and Design. Report of a Workshop on ‘History & Theory of Infrastructure: Lessons for New Scientific Cyberinfrastructures’*. Ann Arbor: University of Michigan. <https://pne.people.si.umich.edu/PDF/ui.pdf>**

Description: A detailed examination of how cyberinfrastructures develop, become (relatively) ubiquitous, and sometimes fail.

Notes: From the summary: ‘First, true infrastructures only begin to form when locally constructed, centrally controlled systems are linked into networks and internetworks governed by distributed control and coordination processes. Second, infrastructure formation typically starts with technology transfer from one location or domain to another; adapting a system to new conditions introduces technical variations as well as social, cultural, organization, legal, and financial adjustment. Third, infrastructures are consolidated by means of gateways that permit the linking of heterogeneous systems into networks’ (7).

**Egyedi, T. M., & D. C. Mehos (Eds.) (2012). *Inverse Infrastructures: Disrupting Networks from Below*. Cheltenham: Edward Elgar. doi:10.4337/9781781952290**

Description: The notion of inverse infrastructures—that is, bottom-up, user-driven, self-organizing networks—gives us a fresh perspective on the omnipresent infrastructure systems that support our economy and structure our way of living. This fascinating book considers the emergence of inverse infrastructures as a new phenomenon that will have a vast impact on consumers, industry and policy. Using a wide range of theories, from institutional economics to complex adaptive systems, it explores the mechanisms and incentives for the rise of these alternatives to large-scale infrastructures and points to their potential disruptive effect on conventional markets and governance models.

The approach in this unique book challenges the existing literature on infrastructures, which primarily focuses on large technical systems (LTSs). In contrast, this study highlights unprecedented developments, analyzing the differences and complementarity between LTSs and inverse infrastructures. It illustrates that even large infrastructures need not require a blueprint design or top-down and centralized control to run efficiently. The expert contributors draw upon a captivating and wide-ranging set of case studies, including: Wikipedia, wind energy cooperatives, Wireless Leiden, rural telecom in developing countries, local radio and television distribution, the collection of waste paper, syngas infrastructure design, and e-government projects. The book discusses the feasibility of temporary infrastructures and unprecedented ownership arrangements, and concludes that inverse networks represent a critical transformation of the accepted model of infrastructure development. (Publisher)

Notes: The notion of inverse infrastructures developed from a phrase uttered in a talk by Vree in 2003, and research in this area is largely European, particularly Dutch. The book details the notion of ‘inverse infrastructures’ that disrupt networks from below. Inverse infrastructures are distinguished from centrally controlled infrastructures, often large-scale technical systems (LTS); inverse infrastructures that ‘develop independently and outside the realm of centralized control... are typically user-driven and self-organized’ (3). They may replace/displace larger infrastructural systems (e.g., off-grid power) or complement them (self-organised participation in wikis that provides knowledge infrastructures within a larger architecture where there is a commitment to offer a conducive environment for participants). Case studies in the book include wikis and local

radio and TV distribution networks, and voluntary paper-waste recycling systems that operate independently of, but still within, recycling infrastructures of which it is a part. It is thus a ‘nested inverse infrastructure’ (chap. 5). Other examples of this nesting might be in e-government initiatives that allow more bottom-up user initiatives that are customisable to local conditions (chap. 12). This relies on systems having modular structures, allowing for differences where there is at the same time the challenge of providing common infrastructures, standards, procedures, etc.

**Fuller, M., & A. Goffey (2012). Digital infrastructures and the machinery of topological abstraction. *Theory, Culture & Society* 29(4–5): 311–333. doi:10.1177/0263276412450466**

Abstract: Drawing on contemporary pragmatic philosophy and grounded in a reading of techniques associated with digital media as sophist practices of influence and manipulation, this paper proposes an ‘experimental’ reading of key aspects of the topological qualities of the infrastructure of the knowledge economy, with its obsessive attempts at measuring, recording and monitoring, or ‘qualculation’. Taking seriously, albeit with humour, early criticisms of actor-network for its ostensibly Machiavellian proclivities, it offers a series of playful stratagems for the exploration and analysis of power as an emergent property of socio-technical relations. Topology, in this account, becomes relevant to cultural analysis because of the way that it allows us to think together processes constructive of the intensive continua of ‘desiring production’ with the sociotechnical operations of digital media infrastructures. Different elements operative within digital media (the super-hub, the power of small numbers, recursion and relational databases) are read stratagematically—as figures of a praxis (the material practice of immaterial labour), that reveals different facets of the operations of power, while also allowing for counter-tactics to be deployed. Rather than proposing a theoretical account or an empirical analysis, the paper develops what Stengers (2011) calls ‘operative constructs’, which become ingredients for further active exploration of and thinking about the topological qualities of mediatic infrastructure. The paper addresses four different and overlapping areas of digital media from a point of view that considers the plural, compositional quality of media/power relations.

**Gates, K. (2013). Key questions for communication and critical-cultural studies: Posthumanism, network infrastructures, and sustainability. *Communication and Critical/Cultural Studies* 10(2–3): 242–247. doi:10.1080/14791420.2013.812596**

Abstract: This essay addresses three key issues for critical-cultural studies: posthumanism, network infrastructures, and sustainability. The examples of Google Glass, Google’s ‘Data Centers’ online photo gallery, and James Cameron’s film *Avatar* are used to briefly elaborate on the importance of these issues for critical-cultural studies, and to argue for the integration of materialist and representational forms of analysis.

Notes: While ‘the IT industry itself seems keenly aware of the need to visualize its infrastructures—namely in a way that represents them as clean, efficient, and smoothly functioning systems’ (244), this piece asks some questions about the sustainability of these infrastructures. Considerable greenwash goes into this projection. *Avatar* presents the planet Pandora as a ‘colossal organic server’, but one has to wonder...

**Hector, P., & A. Botero (2022). Generative repair: Everyday infrastructuring between DIY citizen initiatives and institutional arrangements. *CoDesign* 18(4): 399–415. doi:10.1080/15710882.2021.1912778**

Abstract: DIY citizen initiatives exploring everyday-life practices such as collective making or repair are on the rise. These are characterised by the resources, local knowledge, and volunteer labour they mobilise but also by fragility of long-term sustainment. To understand what is at stake in sustaining them, the authors conducted a case study of a longstanding DIY citizen initiative in Berlin, cross-checking the findings by interviewing employees of two supporting institutional arrangements and organisers of three further DIY initiatives nearby. The study revealed how the

DIY initiatives tie together roles and resources to provide concrete everyday infrastructure for citizens while dependent on resources such as space, insurance, legitimacy, and knowledge to navigate surrounding bureaucracy, provided largely via various institutional arrangements. Conversely, these established institutional arrangements benefit from DIY initiatives' local knowledge, authenticity, and expertise. Finally, both sides wish to gain fuller mutual understanding and dialogue-related competencies. The findings highlight the generative repair, performed by both citizen initiatives and the institutional arrangements, that makes their change agendas relevant and lasting. They also point to potential value from considering some of these attempts as forms of infrastructuring with relevance for contemporary participatory design practices.

**Karasti, H. (2014). Infrastructuring in participatory design. In *PDC'14: Proceedings of the 13th Participatory Design Conference: Research Papers* (Vol. 1, pp. 141–150). New York: ACM Press. doi:10.1145/2661435.2661450**

Abstract: This paper reviews literature and reflects on infrastructuring in Participatory Design (PD) with a conceptual interest. It starts with the notion of information infrastructure introduced to the PD community in the mid-1990s by Star and collaborators. It traces how the notion has been adapted, appended, and negotiated within a number of PD approaches known as 'infrastructuring'. Based on this review, the paper discusses a number of themes arising from these approaches that relate to salient information infrastructure characteristics and speak to the specificity of infrastructuring in PD. This paper takes stock of what has happened in conceptual terms with regard to information infrastructure and infrastructuring in the field of PD to inform continuing work.

Notes: Star and Bowker coined the more active gerund 'infrastructuring' in a 2002 paper, 'How to Infrastructure', aiming to convey the ongoing processual work in which infrastructuring unfolds over time. Karasti and Syrjänen used 'Suchman's notion of "artful integrations" (2002), which referred to hybrid systems comprising media, material, and practices. With artful integrations, change is perceived as an aspect of everyday practice where a need for continuity mandates that new forms emerge through juxtapositions and connections with existing forms' (142). This paper points to a shift in studies beyond the technical practices of information professions to adoption by wider communities and publics who wanted to grow their infrastructures to meet specific needs, as well as the increasing interest in the 'things' conceived, designed, traded, etc. In these sociotechnical engagements there is a mutual constitution and shaping.

**Karasti, H., K. S. Baker, & F. Millerand (2010). Infrastructure time: Long-term matters in collaborative development. *Computer Supported Cooperative Work* 19(3): 377–415. doi:10.1007/s10606-010-9113-z**

Abstract: This paper addresses the collaborative development of information infrastructure for supporting data-rich scientific collaboration. Studying infrastructure development empirically not only in terms of spatial issues but also, and equally importantly, temporal ones, we illustrate how the long-term matters. Our case is about the collaborative development of a metadata standard for an ecological research domain. It is a complex example where standards are recognized as one element of infrastructure and standard-making efforts include integration of semantic work and software tools development. With a focus on the temporal scales of short-term and long-term, we analyze the practices and views of the main parties involved in the development of the standard. Our contributions are three-fold: 1) extension of the notion of infrastructure to more explicitly include the temporal dimension, 2) identification of two distinct temporal orientations in information infrastructure development work, namely 'project time' and 'infrastructure time', and 3) association of related development orientations, particularly 'continuing design' as a development orientation that recognizes 'infrastructure time'. We conclude by highlighting the need to enrich understandings of temporality in CSCW, particularly towards longer time scales and more diversified temporal hybrids in collaborative infrastructure development. This work draws



attention to the manifold ramifications that ‘infrastructure time’, as an example of more extended temporal scales, suggests for CSCW and e-Research infrastructures.

**Lobato, R. (2018). *Netflix Nations: The Geography of Digital Distribution*. New York: New York University Press. doi:10.18574/nyu/9781479882281.001.0001**

Description: Combining media industry analysis with cultural theory, Ramon Lobato explores the political and policy tensions at the heart of the digital distribution revolution, tracing their longer history through our evolving understanding of media globalization. *Netflix Nations* considers the ways that subscription video-on-demand services, but most of all Netflix, have irrevocably changed the circulation of media content. It tells the story of how a global video portal interacts with national audiences, markets, and institutions, and what this means for how we understand global media in the internet age.

*Netflix Nations* addresses a fundamental tension in the digital media landscape—the clash between the internet’s capacity for global distribution and the territorial nature of media trade, taste, and regulation. The book also explores the failures and frictions of video-on-demand as experienced by audiences. The actual experience of using video platforms is full of subtle reminders of market boundaries and exclusions: platforms are geo-blocked for out-of-region users (‘this video is not available in your region’); catalogs shrink and expand from country to country; prices appear in different currencies; and subtitles and captions are not available in local languages. These conditions offer rich insight for understanding the actual geographies of digital media distribution.

Contrary to popular belief, the story of Netflix is not just an American one. From Argentina to Australia, Netflix’s ascension from a Silicon Valley start-up to an international television service has transformed media consumption on a global scale. *Netflix Nations* will help readers make sense of a complex, ever-shifting streaming media environment. (Publisher)

**Marttila, S., & A. Botero (2017). Infrastructuring for cultural commons. *Computer Supported Cooperative Work* 26(1–2): 97–133. doi:10.1007/s10606-017-9273-1**

Abstract: In this paper we reflect on our involvement in the design and development of two information systems: *Fusion* and *EUscreen*. Both are infrastructural initiatives aimed at contributing, from different angles, to wider public access to and appropriation of the European digital cultural heritage. Our analysis is founded on the notions of an *installed base* and *gateway* in information infrastructure development. We situate our co-design activities and infrastructuring strategies in relation to a broader interest in advocating not only the preservation of and access to digital cultural heritage, but, more importantly, enabling collaboration, to support the emerging practices of diverse user groups, and to contribute to *cultural commons*.

Notes: The article combines a broader framing of the commons—particularly of cultural commons within digital networks—with a discussion of the concepts of infrastructure and infrastructuring processes as being central to contemporary discussions of design (Star & Bowker 2002; Karasti 2014), particularly the work on participatory design. The paper fixes on notion of the *becoming* of infrastructure (Stuedahl et al. 2016). The argument is that infrastructures are not merely substrates that ‘disappear’ with smooth functioning but are constantly created and ongoing—it is necessary to trace relations ‘between people, things and structures at all levels’ (103). An active term, ‘[i]nfrastructuring can be considered as a framework for thinking about design activities in more emergent terms’ (Karasti & Syrjänen 2004). Gateways are not just technical features but sociotechnical achievements. People and organisations can ‘act as gateways and play an important role in mediating between systems and actors’, i.e., forming in-between infrastructures (104).

**Karasti, H. & A.-L. Syrjänen (2004). Artful infrastructuring in two cases of community. In *PDC 2004: Proceedings of the Eighth Conference on Participatory Design: Artful***

***Integration: Interweaving Media, Materials and Practices* (Vol. 1, pp. 20–30). New York: ACM Press. doi: 10.1145/1011870.1011874**

Abstract: In this paper, we use the notions of artful integrations and infrastructure to analyze two cases of community Participatory Design ‘in the wild’. Though the communities are quite different on the outside, they bear surprising similarities when it comes to collaboration in technology design. We identify several features of how the community members artfully integrate their everyday materials, tools, methods and practices into collaborative processes of infrastructuring. The notions of ‘artful integrations’ and ‘infrastructure’ sensitize our analysis towards a more conceptual understanding on information system development as multi-relational: socio-material, socio-historical and processual. We conclude by suggesting some refinements to the notions in the context of community PD.

**Méndez Cota, G., & A. López Cuenca (2020). Beyond rebellion of the Net: Infrastructural commoning as critical cultural literacy. *Critical Arts* 34(5): 24–38. doi:10.1080/02560046.2020.1779326**

Abstract: This article offers a critical interpretation of the recent cultural and political history of artistic engagements with digital technologies in contemporary Mexico, considering some of them in relation to changing notions of cultural literacy under neoliberal globalization. While educational social research in Latin America has its own critical traditions for studying literacy as a social practice embedded in power relations, art theory and criticism in Mexico and abroad have barely raised the question of new media art’s specific relevance to questions of literacy. Through a cultural and media studies lens acting as a bridge between art theory and criticism on the one hand, and educational research on literacy on the other hand, this article shows how, during the neoliberal conjuncture, artistic engagements with digital technologies articulated cultural experimentation with grassroots political struggles and mediated wider processes of economic and technological transformation. We suggest that new media art, as a post-autonomous practice in times of transition, introduced questions of digital commoning as concerns for cultural literacy in a broad sense. We argue, however, for a non-instrumental and open-ended *infrastructural* understanding of art’s educational role in relation to ongoing historical conjunctures.

**Monteiro, E. (1998). Scaling information infrastructure: The case of next-generation IP in the Internet. *The Information Society* 14(3): 229–245. doi:10.1080/019722498128845**

Abstract: An information infrastructure has to scale, and hence change, as it expands. This creates a dilemma. The expansion fuels new patterns of use, which require changes, while on the other hand, the diffusion of and investments in the information infrastructure have a strong, conservative influence—the inertia of the installed base. The changes required to implement the scaling have to be in small steps. An information infrastructure is not ‘changed’, but rather it undergoes transitions. These transitions are highly involved sociotechnical negotiations. This article is based on a case study of the efforts to change the Internet Protocol (IP) in the Internet to facilitate further growth. The revision of IP is the most serious challenge to the continued scaling of the Internet during its nearly 30 years of existence.

Notes: This approach is clearly based around ‘sociotechnical negotiations’. This is implicit in the notion of an infrastructure being more than just an artefact. In this case of the changing of IP protocols, IP is a key aspect affecting many relationships within a ‘networking food chain’.

The internet is analysed as an actor-network. The ‘huge actor-network of the Internet—the immense installed base of routers, users’ experience and practice, backbones, hosts, software, and specifications—is well aligned and to a large extent irreversible. To change it, one must change it into another equally well-aligned actor-network’ (242).

This insight is useful in thinking about infrastructural stability and change (not only in ICT). Elements of an actor-network may become too ‘well aligned’, as with other closed operating systems (242).

**Mosconi, G., M. Korn, C. Reuter, P. Tolmie, M. Teli, & V. Pipek (2017). From Facebook to the neighborhood: Infrastructuring of hybrid community engagement. *Computer Supported Cooperative Work* 26(4): 959–1003. doi:10.1007/s10606-017-9291-z**

Abstract: In recent years, social media have increased the resources that individuals and organizations are able to mobilize for the development of socially innovative practices. In this article, we engage with a naturally occurring development in a Trentinian neighbourhood to examine the cooperative interactions amongst members of a local community. The first author and local residents of the neighbourhood participated in online discussions, decision making, and physical activities that led to material changes in the area. The interventions are motivated by and based on the concept of Social Street that combines online interactions in a closed Facebook group with face-to-face meetings seeking to practically engage the collective in accomplishing certain immediate or ongoing needs. Over the course of two years, we studied this local instantiation of Social Street in Trento, Italy by way of an action-oriented (digital) ethnography. Through this work, we demonstrate how urban neighbourhoods might benefit from hybrid *forms of community engagement* that are enacted through a constant back and forth between online and face-to-face interactions. We further argue that the infrastructuring of local urban collectives should follow strategies that pay attention to the *multiple issues* in urban neighbourhoods and *people’s attachments* to them. Overall, the paper reflects upon the challenges and configurations of participation that this form of community-work entails.

Notes: This positive account of social media cites Star and Ruhleder (1996), who argue that ‘an infrastructure occurs when local practices are afforded by a larger-scale technology, which can then be used in a natural, ready-to-hand fashion’. Activating infrastructure, or infrastructuring, takes place with the ‘re-conceptualiz[ation of] one’s own work in the context of existing, potential, or envisioned IT tools’ (962). In this research, the increasing mediation of local places and the intermeshing of bodies and physical spaces with digital media was supported by the Italian-developed Facebook strategy Social Street, which seeks to share information and enable the offering of help, etc., at a local level. This was described as a ‘socio-technical resource that supported a new form of civic engagement’ (988). Everyday social processes are adopted in the contexts of Facebook procedures, for instance, filtering new subscribers, regulating practices such as the guidelines around the main wall, and the naming and description of the group, which helped to define desirable values in the community. The community focus—supporting more local face-to-face interaction—may have been achieved, but it is suggested that a working conception of ‘networked publics’ might have supported more complex engagements around social differences.

**Plantin, J.-C., C. Lagoze, P. N. Edwards, & C. Sandvig (2018). Infrastructure studies meet platform studies in the age of Google and Facebook. *New Media & Society* 20(1): 293–310. doi:10.1177/1461444816661553**

Abstract: Two theoretical approaches have recently emerged to characterize new digital objects of study in the media landscape: *infrastructure studies* and *platform studies*. Despite their separate origins and different features, we demonstrate in this article how the cross-articulation of these two perspectives improves our understanding of current digital media. We use case studies of the Open Web, Facebook, and Google to demonstrate that infrastructure studies provide a valuable approach to the evolution of shared, widely accessible systems and services of the type often provided or regulated by governments in the public interest. On the other hand, platform studies captures how communication and expression are both enabled and constrained by new digital systems and new media. In these environments, platform-based services acquire characteristics of infrastructure, while both new and existing infrastructures are built or reorganized on the logic of

platforms. We conclude by underlining the potential of this combined framework for future case studies.

**Rossiter, N. (2016). *Software, Infrastructure, Labor: A Media Theory of Logistical Nightmares*. New York: Routledge. doi:10.4324/9780203758113**

Description: Infrastructure makes worlds. Software coordinates labor. Logistics governs movement. These pillars of contemporary capitalism correspond with the materiality of digital communication systems on a planetary scale. Ned Rossiter theorizes the force of logistical media to discern how subjectivity and labor, economy and society are tied to the logistical imaginary of seamless interoperability. Contingency haunts logistical power. Technologies of capture are prone to infrastructural breakdown, sabotage, and failure. Strategies of evasion, anonymity, and disruption unsettle regimes of calculation and containment.

We live in a computational age where media, again, disappear into the background as infrastructure. *Software, Infrastructure, Labor* intercuts transdisciplinary theoretical reflection with empirical encounters ranging from the Cold War legacy of cybernetics, shipping ports in China and Greece, the territoriality of data centers, video game design, and scrap metal economies in the e-waste industry. Rossiter argues that infrastructural ruins serve as resources for the collective design of blueprints and prototypes demanded of radical politics today. (Publisher's description)

Notes: Rossiter pursues an extended media infrastructure theory encompassing labour, class, logistics and digital systems. The primary interest is in logistical infrastructure, which 'enables the movement of labor, commodities, and data across global supply chains' coordinated by software, code, etc. (xv). Communicative infrastructure enables sovereign media such as data centres (e.g., HFT, high frequency trading) that challenge states as sovereign entities (185). These are 'apparatuses of indifference' (185) unresponsive and unanswerable to publics, to civil society.

What is the infrastructure? Of course, there is a material substrate, for instance cabling. But is this infrastructure neutral (for Brian Larkin infrastructures simply comprise the architecture for circulation—cited 145) or does it have its own ontology, i.e., can it generate 'dispositions' or 'propensities'? The architectural analyst Easterling argues that the dispositional activity of infrastructures relies on the 'unfolding relationships inherent in its arrangement' (Easterling cited 145). This provides a more strongly determining account of infrastructure whereby '[d]esigning infrastructure is designing action' (Easterling 2011: 145).

Logistical media theory emerged out of insights which understood media as 'fundamentally logistical' (e.g., Paul Virilio's 'logistical modernities', John Durham Peters) (5). But because high-end software systems are largely hidden, understanding in its role of organizing and orienting people and property (5) is not straightforward. Global logistics software programmes such as ERP (enterprise resource planning) systems are nevertheless reliant on control by protocols.

There is a causal link to the space of 'infrastructural cities', which reproduce the sociospatial divisions in urban space, such as edge cities. Rossiter demonstrates the continuities with imperial infrastructures (138–163). New kinds of territory are produced along with logistical media. In addition, an emergent territoriality emerges with the production of space and time beyond the territory of the nation state as a 'bordered power-container' (142 citing Giddens). This territoriality 'consists of operational practices specific to infrastructural systems and technical devices, the effect of which produce territory as spatial arrangements and temporal dynamics that may contest or conflict with state-based claims to control over the bounded space of the nation and its sovereign extensions' (145). For instance, high-frequency trading (HFT) generates an almost unlimited appetite for speed to cash in on financial-arbitrage opportunities concentrated in key nodes of the global finance network. Networks of data centres provide technical infrastructure for storage, processing and transmission, supporting cloud computing, finance and banking, supply chain management, transport coordination, entertainment, billing, and military and security systems. The

same ‘computational architecture’ supports many diverse institutions; the differences are probably in the various protocols of hardware and storage (147). The infrastructure here includes building materials and spaces, cabling, security, training regimes, servers, operating systems, software utilities optimising bandwidth, algorithms monitoring data, etc. (147) But these largely invisible technical processes differ from the symbolic visibility of imperial infrastructures.

**Seaver, N. (2021). Seeing like an infrastructure: Avidity and difference in algorithmic recommendation. *Cultural studies* 35(4–5): 771–791. doi:10.1080/09502386.2021.1895248**

Abstract: As the influence of algorithmic systems has grown, critics have come to appreciate that algorithms are not autonomous technical forces, but rather heterogeneous sociotechnical systems. The people who build and maintain these infrastructures play integral roles in their functioning: in the tight and continuous cycles of contemporary software development, the thinking of developers shapes how data drives ‘data-driven’ organizations. This article contributes to contemporary debates on infrastructural politics by describing how the vernacular social theorizing of one group of developers tangles with their technical work. Drawing on ethnographic fieldwork with developers of music recommender systems in the US, I examine how they understand the variability of music listeners. I find that the dominant frame for making sense of listener variation is *avidity*: a level of enthusiasm for music, which manifests as a willingness to expend effort in finding listening material. For people working in this industry, avidity displaces other ways of understanding human variety—particularly demography. While the technical communities behind these systems were predominantly white and male, they understood the difference that set them apart from most users to be their enthusiasm for music. Centring avidity provided a way to claim elite cultural status and to avoid talking about demographic diversity. It also reflects the infrastructures through which recommender system developers know and intervene upon their users: avidity is what users look like when seen through interaction logs. Less avid users leave fewer traces, and the goal of the recommender system is to encourage them to leave more. As a result, the figure of the less avid listener serves to justify increasingly rapacious data collection practices.

**Star, S. L. (1999). The ethnography of infrastructure. *American Behavioral Scientist* 43(3): 377–391. doi:10.1177/00027649921955326**

Abstract: This article asks methodological questions about studying infrastructure with some of the tools and perspectives of ethnography. Infrastructure is both relational and ecological—it means different things to different groups and it is part of the balance of action, tools, and the built environment, inseparable from them. It also is frequently mundane to the point of boredom, involving things such as plugs, standards, and bureaucratic forms. Some of the difficulties of studying infrastructure are how to scale up from traditional ethnographic sites, how to manage large quantities of data such as those produced by transaction logs, and how to understand the interplay of online and offline behavior. Some of the tricks of the trade involved in meeting these challenges include studying the design of infrastructure, understanding the paradoxes of infrastructure as both transparent and opaque, including invisible work in the ecological analysis, and pinpointing the epistemological status of indicators [sic].

Notes: On the face of it, Star’s article is more methodological than theoretical. ‘Study the understudied’ (379), Star advises, citing her ‘teacher’, sociologist Anselm Strauss, the instigator of grounded theory. Star argues that infrastructure—usually understood as ‘a system of substrates’—is ‘by definition invisible, part of the background for other kinds of work... sunk into and inside of other structures, social arrangements, and technologies’ (380–381). But these substrates—pipes, wires, etc.—are ‘part of human organization’ (380); an ‘infrastructural inversion’ (380, citing Bowker 1994) is a way of attending to the sociotechnical elements of large-scale systems.

Elements to be attended to in infrastructural relationships:

- embeddedness—how infrastructure is embedded in other structures, social arrangements, etc. For example, optical fibres might run along old railway lines.
- transparency—ease of access, understanding, required expertise, etc.
- reach or scope (in time or space)
- learned as part of membership—links to a particular community of practice
- embodiment of standards—how it plugs into other infrastructures, tools, conventions, etc.

On change: Because infrastructures are large and modular, they are rarely changed quickly, usually incrementally, and rarely from above—‘nobody is really in charge of infrastructure’ (382). But what is infrastructure for Star? While it is embedded in American sociological methods of the period (Becker, Strauss), it seems very specific to information technology and science studies. It is focused on the substrate, whatever that is, but considered in relation to its conditions of use. Values are inscribed in technical systems. Hence for information infrastructures, every aspect of ‘practice, culture, and norm is inscribed at the deepest levels of design’ (289). Some are malleable, even programmable, by those with the capacity to do so, but others, like a census form, are fixed, and only changeable through a social movement.

**Star, S. L., & K. Ruhleder (1996). Steps toward an ecology of infrastructure: Design and access for large information spaces.** *Information Systems Research* 7(1): 111–134. doi:10.1287/isre.7.1.111

Abstract: We analyze a large-scale custom software effort, the Worm Community System (WCS), a collaborative system designed for a geographically dispersed community of geneticists. There were complex challenges in creating this infrastructural tool, ranging from simple lack of resources to complex organizational and intellectual communication failures and trade-offs. Despite high user satisfaction with the system and interface, and extensive user needs assessment, feedback, and analysis, many users experienced difficulties in signing on and use. The study was conducted during a time of unprecedented growth in the Internet and its utilities (1991–1994), and many respondents turned to the World Wide Web for their information exchange. Using Bateson’s model of levels of learning, we analyze the levels of infrastructural complexity involved in system access and designer-user communication. We analyze the connection between systems development aimed at supporting specific forms of collaborative knowledge work, local organizational transformation, and large-scale infrastructural change.

**Stuedahl, D., M. Runardotter, & C. Mörtberg (2016). Attachments to participatory digital infrastructures in the cultural heritage sector.** *Science & Technology Studies* 29(4): 50–69. doi:10.23987/sts.60223

Abstract: This paper explores knowledge infrastructures developed with the aim of opening cultural heritage institutions for public access and involvement. We concentrate on the new modes of knowledge production of professionals and amateur experts involved in the design and use of open archives and wiki communities as a part of transformations towards participatory digital public infrastructures. Ideas of crowdsourcing, policies of open data and engagements in community-based cultural heritage influence participants’ visions of future ways of generating, sharing and maintaining their knowledge. The paper identifies how the concept of attachments may help us analytically to understand the dynamics of multiple situated knowledges that are played out when people embrace digital technologies and open-data policies to connect past, present and future orientation of cultural heritage engagements.

Notes: The two case studies were 1) a Swedish project to create citizen-centric digital services on archival material in a public institution in line with a government directive to develop more open data from 2003, and 2) the lokalhistoriewiki.no project in Norway that involves infrastructuring in

a nongovernmental setting heading towards community-based development of local history writing.

**Thylstrup, N., & S. Teilmann-Lock (2017). The transformative power of the thumbnail image: Media logistics and infrastructural aesthetics. *First Monday* 22(10). doi:10.5210/fm.v22i10.7869**

Abstract: Thumbnail images are discreet, yet central navigational tools in increasingly complex visual information environments. Indeed, without thumbnail images there would be no image search: they are an inherent part of the information architecture of most digital information platforms. Yet, how might we understand the role of the thumbnail as an attention technology in the digital economy? And what kind of aesthetic does it produce? This paper examines the legal negotiations of the thumbnail image and the ensuing decision to conceptualize the thumbnail as a functional image against the cultural history of visual attention technologies and the aesthetics of their connective function. Such an endeavour, we propose, allows us to understand and appreciate the significant digital economy and particular aesthetic of the thumbnail image despite its apparent subtlety.

Notes: The authors attempt to place the thumbnail image historically: 'Building on our understanding of the thumbnail image as an affective infrastructure, we outline and explore the cultural historical trajectory of thumbnail images as visual attention technologies. The thumbnail image has yet to be historicized properly, but this paper draws parallels between the emergence of the photographic contact sheet in the 1930s and the thumbnail image in the 2000s. Moreover, we argue that the interplay between the complex visual and digital economy of the thumbnail image and the legal framework of copyright produce a "good enough" aesthetic of access known also from bootleg videos and visual material mediated by mobile screens. Finally, we link the aesthetic of the thumbnail image to the desirous databases of visual search engines.'

Legal cases in 2003 and 2007 established thumbnails as a 'transformative use', thus avoiding copyright. They are 'attention technologies' that are also link to algorithmic technologies: 'thumbnail images are more than simple infrastructural objects; they are also complex algorithmic and relational images that play a significant role in today's attention economy. Their subtle demeanour makes them ideal manipulators, unobtrusive, yet satisfying tools of navigation in a wilderness of information consumption. Indeed, thumbnails are designed to, unperceptively, make demands on our attention, time and desire. Despite their helpful and pleasurable presence they live their life in the shadow of content and are rarely afforded much attention in themselves.' On aesthetics: '[t]echnologies are never only functional: any device always has an element of social display or "bling"' (citing Peters). They are 'low grade', 'good enough' and have popular appeal.

**Turner, W., G. Bowker, L. Gasser, & M. Zacklad (2006). Information infrastructures for distributed collective practices. *Computer Supported Cooperative Work* 15(2): 93–110. doi:10.1007/s10606-006-9014-3**

Notes: Useful for an outline of how infrastructure studies dovetail with science studies, actor–network theory, and so on, and how it moves towards a notion of 'distributed collective practices'. Interestingly, infrastructure still refers to information infrastructure; there was no attempt to broaden the notion of infrastructure here.

**Witten, K., R. Kearns, S. Opit, & E. Fergusson (2020). Facebook as soft infrastructure: Producing and performing community in a mixed tenure housing development. *Housing Studies* 36(9): 1345–1353. doi:10.1080/02673037.2020.1769035**

Abstract: Place-based community networks provide a resource that can be drawn on to protect and promote the wellbeing of residents. We investigate the role of social networking sites (SNSs) in community formation in a new master-planned, mixed tenure, affordable housing estate in

Auckland, Aotearoa/New Zealand. Waimahia Inlet was developed by a consortium of Māori organizations and community housing providers. Community formation was an explicit developer goal with public spaces to encourage face-to-face interaction designed into the development and social infrastructure nurtured on site. New residents were invited to join a closed Facebook group, created and moderated by a residents' association set up by the developer. In-depth interviews with 38 residents between 2017/18 revealed synergies between residents' use of online and offline interactional spaces for producing and performing an engaged and supportive community. Neighbourhood networks contributed to strengthened attachment to place and sense of security by residents.

Notes: No discussion of theory, but there is an assumption that soft infrastructure was community' generated through action and communication:

'The Facebook site enabled the *doing* of social infrastructuring by residents.... In other words, residents not only used types of "hard" infrastructure commonly associated with housing (e.g., roads, drains electrical wiring); in the case of the Facebook page their regular and collective transactions through the platform amount to a co-creation of "soft" community infrastructure' (1357). Is Facebook the infrastructure or the people's use of it? Clearly both, in this formulation.

**Wong, R., & S. Jackson (2015). Wireless visions: Infrastructure, imagination, and US spectrum policy. In *CSCW '15: Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (pp. 105–115). New York: ACM Press. doi:10.1145/2675133.2675229**

Abstract: Effective use of spectrum is essential to the forms of mobile, ubiquitous, and social computing that increasingly shape and define CSCW research. This paper calls attention to the key policy processes by which the future of wireless spectrum—and the forms of technology design and use that depend on it—is being imagined, shaped, and contested. We review CSCW and HCI scholarship arguing for infrastructure and policy as important but neglected sites of CSCW analysis, and separate lines of work arguing for 'sociotechnical imaginaries' as key sites and outcomes of technology policy and design. We then turn to histories of U.S. spectrum regulation, before analyzing ongoing FCC policy actions around incentive auctions and unlicensed spectrum use. We argue that such processes are central to the imagination and future of mobile computing; and that CSCW can benefit from adding such policy concerns to its traditional repertoires of design and use.

Notes: Develops the notion of sociotechnical imaginaries, which emerge as 'collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects' (106, citing Jasanoff & Kim) (the imaginary perspective comes from Charles Taylor). This is explicitly a policy-oriented concept that attempts to tie in the role of the state in developing visions of culture and identity within its policymaking in a way that a purely technical and network focus cannot; it also seeks to embed an understanding of the mutual relationship between policy, design and use. Nevertheless, there could be wider use of 'sociotechnical imaginaries' in infrastructure analysis.

## Urban studies and spatial approaches

**Dodson, J. (2017). The global infrastructure turn and urban practice. *Urban Policy and Research* 35(1): 87–92. doi:10.1080/08111146.2017.1284036**

Abstract: This paper assesses the emergence of a global 'infrastructure turn' and its implications for urban scholarship. The global infrastructure turn involves the emergence of a coordinated effort to stimulate infrastructure development at the national and global level via an array of international frameworks. The key elements of this shift are described, and explanations are presented, which are founded in the working out of contradictions within global capitalist



urbanization. The need for urbanists to attend to the global infrastructure turn is emphasised, and a set of elements to which attention must be given—discourse, technical practices and politics—is described. The paper concludes by arguing for greater attention to the global infrastructure turn by urban scholars.

Notes: Australia was a leader in infrastructure governance: ‘In Australia infrastructure as a specific category of government interest was not a major focus of government until 2007. Prior to the election of the Rudd Labor government in that year infrastructure had typically been handled via sectoral portfolios, such as transport, energy or water. The Rudd Labor government established the Infrastructure Australia agency which took responsibility for providing a national policy perspective on infrastructure planning and financing, including harmonisation of business case models and a priority infrastructure list’ (88).

Argues the need to consider infrastructure practices critically in three areas: infrastructure discourse, infrastructure instrumentalities (technical practices) and infrastructure politics.

**Easterling, K. (2012). *Zone: The spatial softwares of extrastatecraft*. *Places*, June 2012. doi:10.22269/120610**

Notes: ‘Massive global systems—meta-infrastructures administered by public and private cohorts, and driven by profound irrationalities—are generating de facto, undeclared forms of polity faster than any even quasi-official forms of governance can legislate them’ (np.) Spaces beyond governance were generated out of colonial/postcolonial statecraft to form ‘states of exception’; now free trade zones and export processing zones are increasingly central rather than peripheral.

Interesting material on China and the proliferation of ‘zones’ starting with Shenzhen: ‘In 1995 the sociologist and political scientist Xiangming Chen charted three eras in the evolution of the zone. The first era, from the mid-16th century to the 1930s, is dominated by the free port and early free trade zones; the second, from the late 1950s through the 1970s, is characterized by the export processing zones, such as maquiladoras, which focused largely on manufacturing; the third stage, starting in the 1980s, saw the rise of the Special Economic Zones, the Economic and Technological Development Zones, and the Science Industrial Parks’ (np.) (see Meng 2005 and Chen 1995).

This paragraph captures the contradictions of this creation of liberal planning:

‘Paradoxically, the zone is at once the mascot and contradiction of the basic tenets of “free market” liberalism. The United Nations and global business interests promoted the zone as a market mechanism—and then lobbied for its adoption as government policy. In a sense the free zone is itself a form of big government par excellence, constituting a significant effort to thread together existing networks of global contractual relations in the absence of any robust international law. Global consultancies, multinational corporations, real estate interests, intergovernmental organizations and state governments—all have contributed to fuelling an engine that appears unstoppable. The proliferation of the zone as a worldwide urban-infrastructural format is deriving less from any financial return or economic wisdom than from the very fact of its self-perpetuating proliferation.’ Here infrastructure both underlies and exceeds the liberal imaginary.

**Easterling, K. (2014). *Extrastatecraft: The Power of Infrastructure Space*. London; Brooklyn, NY: Verso.**

Description: Infrastructure is not only the underground pipes and wires that control our cities but also the hidden rules for structuring the spaces all around us—free trade zones, smart cities, suburbs and malls. *Extrastatecraft* charts the rise of the hidden rules that control this ‘infrastructure space,’ and shows how it is creating new forms of power, beyond the reach of government. In a series of fascinating case studies, Easterling visits fields of infrastructure with the greatest impact on our world—tracking everything from standards for the thinness of credit cards, to the urbanism

of mobile telephony as the world's largest shared platform, to the rules for the free zone as the most contagious new world city paradigm. In conclusion, she proposes some unexpected techniques for resisting power in a contemporary world.

Notes: This is a vivid piece of meta-theory that can be rather fuzzy, but yields many insights through its groundings in architecture, urban space, infrastructural history, digital governance, corporate cultures and so on. The key term is 'infrastructural space', which extends—and perhaps surpasses—the notion of infrastructure. It ties in the generative spatiality (and temporality) of infrastructure activity and identifies a field of action that is now central, providing a medium for largely undisclosed activities she characterises as extrastatecraft. Infrastructural space, somewhat like 'an operating system for shaping the city' (15), is contrasted with traditional architectural space—with which it has effectively merged. Buildings are no longer 'singularly crafted enclosures, uniquely imagined by an architect, but reproducible products set within similar urban arrangements' (11). This infrastructure 'includes pools of microwaves beaming from satellites and populations of atomized electronic devices we hold in our hands' (11). It also includes 'shared standards and ideas', the 'soupy matrix of details and repeatable formulas that generate most of the space in the world' (11). Ironically, this is no longer really hidden substrate, as infrastructure is more and more the 'overt point of contact and access between us all' (11). Is it then infrastructure?

Infrastructure space is described as an informational form, not a container like a building, residing in the bits of code in software that organizes the building—the action of what it does is the form, an 'updating platform unfolding in time to handle new circumstances' (14). The analogy with an operating system is nevertheless socially—or sociotechnically—interfaced. Contemporary infrastructure needs to be culturally and socially populated. The properties of infrastructural space include dispositions, narratives and stories able to create logics for using infrastructural systems. She draws on Foucault's notion of *dispositif*, a 'heterogeneous ensemble' that includes discourses, institutions, architectural forms, regulatory decisions, laws, moral propositions. This is supplemented by historically generated narratives or stories that provide 'fluid scripts for shaping a technology into ideologies that dictate the disposition of an organization' (93). These intertwined stories include the strands of military and security thinking, liberalism and its newer versions, universalism or at least appeals to 'one world', and the discourses of quality and standards (see chapter 5 on the example of the International Standards Organization), management and corporate thinking.

**Gokhale, C. (2020). Holistic approach for cultural infrastructure with reference to future smart cities. *E3S Web of Conferences* 170: 05002. doi:10.1051/e3sconf/202017005002**

Abstract: To take the initiative of smart cities to new heights is a responsibility of every citizen. Bona fide progress will be seen when people's approach towards their city will change through awareness and education about the prevalent systems. This paper focuses on improving the cultural aspects of a smart city, especially visually, and on improving governance with reference to the 21st century. A majority of the information deals with the must-haves of smart city, later moving on to more specific problems. In the following paper, evaluation, analysis, ideas, innovative solutions along with comparisons and examples from life have been suggested with a view of enhancing the pre-existent, and further developing the cultural infrastructure of a smart city. This is proposed in a way that will help old traditions and historical heritage keep pace with modernism and other urban developments in the age of internet without changing their essence. This, in turn, will lead to touristic developments. Attention has also been paid to heritage restoration and its methods. Special focus has been given to the aesthetics of proposed, self-designed signage systems of the city. It is hoped that the insights presented herewith encourage greater enthusiasm towards art and encourage appreciation towards the culture and heritage of a smart city. This will add value to the quality of life of its citizens.

Notes: Almost the epitome of a positive planner's view of the uses of cultural infrastructure, which is never 'for itself': 'Smart cities in different parts of the world have started including public art installations, pop arts and street displays. These social and personal endeavours leave individuals with an increased sense of pride, belonging and regard for their city, and, in turn, the public benefits from an increased sense of awareness and understanding' (3).

**Graham, S. (2000). Constructing premium network spaces: Reflections on infrastructure networks and contemporary urban development. *International Journal of Urban and Regional Research* 24(1): 183–200. doi:10.1111/1468-2427.00242**

Abstract: This article argues that standardized, public or private infrastructure monopolies are receding as hegemonic forms of urban infrastructure development. We are starting to witness the uneven overlaying of new, customized, high-performance urban infrastructures onto the apparently immanent, universal and (usually) public monopoly networks laid down in developed cities between the 1930s and 1960s. This article seeks to develop a broad and international exploration of the construction of such premium networked spaces and to begin analysing how they are bound up within wider processes of urban change and restructuring. To this end it highlights four processes of socio-technical and political economic change that are supporting the emergence of premium networked infrastructures. These are: the 'unbundling' of urban infrastructure provision; the erosion of comprehensive urban planning and the construction of new consumption spaces; the emergence of infrastructural consumerism; and the widespread shift towards extended and automobilized cityscapes. In each case, the article explores emerging examples of premium networked spaces via brief case studies. Finally, the article reflects on the likely limits to these trends, by way of a brief conclusion.

**Graham, S., & S. Marvin (2001). *Splintering Urbanism: Networked Infrastructures, Technological Mobilities, and the Urban Condition*. London: Routledge.**

Description: *Splintering Urbanism* makes an international and interdisciplinary analysis of the complex interactions between infrastructure networks and urban spaces. It delivers a new and powerful way of understanding contemporary urban change, bringing together discussions about:

- globalization and the city
- technology and society
- urban space and urban networks
- infrastructure and the built environment
- developed, developing and post-communist worlds.

With a range of case studies, illustrations and boxed examples, from New York to Jakarta, Johannesburg to Manila and Sao Paolo to Melbourne, *Splintering Urbanism* demonstrates the latest social, urban and technological theories, which give us an understanding of our contemporary metropolis. (Publisher's description)

Notes: An initial argument is that urban infrastructure networks, once largely developed and maintained by the public sector, have been opened to private competition, a shift with a range of consequences for politics, culture and society, and particularly cities. Neoliberal privatisation and concentration of infrastructures have resulted in a collapse of the infrastructure ideal that characterised both Keynesian welfare states and socialist economies. With the collapse of Soviet and Eastern European communisms with their 'standardised, centralised and often obsolescent infrastructure networks', these territories were incorporated highly unevenly into global capitalist networks and flows (91). The core conceptual term is 'networked infrastructures' enabled by digital media, the key to understanding the 'emerging infrastructure networks and urban landscapes of internationalising capitalism' and particularly the 'privatised, customised infrastructure networks across transport, telecommunications, energy and water ... interwoven with the changing material

and socioeconomic and ecological development of cities and urban regions' (9). Infrastructural linkages were developed historically between 1850 and the 1960s through attempts at standardisation. But now with the demise of the 'modern ideal of monopolistic, standardised and integrated networked infrastructures', the trend has been towards 'infrastructural unbundling' and increasingly segmented infrastructure (138). In these processes, telecommunication and ICT systems 'facilitate the unbundling of integrated networks, allowing new entrants to construct parallel segments of networks' (174). This 'multiscalar process' intensifies connections between 'most valued users and places while simultaneously weakening the connections with least valued users and places' (176). This produces new lumpy geographies: infrastructure and technology enclaves within cities, gentrified 'cyberdistricts', technopoles and high-tech innovation clusters, multimedia supercorridors in countries like Malaysia, concentrated high-level transport networks as in the Pearl River delta, business parks and logistics enclaves, export processing zones, e-commerce spaces and so on. This is a global and interconnected landscape, moving beyond 'glocal' infrastructures in the developing world, whereby new global peripheries emerge 'beyond the increasingly isolated and secessionary enclaves that are connected like beads on a string to the extended archipelagoes of glocal infrastructure nodes and networks' (373). In these new peripheries, people are increasingly reliant on self-provisioning of basic infrastructures such as water and transport (373). The authors warn against an idealising of older ideals of monopolised and integrated infrastructures, proposing instead a 'manifesto for a progressive networked urbanism' (404–420).

**Graham, S., & N. Thrift (2007). Out of order: Understanding repair and maintenance. *Theory, Culture & Society* 24(3): 1–25. doi:10.1177/0263276407075954**

**Abstract:** This article seeks to demonstrate the centrality of maintenance and repair to an understanding of modern societies and, particularly, cities. Arguing that repair and maintenance activities present a kind of 'missing link' in social theory, which is usually overlooked or forgotten, the article begins by recalling Heidegger's concept of material things as being 'ready to hand'. The main elements of practices of repair and maintenance are then elaborated on so as to help establish the argument that, by focusing on failure and breakdown in technical artefacts and systems, their vital contribution can be brought to the fore. The article then moves on to suggest that prevailing cultural constructions, and imaginations, of the 'infrastructure' that sustains modern societies, actively work to push repair and maintenance activities beyond the attention of social science. To exemplify these arguments, the article explores in detail some of the repair and maintenance activities that sustain, first, the nexus between computer communications and electricity and, second, the system of automobility. The article concludes by excavating a politics of repair and maintenance in modern cities and societies.

**Notes:** An interesting piece about infrastructures and the way they generate their own regimes of maintenance and repair. Firstly, things decay—and they decay differently depending on the kinds of infrastructure. Secondly, repair and maintenance generate their own impulses, being in themselves a 'vital source of variation, improvisation and innovation' (6). In other words, infrastructure is constantly changed in the process of being maintained or repaired—renovated, so to speak. Infrastructure (echoing Star) tends to become visible only when it fails or breaks down—maintenance and repair are also moments of 'unblackboxing', when infrastructure becomes more visible, as alternatives must be negotiated. Taken-for-granted processes can become problematic, backstage processes can become frontstage. But then there is the question of more catastrophic or cascading 'accidents', emergencies and threats that magnify the sense of vulnerability and risk, perhaps shattering the image of infrastructure as hidden, stable, fixed emplacement. (COVID-19 lockdowns spring to mind, with their cleansing, emptying/thinning, quarantining, sequestering, etc.). All infrastructures then generate inherent and continuous unreliabilities (computer systems, freeways, health systems) that generate their own generic kinds of 'accidents' (citing Lotringer & Virilio), although these are much more consistent in decaying cities of the Global South, Rust Belt

areas, regions left behind by newer infrastructures, etc. Digital technologies produce new demands for power (electrical and server storage, etc.); power and data shortages can produce cascading problems in the many economic sectors that are networked/entangled through digital infrastructures. And deepening problems result from the waste from computers and the constant need for new hardware. Repair and maintenance are key to ‘the political economies surrounding the application of neoliberal economic ideologies to networked infrastructures’ (14)—privatisation produces a siloing and greater unevenness of these processes. A ‘politics of repair and maintenance’ (17) also plays out across many issues and scales, resulting in very different access to infrastructural renewal and repair (e.g., recycling as international waste dumping).

**Hodson, M., J. Kasmire, A. McMeekin, J. G. Stehlin, & K. Ward (Eds.) (2021). *Urban Platforms and the Future City: Transformations in Infrastructure, Governance, Knowledge and Everyday Life*. Abingdon, Oxon; New York, NY Routledge. doi:10.4324/9780429319754**

Description: This title takes the broadest possible scope to interrogate the emergence of ‘platform urbanism’, examining how it transforms urban infrastructure, governance, knowledge production, and everyday life, and brings together leading scholars and early-career researchers from across five continents and multiple disciplines. The volume advances theoretical debates at the leading edge of the intersection between urbanism, governance, and the digital economy, by drawing on a range of empirically detailed cases from which to theorize the multiplicity of forms that platform urbanism takes. It draws international comparisons between urban platforms across sites, with attention to the leading edges of theory and practice and explores the potential for a renewal of civic life, engagement, and participatory governance through ‘platform cooperativism’ and related movements. A breadth of tangible and diverse examples of platform urbanism provides critical insights to scholars examining the interface of digital technologies and urban infrastructure, urban governance, urban knowledge production, and everyday urban life.

**Kim, A. M. (2020). Can we design for culture? Paradigms and provocations. *Built Environment* 46(2): 39–53. doi:10.2148/benv.46.2.199**

Abstract: While creative placemaking has proved a long-standing paradigm for the arts in city-making strategy, recently there has been a shift towards a cultural infrastructure approach. This article takes critical stock of this paradigm shift, to engage the broader question of whether we can design for culture in the built environment. Conceptualizing creative placemaking within a larger genealogical framework, I argue that this shift might be understood as responsive to some of the limitations and unintended social consequences of the movement: its temporal nature and contribution to cycles of gentrification and displacement.

**Latham, A., & J. Layton (2019). Social infrastructure and the public life of cities: Studying urban sociality and public spaces. *Geography Compass* 13(7): e12444, 15. doi:10.1111/gec3.12444**

Abstract: Libraries, laundrettes, and lidos. Pizzerias, plazas, and playgrounds. Sidewalks, swimming pools, and schools. These are just some of the kinds of spaces and facilities that contribute to the public life of cities. Drawing on the arguments of the sociologist Eric Klinenberg, this article develops the concept of ‘social infrastructure’ as a way to research and value these kinds of spaces. Social infrastructure helps in recognising the public dimensions of often overlooked and undervalued spaces. It draws attention to the breadth, depth, and textures of sociality that can be afforded by different urban environments. In developing the concept of social infrastructure, this article pulls together four related strands of social scientific inquiry: work on infrastructure; publicness and public space; sociality and encounter; and the politics of provision. An infrastructural approach to the topic of public space presents geographers with some productive tools for understanding the public life of cities.

Notes: Here infrastructure is simply ‘the background structures and systems that allow social, economic, cultural, and political life to happen’ (3/15) and basically follows Star in describing infrastructural dynamics. A typology of spatial types is produced for public institutions, commerce, recreation, religion and transit (6/15), in making an argument for better provision to support these.

**O’Neill, P. M. (2010). Infrastructure financing and operation in the contemporary city. *Geographical Research* 48(1): 3–12. doi:10.1111/j.1745-5871.2009.00606.x**

Abstract: The provision of large economic infrastructure in Australian cities is widely seen to be in crisis. This paper examines the reasons why crisis has arisen in the urban infrastructure sector and what might be done to redress this. The analysis and the argument are based on a resuscitation of the ideas and ideals of infrastructure provision and how these have been eroded. The paper shows how these ideas/ideals once underpinned the formulation of state role, governance and regulation systems, financial arrangements, and even community need and expectation. Critical to this was an acceptance of the ideals of universality, access, bundling and free positive externalities, and the belief that these should be assembled necessarily as part of any urban infrastructure roll-out. This package became instinctive in post-war economic and urban management. Yet this instinct has been lost as governments shift from models of infrastructure provision to infrastructure procurement where a major role for the private sector is now common. While such an involvement has its benefits, there are concerns for the urban condition when privatisation of infrastructure construction, delivery and operation becomes dominant. Citing Graham and Marvin (2001), the paper argues that, where once infrastructure was the key device for integrating the elements of the city and its people, the way it is now being delivered produces a splintered urbanism. There is an urgent need, then, to re-think what infrastructure means in today’s urban context and thereafter to re-assess the criteria for deciding what infrastructure is to be provided, in what form it should be provided, who should provide it, who should pay, and who should operate it.

**Ruby, I., & A. Ruby (Eds.) (2017). *Infrastructure Space*. Berlin: Ruby Press.**

Description: *Infrastructure Space* is a collection of 25 essays inspired by the 5th LafargeHolcim Forum for Sustainable Construction on the theme of ‘Infrastructure Space’ held in Detroit, USA in April 2016.

Is infrastructure but the plumbing and wiring of the human environment, or is it the true lifeblood of the spaces we inhabit? Infrastructural systems facilitate the flow of anything from people and goods to resources and information. While engineered to perform specific tasks, such networks also determine the structure of buildings, cities, and metropolitan regions, if not of entire nations and the planet itself.

Taking this critical leverage in consideration, this book calls for expanding and renegotiating the roles of infrastructure not only as a technical, but also as a political, economic, social, and even aesthetic matter of concern for all, claimed not only as the means for achieving more resilient forms of development, but moreover as a right to a sustainable way of life. (Publisher)

**Sage, D., P. Fussey, & A. Dainty (2015). Securing and scaling resilient futures: Neoliberalization, infrastructure, and topologies of power. *Environment and Planning D: Society & Space* 33(3): 494–511. doi:10.1068/d14154p**

Abstract: In this paper we explore the scaling of resilience policy and practice not as an effect upon infrastructure but as enacted *through* infrastructure. Drawing on Foucault’s topological analyses of governmental power, especially his elaboration of its coeval centripetal *and* centrifugal flows, we argue that understanding the scaling of resilience policy and practice involves acknowledging its infrastructural composition. We examine this infrastructural scaling through an empirical analysis of UK resilience policy and practice, as recounted by those working across multiple organizations

involved in planning for, and coping with, aleatory events. This reveals how the neoliberal decentralizing refrain, expressed in resilience policy and its critique, is both sustained and displaced by interwoven circulatory mechanisms of obstruction, filtration, and acceleration. Together these infrastructural flows amount to ‘fractionally coherent’ scalings that not only centralize governmental power but are constitutive of governmental centres. Our analyses of infrastructural scaling suggest that resiliency policy and practice is far less decentralized, or localized, than others have suggested, with both centripetal *and* centrifugal flows of power resulting from a composite of infrastructural circulatory mechanisms that can variously scale political agency in relation to aleatory events.

Notes: This densely argued paper uses Foucaultian analytics in tracking the use of resilience policy by states. Foucault’s notion of power is topological, constituted by constantly shifting and spatially dispersed relations between differing modes of thought and bodily techniques rather than centralised sovereign or governmental power (498). Resilience can be seen as accompanying a neoliberal order, with its appearance of empowerment accompanied by the evasion of responsibilities by governments and elites (495). Infrastructures, on the other hand, ‘allow policy makers to think and act at a distance by accelerating or obstructing circulations of food, building materials, or information during a shock event, or more subtly filtering the flow of information, money, and materials in emergency planning’ (500). Infrastructure is not simply a material support system; discursively, it serves to modulate the scale of political agency, particularly in crisis situations.

## **Anthropology and ethnography of infrastructures**

**Anand, N., A. Gupta, & H. Appel (Eds.) (2018). *The Promise of Infrastructure*. Durham, London: Duke University Press. doi:10.1215/9781478002031**

Description: From U.S.-Mexico border walls to Flint’s poisoned pipes, there is a new urgency to the politics of infrastructure. Roads, electricity lines, water pipes, and oil installations promise to distribute the resources necessary for everyday life. Yet an attention to their ongoing processes also reveals how infrastructures are made with fragile and often violent relations among people, materials, and institutions. While infrastructures promise modernity and development, their breakdowns and absences reveal the underbelly of progress, liberal equality, and economic growth. This tension, between aspiration and failure, makes infrastructure a productive location for social theory. Contributing to the everyday lives of infrastructure across four continents, some of the leading anthropologists of infrastructure demonstrate in *The Promise of Infrastructure* how these more-than-human assemblages made over more-than-human lifetimes offer new opportunities to theorize time, politics, and promise in the contemporary moment.

**Barlow, M., & G. Drew (2021). Slow infrastructures in times of crisis: Unworking speed and convenience. *Postcolonial Studies* 24(2): 212–233. doi:10.1080/13688790.2020.1804105**

Abstract: The (post)colonial logics of speed and convenience are manifest in many of today’s infrastructural projects, creating what we consider to be ‘fast infrastructures’. These infrastructures create ease for some and harm for others while exacerbating social and environmental crises around the world. Addressing these crises requires, we argue, a slowing down. Enter the role of ‘slow infrastructures’. In this paper, we highlight two forms of slow infrastructure that provide possibilities for rearranging our infrastructural orientations: composting and rainwater harvesting. Drawing on fieldwork conducted throughout 2018 and 2019 in Kochi, Kerala, this research asserts that in order to do infrastructure differently, an unworking of convenience and speed is required. This unworking can be achieved through an attunement to multi-species and more-than-human relations, matched with a distributed ethic of maintenance and care. Our ethnographic examples, one from a hospital and another from a hotel, suggest that slow infrastructures can meaningfully offset the threat of disfunction and ‘urban failure’ that confronts cities increasingly marked by

turbulence and uncertainty. While these examples draw from the tropics of urban South India, they offer lessons helpful to unworking the harm caused by fast infrastructures in other parts of the globe.

Notes: The authors argue that ‘fast infrastructures require an “unworking” to be more equitable and ecological—an unworking that requires revisions of the predominant orientation towards speed, convenience and endless growth. Such an unworking might involve a slowing down, and a turn towards slow(er) infrastructures. These slower infrastructures can offset the threat of disfunction and “urban failure” that confronts cities increasingly marked by turbulence and uncertainty’ (213). Slow infrastructures seem to be aligned with equity and care.

**Boyer, D., & I. Lowrie (2014). Dominic Boyer on the Anthropology of Infrastructure. Platyus: The CASTAC Blog, 3 March 2014. Retrieved from <http://blog.castac.org/2014/03/dominic-boyer-on-the-anthropology-of-infrastructure/>**

Notes: This is a 2014 interview with anthropologist Dominic Boyer speculating on the anthropology of infrastructure and why infrastructure talk is so prominent now. The failures of infrastructure are more apparent, particularly with the emergence of the Anthropocene, and so a focus beyond anthropocentric explanation becomes more prominent.

**Elyachar, J. (2012). Next practices: Knowledge, infrastructure, and public goods at the bottom of the pyramid. *Public Culture* 24(1): 109–129. doi:10.1215/08992363-1443583**

Abstract: How to move beyond the failures of development? In the bottom of the pyramid (BOP) approach, the state, development, and public goods disappear. Instead, nongovernmental organizations help businesspeople realize poor people’s capacity to create infrastructure and business models. I draw on the history of development to show how the BOP is an unintended outgrowth of the critique of development. Drawing on previous formulations of the BOP, I propose that the infrastructures created by poor people’s social practices can also be understood as a ‘commons’ for which compensation should be paid or as a public good to be regulated by the state.

**Harvey, P., & H. Knox (2012). The enchantments of infrastructure. *Mobilities* 7(4): 521–536. doi:10.1080/17450101.2012.718935**

Abstract: This paper addresses the unstable material and social environments that large-scale road construction projects attempt to tame and fix in place as a way of exploring the affective force of roads as technologies for delivering progress and development. Drawing from our ethnography of the construction of two roads in Peru, we trace the disruptive and destabilising processes through which roads come to hold the promise of transformation. We approach roads with curiosity as to their capacity to enchant with respect to three specific promises: speed, political integration and economic connectivity. We suggest that whilst the abstractions of engineering and politics are provisional attempts to demarcate the capacity of roads to bring about the enhancement of international trade, promote the growth of national economies and provide economic opportunity for those prepared to engage with the road’s potential, that these practices alone are not sufficient to explain the passionate promise that roads hold in Peruvian society. We suggest, rather, that the promise of stability is invigorated by mundane engagements with unruly forces that threaten to subvert the best laid plans of politicians and engineers. We argue that such forces are integral to the ways in which roads come to endure as enchanted sites of contemporary statecraft despite their capacity to disappoint and/or the likelihood of generating negative consequences. The political and material process of creating roads, calls forth competing, unauthorised and openly unstable dimensions of being—shifting soils and water courses, side-roads and short-cuts which both challenge and reinvigorate the promises of speed, integration and connectivity.



**LaDuke, W., & D. Cowen (2020). Beyond Wiindigo infrastructure. *The South Atlantic Quarterly* 119(2): 243–268. doi:10.1215/00382876-8177747**

Abstract: Infrastructure has long been central to the destruction of Indigenous life and the making of settler colonial futurity. Infrastructure constitutes the body of the Wiindigo—the beast of Anishinaabe legend. Roads and rails, pipelines and dams, prisons and borders have all worked to carve up Turtle Island into preserves of settler jurisdiction, while entrenching and hardening the very means of settler economy and sociality into tangible material structures. Yet infrastructure is not inherently violent—it is also essential for transformation; a pipe can carry fresh water as well as toxic sludge. In this paper we suggest that effective initiatives for justice, decolonization, and planetary survival must center infrastructure in their efforts, and we explore how Indigenous stories can help us envision and walk a different path. Drawing on our distinct work in communities, classrooms, court houses and city streets, we insist that our collective futures hinge on remaking socio-technical systems—on building *beyond* Wiindigo infrastructure.

**Larkin, B. (2015). Degraded images, distorted sounds: Nigerian video and the infrastructure of piracy. In T. Baumgärtel (Ed.), *A Reader in International Media Piracy: Pirate Essays* (pp. 183–205). Amsterdam: Amsterdam University Press.**

Extract: In Kano, the economic center of northern Nigeria, media piracy is part of the ‘organizational architecture’ of globalization (Sassen 2002), providing the infrastructure that allows media goods to circulate. Infrastructures organize the construction of buildings, the training of personnel, the building of railway lines, and the elaboration of juridicolegal frameworks without which the movement of goods and people cannot occur. But once in place, infrastructures generate possibilities for their own corruption and parasitism. Media piracy is one example of this in operation. It represents the potential of technologies of reproduction—the supple ability to store, reproduce, and retrieve data.

**Simone, A. (2004). People as infrastructure: Intersecting fragments in Johannesburg. *Public Culture* 16(3): 407–429. doi:10.1215/08992363-16-3-407**

Extract: This essay is framed around the notion of *people as infrastructure*, which emphasizes economic collaboration among residents seemingly marginalized from and immiserated by urban life. Infrastructure is commonly understood in physical terms, as reticulated systems of highways, pipes, wires, or cables. These modes of provisioning and articulation are viewed as making the city productive, reproducing it, and positioning its residents, territories, and resources in specific ensembles where the energies of individuals can be most efficiently deployed and accounted for.

By contrast, I wish to extend the notion of infrastructure directly to people’s activities in the city. African cities are characterized by incessantly flexible, mobile, and provisional intersections of residents that operate without clearly delineated notions of how the city is to be inhabited and used. These intersections, particularly in the last two decades, have depended on the ability of residents to engage complex combinations of objects, spaces, persons, and practices. These conjunctions become an infrastructure—a platform providing for and reproducing life in the city. Indeed, as I illustrate through a range of ethnographic materials on inner-city Johannesburg, an experience of regularity capable of anchoring the livelihoods of residents and their transactions with one another is consolidated precisely because the outcomes of residents’ reciprocal efforts are radically open, flexible, and provisional. In other words, a specific economy of perception and collaborative practice is constituted through the capacity of individual actors to circulate across and become familiar with a broad range of spatial, residential, economic, and transactional positions. Even when actors do different things with one another in different places, each carries traces of past collaboration and an implicit willingness to interact with one another in ways that draw on multiple social positions. The critical question thus raised in this ethnography of inner-city Johannesburg is how researchers, policymakers, and urban activists can practice ways of seeing and engaging urban spaces that are characterized simultaneously by regularity and provisionality.

Notes: See also Simone's 2021 article revisiting the concept of 'people as infrastructure'.

**Simone, A. (2021). Ritornello: 'People as Infrastructure'. *Urban Geography* 42(9): 1341–1348. doi:10.1080/02723638.2021.1894397**

Abstract: 'People as Infrastructure' was a concept deployed by the author in a 2004 publication of *Public Culture*. This essay returns to this notion following widespread use across the urban studies community, and attempts to find new dimensions of applicability not considered in the original publication. These are rooted in an exploration of a techno-poetics of urbanism, the continuous and oscillating relationships between human agencies and technicity, and the subsequent need to reimagine the basic terms of urban collective life.

Notes: Simone reflects on the irony that 'people as infrastructure' was a 'throwaway formulation' used to point to 'anthropological empathy' that went beyond social terminologies such as households, communities or institutions (p. 1341). Nevertheless, the term still has relevance given the global scale of urban problems. People as infrastructure aims to capture social ontologies characterised by a 'dialectic of fragmentation and order', in which situations are 'improvisational, ephemeral, always evolving and incomplete, and assimilative of countless processes and inheritances' (1348).

## **Economics approaches**

**Foundational Economy Collective (2018). *Foundational Economy: The Infrastructure of Everyday Life*. Manchester: Manchester University Press.**

Description: Privatisation, market choice, outsourcing: these are the watchwords that have shaped policy in numerous democratic states in the last generation. The end result is the degradation of the foundational economy. The foundational economy encompasses the material infrastructure at the foundation of civilised life—things like water pipes and sewers—and the providential services like education, health care and care for the old which are at the base of any civilised life. This book shows how these services were built up in the century between 1880 and 1980 so that they were collectively paid for, collectively delivered and collectively consumed. This system of provision has been undermined in the age of privatisation and outsourcing. The book describes the principles that should guide renewal of the foundational economy and the initiatives which could begin to put these principles into practice.

**Frischmann, B. M. (2012). *Infrastructure: The Social Value of Shared Resources*. New York: Oxford University Press. doi:10.1093/acprof:oso/9780199895656.001.0001**

Abstract: Infrastructure resources are the subject of many contentious public policy debates, including what to do about crumbling roads and bridges, whether and how to protect our natural environment, energy policy, even patent law reform, universal health care, network neutrality regulation, and the future of the Internet. Each of these involves a battle to control infrastructure resources, to establish the terms and conditions under which the public receives access, and to determine how the infrastructure and various dependent systems evolve over time. This book pays much needed attention to understanding how society benefits from infrastructure resources and how management decisions affect a wide variety of interests. The book links infrastructure, a particular set of resources defined in terms of the manner in which they create value, with commons, a resource management principle by which a resource is shared within a community. The infrastructure commons ideas have broad implications for scholarship and public policy across many fields ranging from traditional infrastructure like roads to environmental economics to intellectual property to Internet policy. Economics has become the methodology of choice for many scholars and policymakers in these areas. The book offers a rigorous economic challenge to the prevailing wisdom, which focuses primarily on problems associated with ensuring adequate

supply. The book explores a set of questions: what drives the demand side of the equation, and how should demand-side drivers affect public policy? Demand for infrastructure resources involves a range of important considerations that bear on the optimal design of a regime for infrastructure management. The book identifies resource valuation and attendant management problems that recur across many different fields and many different resource types, and it develops a functional economic approach to understanding and analyzing these problems and potential solutions.

Notes: Frischmann sidesteps supply side economics by giving primacy to social demands that should be supplied with reference to an expected social value. Rather than looking at how much money there is, he adopts a future-oriented policy to invest in infrastructures based on social value that does not yet exist. He advocates the economic advantage of the management of these infrastructures as commons, arguing that nonmarket management would be more flexible, fluid and adaptable, and more likely to deal with unforeseen and unpredictable shifts and changes.

**Niskanen, W. A. (1991). The soft infrastructure of a market economy. *Cato Journal* 11(2): 233–238.**

Notes: Apparently the first mention of ‘soft infrastructure’. The piece is also something of a Cold War tract.

## **Sociology of infrastructures**

**Klinenberg, E. (2018). *Palaces for the People: How to Build a More Equal and United Society*. London, Bodley Head.**

Description: An eminent sociologist and bestselling author offers an inspiring blueprint for rebuilding our fractured society. We are living in a time of deep divisions. Americans are sorting themselves along racial, religious, and cultural lines, leading to a level of polarization that the country hasn’t seen since the Civil War. Pundits and politicians are calling for us to come together, to find common purpose. But how, exactly, can this be done? In *Palaces for the People*, Eric Klinenberg suggests a way forward. He believes that the future of democratic societies rests not simply on shared values but on shared spaces: the libraries, childcare centers, bookstores, churches, synagogues, and parks where crucial, sometimes life-saving connections, are formed. These are places where people gather and linger, making friends across group lines and strengthening the entire community. Klinenberg calls this the ‘social infrastructure’: When it is strong, neighborhoods flourish, when it is neglected, as it has been in recent years, families and individuals must fend for themselves. Klinenberg takes us around the globe—from a floating school in Bangladesh to an arts incubator in Chicago, from a soccer pitch in Queens to an evangelical church in Houston—to show how social infrastructure is helping to solve some of our most pressing challenges: isolation, crime, education, addiction, political polarization, and even climate change. Richly reported, elegantly written, and ultimately uplifting, *Palaces for the People* urges us to acknowledge the crucial role these spaces play in civic life. Our social infrastructure could be the key to bridging our seemingly unbridgeable divides—and safeguarding democracy. (Publisher)

Notes: Klinenberg uses a conception of social infrastructure that links it to shared sociality. Social infrastructure is defined as ‘the physical places and organizations that shape the way people interact.... When the social infrastructure is robust it fosters contact, mutual support and collaboration... When degraded it inhibits social activity, leaving families and individuals to fend for themselves. It is not “social capital”, but things and conditions that support it’ (5).

What counts as social infrastructure? Klinenberg capaciously includes public institutions such as libraries, schools, parks, and places such as sidewalks or community gardens. Then there are community organizations like churches and civic associations and centres; and there are gathering

places, or ‘third places’ (sociologist Ray Oldenburg), such as bars, barbershops, cafes, bookstores (the first places are home; the second places are work). On the one hand social infrastructure is largely empirical and material supports for bringing people together, while on the other hand it has symbolic dimensions (the wall, or iconic projects designed to embody an age, modernity, etc.).

For Klinenberg, hard infrastructure such as airports, freeways or supply chain facilities that aim to increase circulation of goods and people can also promote social atomisation. Some infrastructure is actively antisocial, such as Trump’s border wall, although it can paradoxically provide zones that assemble the very people ‘the structure is meant to separate’—checkpoints, access gates etc. (19).

**Mann, M. (1984). The autonomous power of the state: Its origins, mechanisms and results. *European Journal of Sociology/Archives européennes de sociologie* 25(2): 185–213. doi:10.1017/S0003975600004239**

Abstract: This essay tries to specify the origins, mechanisms and results of the autonomous power which the state possesses in relation to the major power groupings of ‘civil society’. The argument is couched generally, but it derives from a large, ongoing empirical research project into the development of power in human societies. At the moment, my generalisations are bolder about agrarian societies; concerning industrial societies I will be more tentative. I define the state and then pursue the implications of that definition. I discuss two essential parts of the definition, centrality and territoriality, in relation to two types of state power, termed here *despotic* and *infrastructural* power. I argue that state autonomy, of both despotic and infrastructural forms, flows principally from the state’s unique ability to provide a *territorially-centralised* form of organization.

**Mann, M. (2008). Infrastructural power revisited. *Studies in Comparative International Development* 43(3–4): 355–365. doi:10.1007/s12116-008-9027-7**

Notes: Infrastructural power was defined—in contradistinction to despotic power—as the capacity of states to penetrate civil society. Here infrastructure refers to internal political infrastructures within sovereign territories. States may be weak in despotic power but stronger in infrastructural power, typically in democracies, multiparty states, or where a ‘governed interdependence’ has been achieved, for instance in the case of post-WW2 East Asian Tiger states, where negotiation between government and civil society groups is able to coordinate a blending of public and private resources to pursue developmental goals. In Mann’s schema, infrastructural power is only one form of state power, alongside ideological power—control over meaning systems; economic power—the extraction, transformation, distribution, and consumption of the resources; and military power, the social organization of violence (358). These forms of power also have their own infrastructures, i.e., ‘routinized media through which information and commands are transmitted’ (358); often media will be shared or overlapping between forms of power, such as roads, education systems and computer networks.

**Turner, J. H. (2004). Toward a general sociological theory of the economy. *Sociological Theory* 22(2): 229–246. doi:10.1111/j.0735-2751.2004.00214.x**

Abstract: In the spirit of Gerhard Lenski’s macro-level analysis of stratification and societal evolution, a theory of the economy is presented. Like Lenski’s work, this theory emphasizes population and power as they interact with production and distribution dynamics. Macro-level social organization in general, and economic processes in particular, are viewed as driven by the forces of population, power, production, and distribution. For each force, a theoretical proposition is presented. Forces are all implicated in each other; the resulting set of principles provides a view of how production and distribution, as the core of an economy, are embedded in population and power processes, and vice versa. The end result is a more general macro-level theory that captures the spirit and substance of Lenski’s models of societal organization.

Notes: Some extracted passages on infrastructure in liberal societies: ‘*Distributive infrastructures* are composed of those physical facilities that can move resources, information, and people in space’ (233). These generate mobility costs and ‘logistical loads’ (235). ‘[D]istributive infrastructures and differentiation of markets using generalized media of exchange all become essential to drive production as they commodify an ever-expanding array of goods and services’ (239).

‘The consolidation of power is also crucial, for as power is initially consolidated and centralized, it can encourage technological development, production, and market exchanges, although highly centralized power will begin to create disincentives for innovation and free market exchanges. Reciprocally, a well-developed distributive infrastructure can facilitate the consolidation of power by moving information, coercive forces, symbols, material incentives, and administrative directives rapidly about a population.

If power becomes too centralized, however, infrastructures will become biased toward military and administrative goals, and perhaps ideological manipulation as well, thereby dampening many of the positive effects of distributive infrastructures on market exchanges’ (240).

‘With liquid capital ... physical facilities, information networks, and other infrastructural structures can be moved to new markets, pools of human capital, sources of resources, and emerging productive centres, thereby expanding the volume, velocity, and scope of market exchanges’ (242).

‘When the centralization of power around the coercive and administrative bases is devoted to development of distributive infrastructures, formation of physical capital, expansion of human capital, and encouragement of market exchanges geared toward imports of technology and physical capital and export of goods and services, then economic development will ensue and, initially, at a rapid rate.

This path to development is highly effective in the short run because government provides institutional sources of entrepreneurship, while facilitating capital formation and entrepreneurial activity of private corporate units. However, in the long run, structural problems become increasingly evident in such ‘managed systems.’ These problems revolve around (a) the contradiction of state control in market systems that generate individualism and liberal-democratic ideologies among members of a population; (b) the problems of physical capital formation that arise when its formation is not subject wholly to market distribution and, instead, is managed through cronyism, patronage, government enterprises, and political favouritism. As these problems emerge, the stability of currency, the ability to sustain full employment, and the capacity to maintain the flow of physical capital all decline and thereby set off a downwardly spiralling economic crisis’ (243).

## History and/of infrastructures

**Attewell, N., & W. Attewell (2019). Between Asia and empire: Infrastructures of encounter in the archive of war. *Inter-Asia Cultural Studies* 20(2): 162–179. doi:10.1080/14649373.2019.1613725**

Abstract: In this essay, we stage a conversation about our experiences researching everyday histories of encounter between Asian and Asian diasporic subjects during the Pacific and Vietnam Wars. Through readings of materials from the archives of two empires, Britain and the United States, with bloody records of military intervention in east and south-east Asia, we show how wartime inter-Asian, Afro-Asian, and Asian diasporic geographies of relation overlapped with and animated one another, helping to (re)produce trans-local communities of affinity over space and time even as they also functioned as infrastructures for empire. Throughout, we reflect on the infrastructures—material, institutional, epistemological, affective—that make inter-referencing possible, both for our subjects and, importantly, for ourselves. If our archives resonate, what does

this tell us about the trans-imperial durability of the intimate infrastructures we show taking shape in 1940s China and 1960s Vietnam respectively?

**Badenoch, A., & A. Fickers (2010). *Materializing Europe: Transnational Infrastructures and the Project of Europe*. London: Palgrave Macmillan UK. doi:10.1057/9780230292314**

Abstract: This book explores the relationships between European integration and material infrastructures. Taking transnational infrastructures as the focal point of study, the book focuses on the various forms of mediation between the material, institutional and discursive levels of European integration and fragmentation in a truly transnational perspective. Transnational infrastructures have long been an integral part of projects to unite Europe. From the first ceremonial train of the European Coal and Steel Community to the new border signs that have replaced checkpoints along motorways, such technologies of connection have served as powerful symbols of European unification. In interpreting infrastructures as mediating interfaces of European projects, this book aims to analyze the complex histories of network technologies in their material, institutional and symbolic performances. Taking material networks as the focal point of study allows the authors to tell a truly transnational history, broadening fruitfully our perspectives on a number of historical narratives. It expands the time frame for exploring European integration by pointing to the longer processes of international connection and co-operation. These broadened spatial and temporal horizons allow to de-centre the processes of formal integration surrounding the EU after WWII to reveal a broader range of actors and forces in European history.

Notes: While this book uses an economic notion of infrastructures, it attempts to broaden the analysis of infrastructure to focus on material networks, and to extend it spatially to transnational fields and—temporally—to historical time.

**Bear, L. (2020). Speculations on infrastructure: From colonial public works to a post-colonial global asset class on the Indian railways 1840–2017. *Economy and Society* 49(1): 45–70. doi:10.1080/03085147.2020.1702416**

Abstract: This paper issues a challenge to examine the current emergence of infrastructure as a global asset class against a longer-term colonial history of speculation. Taking the case of the Indian railways, it shows that their current financialization and transformation into a logistical network emerges from colonial techniques of calculations of risky frontiers, state guarantees and debt accounting. Historical forms built from racial and national inequalities have been incorporated into a new era of the financialization of public works led globally by the World Bank. This new moment erases the distinctive political histories of public works, while also capitalizing on these. Overall, this leads to two theoretical claims: firstly, that we should only use the term ‘infrastructure’ self-consciously as a mode of critique of such contemporary moves. Secondly, that our theories derived from Marx, Foucault and Callon place too much emphasis on ‘economization’ and that we need to replace this with attention to speculation. Speculation is affective, intellectual and physical labour that aims to direct capital towards various ends. It involves the ethical imagination of social differences and places distinctions of race, nation and gender at the core of calculative regimes. This labour is governed by key nodal contracts between the market and the state and associated accounting and legal regimes or treaties for accumulation.

**Bennett, T., & P. Joyce (Eds.) (2010). *Material Powers: Cultural Studies, History and the Material Turn*. London; New York: Routledge.**

Description: This edited collection is a major contribution to the current development of a ‘material turn’ in the social sciences and humanities. It does so by exploring new understandings of how power is made up and exercised by examining the role of material infrastructures in the organization of state power and the role of material cultural practices in the organization of colonial forms of governance. A diverse range of historical examples is drawn on in illustrating these

concerns—from the role of territorial engineering projects in seventeenth-century France through the development of the postal system in nineteenth-century Britain to the relations between the state and roadbuilding in contemporary Peru, for example. The colonial contexts examined are similarly varied, ranging from the role of photographic practices in the constitution of colonial power in India and the measurement of the bodies of the colonized in French colonial practices to the part played by the relations between museums and expeditions in the organization of Australian forms of colonial rule. These specific concerns are connected to major critical re-examination of the limits of the earlier formulations of cultural materialism and the logic of the 'cultural turn'. (Publisher)

**Besky, S. (2016). The future of price: Communicative infrastructures and the financialization of Indian tea. *Cultural Anthropology* 31(1): 4–29. doi:10.14506/ca31.1.02**

Abstract: For more than 150 years, most tea grown on plantations in northeast India has been sold in open-outcry auctions in Kolkata. In this essay, I describe how, in 2009, the Tea Board of India, the government regulator of the tea trade, began to convert auctioning from a face-to-face outcry process to a face-to-computer digital one. The Tea Board hoped that with the implementation of digital technologies, trade would soon revolve around the buying and selling of futures contracts, not individual lots of tea. Despite these efforts, the tea industry has thus far resisted all attempts at financialization. That so prominent a commodity as tea has yet to be financialized provides a unique opportunity to examine the *how* of financialization—the governmental and technical steps that precede futures and other kinds of derivatives markets. Futures markets rely on a standardized notion of price and of the material things being priced. The story of Indian tea's resistance to financialization shows how such standardization requires not just a disentangling of commodities at the level of productive infrastructure (that is, the separation of individual trader and thing being traded) but also a reworking of the communicative infrastructure of trading. In this essay, I analyze this reworking by examining the effort to reform how tea is priced at auction. Specifically, I describe a transition in tea valuation from socially embedded price stories to standardized price scenarios.

**Guldi, J. (2012). *Roads to Power: Britain Invents the Infrastructure State*. Cambridge, MA: Harvard University Press.**

Description: *Roads to Power* tells the story of how Britain built the first nation connected by infrastructure, how a libertarian revolution destroyed a national economy, and how technology caused strangers to stop speaking. In early eighteenth-century Britain, nothing but dirt track ran between most towns. By 1848 the primitive roads were transformed into a network of highways connecting every village and island in the nation—and also dividing them in unforeseen ways. The highway network led to contests for control over everything from road management to market access. Peripheries like the Highlands demanded that centralized government pay for roads they could not afford, while English counties wanted to be spared the cost of underwriting roads to Scotland. The new network also transformed social relationships. Although travellers moved along the same routes, they occupied increasingly isolated spheres. The roads were the product of a new form of government, the infrastructure state, marked by the unprecedented control bureaucrats wielded over decisions relating to everyday life. Does information really work to unite strangers? Do markets unite nations and peoples in common interests? There are lessons here for all who would end poverty or design their markets around the principle of participation. Guldi draws direct connections between traditional infrastructure and the contemporary collapse of the American Rust Belt, the decline of American infrastructure, the digital divide, and net neutrality. In the modern world, infrastructure is our principal tool for forging new communities, but it cannot outlast the control of governance by visionaries.

Joyce, P., & C. Mukerji (2017). *The state of things: State history and theory reconfigured. Theory and Society* 46(1): 1–19. doi:10.1007/s11186-017-9282-6

Abstract: This article looks at the relationship between logistical power and the assemblages of sites that constitute modern states. Rather than treating states as centralizing institutions and singular sites of power, we treat them as multi-sited. They gain power by using logistical methods of problem solving, using infrastructures to enforce and depersonalize relations of domination and limit the autonomy of elites. But states necessarily solve diverse problems by different means in multiple locations. So, educating children is not continuous with governing colonies even though both are necessary to nineteenth-century states. For this reason, states use logistical means of coordination to link sites, and they make the power of the state seem unitary even though the exercise of state power is not.

Notes: The argument begins with a Weberian principle linking the state to impersonal functioning and use. The article hints at many kinds of infrastructure: engineering infrastructures that linked places and territories; the ‘physical presence of states in territorial infrastructures, military weaponry, agency archives, and post offices [which] give it a palpable presence and identifying features’ (2); knowledge infrastructures (maps, surveys, testimonies) (territorial and knowledge infrastructures, which were necessarily co-constitutive, creating dual sites and practices of power. Knowledge infrastructures were also used to control the patrimonial patterns of existing elites and the legal bases of elite power. Political identities were forged through public architecture, squares, public art and transport infrastructure. These were all ways in which material infrastructures were configured as forms of logistical power.

Leighninger, R. D., Jr. (1996). *Cultural infrastructure: The legacy of New Deal public space. Journal of Architectural Education* 49(4): 226–236. doi:10.1080/10464883.1996.10734689

Abstract: The agencies of the Franklin D. Roosevelt administration had an enormous and largely unrecognized role in defining the public space we now use. In a short period of ten years, the Public Works Administration, the Works Progress Administration, and the Civilian Conservation Corps built facilities in practically every community in the country. Most are still providing service half a century later. It is time we recognized this legacy and attempted to comprehend its relationship to our contemporary situation.

Marklund, A., & M. Rüdiger (Eds.) (2017). *Historicizing Infrastructure*. Aalborg, DK: Aalborg University Press.

Description: How does one handle a concept like ‘infrastructure’, which seems, simultaneously, so vague and yet heavily technical? In this international research volume, nine historians and cultural researchers from different academic institutions delve into the historical dimensions of infrastructural development. The interplay of infrastructures with society and its dominant political ideas and cultural beliefs is at the core of the analyses. A wide range of topics and historical contexts are covered by the book, from nineteenth-century railroads and territorial identities, and the sonic features of pneumatic tube systems, to privacy and security issues in relation to modern telecommunications, and the materiality of satellite television at the end of the Cold War.

Wray, I. (2019). *No Little Plans: How Government Built America’s Wealth and Infrastructure*. Abingdon, Oxfordshire; New York, NY: Routledge.

Abstract: Is planning for America anathema to the pursuit of life, liberty and happiness? Is it true, as ideologues like Friedrich Von Hayek, Milton Friedman, and Ayn Rand have claimed, that planning leads to dictatorship, that the state is wholly destructive, and that prosperity is owed entirely to the workings of a free market? To answer these questions Ian Wray’s book goes in search of an America shaped by government, plans and bureaucrats, not by businesses, bankers and shareholders. He demonstrates that government plans did not damage American wealth. On



the contrary, they built it, and in the most profound ways. In three parts, the book is an intellectual roller coaster. Part I takes the reader downhill, examining the rise and fall of rational planning, and looks at the converging bands of planning critics, led on the right by the Chicago School of Economics, on the left by the rise of conservation and the ‘counterculture’, and two brilliantly iconoclastic writers—Jane Jacobs and Rachel Carson. In Part II, eight case studies take us from the trans-continental railroads through the national parks, the Federal dams and hydropower schemes, the wartime arsenal of democracy, to the postwar interstate highways, planning for New York, the moon shot and the creation of the internet. These are stories of immense government achievement. Part III looks at what might lie ahead, reflecting on a huge irony: the ideology which underpins the economic and political rise of Asia (by which America now feels so threatened) echoes the pragmatic plans and actions which once secured America’s rise to globalism.

## Governance and state infrastructures

**Addie, J.-P. D., M. R. Glass, & J. Nelles (2020). Regionalizing the infrastructure turn: A research agenda. *Regional Studies, Regional Science* 7(1): 10–26. doi:10.1080/21681376.2019.1701543**

Abstract: An interdisciplinary ‘infrastructure turn’ has emerged over the past 20 years that disputes the concept of urban infrastructure as a staid or neutral set of physical artefacts. Responding to the increased conceptual, geographical and political importance of infrastructure—and endemic issues of access, expertise and governance that the varied provision of infrastructures can cause—this intervention asserts the significance of applying a regional perspective to the infrastructure turn. This paper forwards a critical research agenda for the study of ‘infrastructural regionalisms’ to interrogate: (1) how we study and produce knowledge about infrastructure; (2) how infrastructure is governed across or constrained by jurisdictional boundaries; (3) who drives the construction of regional infrastructural imaginaries; and (4) how individuals and communities differentially experience regional space through infrastructure. Analysing regions *through* infrastructure provides a novel perspective on the regional question and consequently offers a framework to understand better the implications of the current infrastructure moment for regional spaces worldwide.

**Badenoch, A., & A. Fickers (2010). *Materializing Europe: Transnational Infrastructures and the Project of Europe*. London: Palgrave Macmillan UK. doi:10.1057/9780230292314**

Abstract: This book explores the relationships between European integration and material infrastructures. Taking transnational infrastructures as the focal point of study, the book focuses on the various forms of mediation between the material, institutional and discursive levels of European integration and fragmentation in a truly transnational perspective. Transnational infrastructures have long been an integral part of projects to unite Europe. From the first ceremonial train of the European Coal and Steel Community to the new border signs that have replaced checkpoints along motorways, such technologies of connection have served as powerful symbols of European unification. In interpreting infrastructures as mediating interfaces of European projects, this book aims to analyze the complex histories of network technologies in their material, institutional and symbolic performances. Taking material networks as the focal point of study allows the authors to tell a truly transnational history, broadening fruitfully our perspectives on a number of historical narratives. It expands the time frame for exploring European integration by pointing to the longer processes of international connection and co-operation. These broadened spatial and temporal horizons allow to de-centre the processes of formal integration surrounding the EU after WWII to reveal a broader range of actors and forces in European history.

**Conley, M., & J. Shefner (2020). Infrastructures of repression and resistance: How Tennesseans respond to the immigration enforcement regime. *Ethnic and Racial Studies* 43(1): 161–179. doi:10.1080/01419870.2019.1667513**

Abstract: This paper addresses challenges faced by immigrants in two Tennessee locales, Nashville and Knoxville, focusing on Latino immigrant communities and the institutions to which they have responded during the period spanning the 2005 passage of the Sensenbrenner Bill and the Trump administration. We examine how the K-12 school system has reacted to draconian legislation and review the ways in which law enforcement affects the lives of immigrants and their children. We also investigate ways in which immigrants have circumvented or embraced political mobilization, responding to barriers and seizing occasional opportunities.

Notes: No explicit theorisation of infrastructures. Mention of immigrants' rights and activist infrastructures that have developed in Tennessee. The repressive infrastructures include anti-immigration laws and practices (e.g., policing and education) operating in the state that are principally aimed at Latinos. Conley's work is on 'movement infrastructures'—she has a book on immigrant rights in the *Nuevo* South.

**DeNardis, L. (2012). Hidden levers of Internet control: An infrastructure-based theory of Internet governance. *Information, Communication & Society* 15(5): 720–738. doi:10.1080/1369118X.2012.659199**

Abstract: Battles over the control of information online are often fought at the level of Internet infrastructure. Forces of globalization and technological change have diminished the capacity of sovereign nation states and media content producers to directly control information flows. This loss of control over content and the failure of laws and markets to regain this control have redirected political and economic battles into the realm of infrastructure and, in particular, technologies of Internet governance. These arrangements of technical architecture are also arrangements of power. This shift of power to infrastructure is drawing renewed attention to the politics of Internet architecture and the legitimacy of the coordinating institutions and private ordering that create and administer these infrastructures. It also raises questions related to freedom of expression in the context of this increasing turn to infrastructure to control information. This article explores the relationship between governance and infrastructure, focusing on three specific examples of how battles over content have shifted into the realm of this Internet governance infrastructure: the use of the Internet's domain name system for intellectual property rights enforcement; the use of 'kill-switch' approaches to restrict the flow of information; and the termination of infrastructure services to WikiLeaks. The article concludes with some thoughts about the implications of this infrastructure-mediated governance for economic and expressive liberties.

**Dodson, J. (2017). The global infrastructure turn and urban practice. *Urban Policy and Research* 35(1): 87–92. doi:10.1080/08111146.2017.1284036**

Abstract: This paper assesses the emergence of a global 'infrastructure turn' and its implications for urban scholarship. The global infrastructure turn involves the emergence of a coordinated effort to stimulate infrastructure development at the national and global level via an array of international frameworks. The key elements of this shift are described and explanations are presented, which are founded in the working out of contradictions within global capitalist urbanization. The need for urbanists to attend to the global infrastructure turn is emphasised, and a set of elements to which attention must be given—discourse, technical practices and politics—is described. The paper concludes by arguing for greater attention to the global infrastructure turn by urban scholars.

Notes: Australia as infrastructure governance pioneer: 'In Australia infrastructure as a specific category of government interest was not a major focus of government until 2007. Prior to the

election of the Rudd Labor government in that year infrastructure had typically been handled via sectoral portfolios, such as transport, energy or water. The Rudd Labor government established the Infrastructure Australia agency which took responsibility for providing a national policy perspective on infrastructure planning and financing, including harmonisation of business case models and a priority infrastructure list' (88).

Argues the need to consider infrastructure practices critically in three areas: infrastructure discourse, infrastructure instrumentalities (technical practices) and infrastructure politics.

**Gallais, C., & E. Filiol (2017). Critical infrastructure: Where do we stand today? A comprehensive and comparative study of the definitions of a critical infrastructure. *Journal of Information Warfare* 16(1): 64–87. <https://www.jstor.org/stable/26502877>**

Abstract: The concept of 'critical infrastructure' has become a key issue as far as the cyber dimension is concerned. All industrialized nation-states that depend on information and communication technologies have defined this concept or established a list of critical sectors to identify their critical infrastructures. Despite the high number of definitions, none of them considers a realistic view of a critical infrastructure as it tends to be reduced to its simple computerized dimension. The survey of definitions of critical infrastructure presented in this paper highlights the omissions in these definitions. This paper suggests the need for a new definition of critical infrastructure—a definition which includes the missing elements identified herein.

**Hall, J. H., M. Tran, A. J. Hickford, & R. J. Nichols (Eds.) (2016). *The Future of National Infrastructure: A System-of-Systems Approach*. Cambridge: Cambridge University Press.**

Description: Infrastructure forms the economic backbone of modern society. It is a key determinant of economic competitiveness, social well-being and environmental sustainability. Yet infrastructure systems (energy, transport, water, waste and ICT) in advanced economies globally face serious challenges. For the first time, a leading team of researchers sets out a systematic approach to making long-term choices about national infrastructure systems. Great Britain is used as a case study to demonstrate how the methodologies and accompanying models can be effectively applied in a national infrastructure assessment. Lessons and insights for other industrialised nations and emerging economies are highlighted, demonstrating practical scenarios for delivering infrastructure services in a wide range of future socio-economic and environmental conditions. *The Future of National Infrastructure* provides practitioners, policy-makers, and academics with the concepts, models and tools needed to identify and test robust, sustainable, and resilient strategies for the provision of national infrastructure. (Publisher)

Note: Seems to be restricted to physical infrastructure.

**Joyce, P., & C. Mukerji (2017). The state of things: State history and theory reconfigured. *Theory and Society* 46(1): 1–19. doi:10.1007/s11186-017-9282-6**

Abstract: This article looks at the relationship between logistical power and the assemblages of sites that constitute modern states. Rather than treating states as centralizing institutions and singular sites of power, we treat them as multi-sited. They gain power by using logistical methods of problem solving, using infrastructures to enforce and depersonalize relations of domination and limit the autonomy of elites. But states necessarily solve diverse problems by different means in multiple locations. So, educating children is not continuous with governing colonies even though both are necessary to nineteenth-century states. For this reason, states use logistical means of coordination to link sites, and they make the power of the state seem unitary even though the exercise of state power is not.

**O'Neill, P. M. (2010). Infrastructure financing and operation in the contemporary city. *Geographical Research* 48(1): 3–12. doi:10.1111/j.1745-5871.2009.00606.x**

**Abstract:** The provision of large economic infrastructure in Australian cities is widely seen to be in crisis. This paper examines the reasons why crisis has arisen in the urban infrastructure sector and what might be done to redress this. The analysis and the argument are based on a resuscitation of the ideas and ideals of infrastructure provision and how these have been eroded. The paper shows how these ideas/ideals once underpinned the formulation of state role, governance and regulation systems, financial arrangements, and even community need and expectation. Critical to this was an acceptance of the ideals of universality, access, bundling and free positive externalities, and the belief that these should be assembled necessarily as part of any urban infrastructure roll-out. This package became instinctive in post-war economic and urban management. Yet this instinct has been lost as governments shift from models of infrastructure provision to infrastructure procurement where a major role for the private sector is now common. While such an involvement has its benefits, there are concerns for the urban condition when privatisation of infrastructure construction, delivery and operation becomes dominant. Citing Graham and Marvin (2001), the paper argues that, where once infrastructure was the key device for integrating the elements of the city and its people, the way it is now being delivered produces a splintered urbanism. There is an urgent need, then, to re-think what infrastructure means in today's urban context and thereafter to re-assess the criteria for deciding what infrastructure is to be provided, in what form it should be provided, who should provide it, who should pay, and who should operate it.

**Ouyang, M. (2014). Review on modeling and simulation of interdependent critical infrastructure systems. *Reliability Engineering & System Safety* 121: 43–60. doi:10.1016/j.res.2013.06.040**

**Abstract:** Modern societies are becoming increasingly dependent on critical infrastructure systems (CISs) to provide essential services that support economic prosperity, governance, and quality of life. These systems are not alone but interdependent at multiple levels to enhance their overall performance. However, recent worldwide events such as the 9/11 terrorist attack, Gulf Coast hurricanes, the Chile and Japanese earthquakes, and even heat waves have highlighted that interdependencies among CISs increase the potential for cascading failures and amplify the impact of both large and small scale initial failures into events of catastrophic proportions. To better understand CISs to support planning, maintenance and emergency decision making, modeling and simulation of interdependencies across CISs has recently become a key field of study. This paper reviews the studies in the field and broadly groups the existing modeling and simulation approaches into six types: empirical approaches, agent based approaches, system dynamics based approaches, economic theory based approaches, network based approaches, and others. Different studies for each type of the approaches are categorized and reviewed in terms of fundamental principles, such as research focus, modeling rationale, and the analysis method, while different types of approaches are further compared according to several criteria, such as the notion of resilience. Finally, this paper offers future research directions and identifies critical challenges in the field.

**Sage, D., P. Fussey, & A. Dainty. (2015). Securing and scaling resilient futures: Neoliberalization, infrastructure, and topologies of power. *Environment and Planning D: Society & Space* 33(3): 494–511. doi:10.1068/d14154p**

**Abstract:** In this paper we explore the scaling of resilience policy and practice not as an effect upon infrastructure but as enacted *through* infrastructure. Drawing on Foucault's topological analyses of governmental power, especially his elaboration of its coeval centripetal *and* centrifugal flows, we argue that understanding the scaling of resilience policy and practice involves acknowledging its infrastructural composition. We examine this infrastructural scaling through an empirical analysis of UK resilience policy and practice, as recounted by those working across multiple organizations involved in planning for, and coping with, aleatory events. This reveals how the neoliberal

decentralizing refrain, expressed in resilience policy and its critique, is both sustained and displaced by interwoven circulatory mechanisms of obstruction, filtration, and acceleration. Together these infrastructural flows amount to ‘fractionally coherent’ scalings that not only centralize governmental power but are constitutive of governmental centres. Our analyses of infrastructural scaling suggest that resiliency policy and practice is far less decentralized, or localized, than others have suggested, with both centripetal *and* centrifugal flows of power resulting from a composite of infrastructural circulatory mechanisms that can variously scale political agency in relation to aleatory events.

Notes: This densely argued paper uses Foucaultian analytics in tracking the use of resilience policy by states. Foucault’s notion of power is topological, constituted by constantly shifting and spatially dispersed relations between differing modes of thought and bodily techniques rather than centralised sovereign or governmental power (498). Resilience can be seen as accompanying a neoliberal order, with its appearance of empowerment accompanied by the evasion of responsibilities by governments and elites (495). Infrastructures, on the other hand, ‘allow policy makers to think and act at a distance by accelerating or obstructing circulations of food, building materials, or information during a shock event, or more subtly filtering the flow of information, money, and materials in emergency planning’ (500). Infrastructure is not simply a material support system; discursively, it serves to modulate the scale of political agency, particularly in crisis situations.

**Turner, C. (2020). *The Infrastructured State: Territoriality and the National Infrastructure System*. Cheltenham, UK: Edward Elgar.**

Description: At the core of the logic of this book is that states engage in infrastructuring as a means of securing and enhancing their territoriality. By positioning infrastructure as a system, there is a presumption that all infrastructures exhibit some degree of mutual dependence. As such, a National Infrastructure System (NIS) is not simply about conventional conceptions of infrastructure based on those that support economic activity (i.e. energy, transport and information) but also about broader hard and soft structures that both enable and are supported by the aforementioned economic infrastructures. Consequently, this book offers an ambitious holistic view on the form of NIS arguing that the infrastructural mandate requires a conception of the state that encapsulates themes from both the competition and the welfare states in infrastructure provision.

Notes: This seems to be a proposal for a national infrastructure system. Turner has also published on global and regional infrastructures. It is not a critical perspective; rather he is concerned with how states can best manage infrastructure needs that are global in scale. Chapter 6 is concerned with social infrastructure.

**Turner, C., & D. Johnson (2017). *Global Infrastructure Networks: The Trans-national Strategy and Policy Interface*. Cheltenham, UK: Edward Elgar.**

Description: Infrastructure represents the core underpinning architecture of the global economic system. Adopting an approach informed by realism, this insightful book looks at the forces for the integration and fragmentation of the global infrastructure system. The authors undertake a thorough examination of the main internationalised infrastructure sectors: energy, transport and information. They argue that the global infrastructure system is a network of national systems and that state strategies exert powerful forces upon the form and function of this system. (Publisher)

**Wegrich, K., G. Kostka, & G. Hammerschmid (Eds.) (2017). *The Governance of Infrastructure*. Oxford; New York: Oxford University Press.**

Description: Infrastructure only tends to be noticed when it is absent, declining, or decrepit, or when enormous cost overruns, time delays, or citizen protests make the headlines. If infrastructure

is indeed a fundamental driver of economic growth and social development, why is it so difficult to get right? In addressing this perennial question, this volume—the fourth edition in an annual series tackling different aspects of governance around the world—makes the case for a governance perspective on infrastructure. This implies moving beyond rational economic analysis of what should be done towards an analysis of the political, institutional, and societal mechanisms that shape decision-making about infrastructure investment, planning, and implementation. Engaging with theories from sociology, political science, and public administration, and drawing on empirical analyses bridging OECD and non-OECD countries, the contributions to this volume dissect the logics of infrastructure governance in a novel way, providing timely analyses that will enrich both scholarly and policy debates about how to get infrastructure governance right. (Publisher)

## **Environmental/Anthropocene infrastructures**

**Hetherington, K. (Ed.) (2019). *Infrastructure, Environment, and Life in the Anthropocene*. Durham: Duke University Press. doi:10.1215/9781478002567**

Description: The contributors chart the shifting conceptions of environment, infrastructure, and both human and nonhuman life in the face of widespread uncertainty about the planet's future.

*Infrastructure, Environment, and Life in the Anthropocene* explores life in the age of climate change through a series of infrastructural puzzles—sites at which it has become impossible to disentangle the natural from the built environment. With topics ranging from breakwaters built of oysters, underground rivers made by leaky pipes, and architecture gone weedy to neighborhoods partially submerged by rising tides, the contributors explore situations that destabilize the concepts we once relied on to address environmental challenges. They take up the challenge that the Anthropocene poses both to life on the planet and to our social-scientific understanding of it by showing how past conceptions of environment and progress have become unmoored and what this means for how we imagine the future.

Notes: The onset (or the awareness) of the Anthropocene leads to a further infrastructural inversion—following Bowker—in which ‘infrastructural inversion is itself inverted, and in which the political stakes of material structures and historical analyses fold into each other’ (8). Hence human infrastructures are supplanted (analytically) by the environmental substates that are produced as unintended consequences of human intervention. Each of the book's chapters ‘describes a moment in which some set of relations switches from environment to infrastructure’ (11). Because ‘environment’ and ‘infrastructure’ have some shared attributes—context, spatial extension, surrounding conditions, interrelationship—there is analytical potential for work between the two.

**Kinder, J. B. (2021). Solar infrastructure as media of resistance, or, Indigenous solarities against settler colonialism. *The South Atlantic Quarterly* 120(1): 63–76. doi:10.1215/00382876-8795718**

Abstract: The ongoing history of settler colonialism is inextricable from the infrastructures of energy and extraction that provide its material foundation. Addressing this inextricable relationship, this article explores how Indigenous solarities in Canada resist extractivism and generate conditions for just energy futures beyond settler colonialism through emergent solar infrastructures. Developing a preliminary theory of Indigenous solarities, this article anchors the author's observations to Lubicon Cree energy justice activist Melina Laboucan-Massimo's Sacred Earth Solar initiative and its two completed projects: the Piitapan Solar Project in Laboucan-Massimo's home community of Little Buffalo, Alberta, Canada, which powers a community health center, and a partnership with the Tiny House Warriors. The Tiny House Warriors is a Secwepemcled movement to construct mobile tiny houses along the path of the Trans Mountain Expansion Pipeline Project. This article's approach is methodologically informed by recent

infrastructural thinking from theorists such as Lauren Berlant and Deborah Cowen who offer an expansive, relational understanding of infrastructure. It is also informed by thinkers such as Myles Lennon and Dagmar Lorenz-Meyer, who respectively see in solar energy infrastructures the possibilities to decolonize energy and to generate a feminist techno-ecological ethos. This article offers a brief account of the historical and contemporary relationship between settler colonialism and infrastructural development in Canada, before providing an overview of three mutually informing frameworks for preliminarily thinking through the materialization of Indigenous solarities: as media of resistance; as expressions of Indigenous feminism; and as expressions of Indigenous futurisms. The article concludes by scaling out from the context of Sacred Earth Solar's emergent infrastructures of Indigenous solarities, connecting these efforts with larger movements of Indigenous resistance and renewable energy infrastructure initiatives. Ultimately, this article argues that Indigenous solarities signify myriad potentialities for reorienting our collective energy imaginaries from scarcity to abundance in ways that foreground Indigenous self-determination against and beyond extractivism.

**Mendelsohn, B. (2014). *Organic Machines*. Public Books, 15 July.**  
<https://www.publicbooks.org/organic-machines/>

Description: Discusses two stylistically dissimilar American artists, photographer Edward Burtynsky and film and performance artist Matthew Barney. What links them is an interest in Anthropocene environments and 'a shared ecological vision tied to an interest in infrastructure, monument, ritual, and deep historical time'. Citing anthropologist Dominic Boyer's question of where 'we go conceptually and theoretically in the Anthropocene', Mendelsohn contends that for Barney and Burtynsky 'infrastructure is also an answer to the question of where we go *aesthetically* in the Anthropocene. Infrastructure allows these artists to confront the paradoxical nature of a geologic epoch defined by human influence—one in which we are in command without being in control' (emphasis in original).

Notes: The term 'organic machines' is taken from Richard White's book 1996 of that name, which details the history of the Columbia River in the Pacific Northwest in terms of conflicting human—Native American and white—and natural claims.

**Parmiggiani, E., E. Monteiro, & V. Hepsø (2015). The digital coral: Infrastructuring environmental monitoring. *Computer Supported Cooperative Work* 24(5): 423–460. doi:10.1007/s10606-015-9233-6**

Abstract: Technologies for collaboration within the oil and gas industry, which are referred to as Integrated Operations, challenge traditional geographical, disciplinary, and organisational boundaries. Fuelled by the availability of sensor networks, faster data transfer technologies, shared data exchange formats, and collaborative workflows, Integrated Operations entail difficult transformations at the technological, social, and political levels. We describe and discuss the efforts of a Scandinavian oil and gas company to develop an information infrastructure for real-time subsea environmental monitoring. This accentuates the ongoing controversy among environmental concerns, fisheries, and the oil and gas industry. Theoretically leaning on infrastructuring and, methodologically, on the concept of infrastructural inversion, our analysis specifically targets the evolution of emergent infrastructures. We identify and discuss the *increasing degree of entanglement of the infrastructuring process over time* by empirically characterizing two concepts: (1) *bootstrapping*, which is particularly pronounced in the early stages of infrastructure evolution and involves exploring the local feasibility of subsea environmental monitoring methods and devices, and (2) *enactment*, which is increasingly present in the later stages of infrastructure evolution to weave environmental information into the agenda of heterogeneous oil and gas professionals.

**Tousignant, N. (2013). Insects-as-infrastructure: Indicating, Project Locustox and the Sahelization of ecotoxicology. *Science as Culture* 22(1): 108–131. doi:10.1080/09505431.2013.776369**

Abstract: Infrastructure, as a potential legacy of transnational scientific collaborations, is usually seen as extrinsic to the immediate production of knowledge. But cumulative collaborative scientific work—what scientists actually do together; the ways in which they act on the world and transform our understanding of it—can also help create durable enabling environments for ongoing scientific practice. Project Locustox began in 1989 as a pilot to evaluate the environmental effect of locust control pesticides in the Sahel. It was prolonged through additional project phases over the next decade; in 1999, a locally-administered permanent ecotoxicological research centre was established in Senegal. Central to this project was the creation of Sahelian bio-indicators. The work of indicating, which was largely performed with and by insects, can be described as enacting infrastructure. Insects formed an axis along which data and expertise were accumulated, and, as a result, they were stabilized as durable tools—as bodies, colonies and the techniques for manipulating them—for future Sahelian ecotoxicology. Considering insects as producing infrastructure invites a reflection on the possibilities and difficulties of scientific capacity-building in the Global South. Specifically, examining the temporal extensions of indicating work leads to an account of how sustained investment in continuous collaborative scientific work can draw together biological entities, techniques, knowledge, materials, working relations and institutions to build durable capacity for science; but insect indicators also reveal the costs of and obstacles to maintaining the integration of methodological, material and institutional components of infrastructure.

Notes: Tousignant lucidly details the infrastructural connections between insects, the scientific project and the indicators that are generated, and the general prospects of the science being able to be adequately funded and to make a difference in the Sahel.

**Wakefield, S. (2018). Infrastructures of liberal life: From modernity and progress to resilience and ruins. *Geography Compass* 12(7): e12377, 14 pp. doi:10.1111/gec3.12377**

Abstract: Whereas until recently, the topic of infrastructure was practically invisible, studies of the spaces, landscapes, and geographies of infrastructure now abound, and for many critical thinkers, infrastructure has become perhaps the political question of the Anthropocene. This review traces two distinct but related paradigms of liberal governmentality and infrastructure, the first, modern infrastructure and its project of mastery and order, and the second, contemporary paradigm of infrastructures of resilience, ruins, and survival. Through this review, I also trace a story of the crisis or dislocations of liberal thought and practice underway as what we now refer to as the Anthropocene. Exploring this crisis and its responses through the lens of infrastructure, I suggest, offers new ideas for other ways to move forward amidst the splinters of the present, and I conclude with some remarks on the political possibilities inherent in both critical infrastructure studies and resilient infrastructures themselves.

Notes: With considerations of climate crisis and the thematisation of the Anthropocene, the definition of infrastructure itself is undergoing further transformation, as we negotiate living in the infrastructural ‘ruins’ of modern life. For Wakefield, nature should now be framed as the primary ‘critical infrastructure’, prompting a shift beyond the ‘brick and mortar past’ to focus on ‘self-organizing and data-sharing human communities’ (6/14) as social or human infrastructural systems aimed at developing resilient responses. She follows Mattern’s (2016) call to promote a ‘grassroots ... infrastructural intelligence’ that views infrastructure as ‘manipulable and hackable’, producing ‘cognition, engagement, a sense of “ownership”, and, most promisingly, technical competence and “emancipation”’ (8/14).



## Cultural infrastructure

**Altman, J. (2007). Art Business: The Indigenous Visual Arts Infrastructure. In H. Perkins & M. West (Eds.), *One Sun One Moon: Aboriginal Art in Australia* (pp. 43–50). Sydney: Art Gallery of New South Wales.**

Notes: Altman describes the ‘intercultural infrastructure’ (49) of Indigenous art —particularly the art centres serving mainly remote communities, which professionally collect, document and market indigenous art. Art centres are ‘cultural mediating institutions’ (43), “hybrid organisations, at once cultural and commercial, local and global — operating between two worlds.” (46) Indigenous art requires brokering institutions that are ‘both intercultural and hybrid’ (49), bridging Indigenous and non-Aboriginal processes.

**Bell, D., & L. Orozco (2021). Neighbourhood arts spaces in place: Cultural infrastructure and participation on the outskirts of the creative city. *International Journal of Cultural Policy* 27(1): 87–101. doi:10.1080/10286632.2019.1709059**

Abstract: Set in the context of tensions between ‘community development’ and ‘creative cities’ policy agendas, which often implicitly privilege large-scale city-centre cultural assets, this paper discusses cultural policy and arts provision in three neighbourhoods in the city of Leeds, UK. It uses findings from a pilot research project centred on three small cultural organisations based in neighbourhoods in Leeds’ ‘outer inner city’. Each venue works in and with its neighbourhood in distinct ways and has a different vision of the contribution that they can and should make to their locales and to the city as a whole. The paper works with research on these organisations to explore the tensions around the ambition and reach of small venues in the light of this policy context, and the scale of the neighbourhood in cultural policy. We argue that city-scale policy-making risks missing local particularities and erasing the role and contribution of small and geographically peripheral initiatives.

Notes: On the Donut project in Leeds: mapping provides accessible and impactful knowledge which is useful for stakeholders and researchers who share a desire to ‘critique the distribution of governmental resources, and more deeply challenge problematic assumptions about “more or less creative” places, industries, and people’ (93). On the contrary, the authors recommend paying more attention to the microgeography of outer-urban cultural ecologies rather than the urban scale of policy and planning focused on large venues as infrastructure.

**Bennett, T., & P. Joyce (Eds.) (2010). *Material Powers: Cultural Studies, History and the Material Turn*. London; New York: Routledge.**

Description: This edited collection is a major contribution to the current development of a ‘material turn’ in the social sciences and humanities. It does so by exploring new understandings of how power is made up and exercised by examining the role of material infrastructures in the organization of state power and the role of material cultural practices in the organization of colonial forms of governance. A diverse range of historical examples is drawn on in illustrating these concerns—from the role of territorial engineering projects in seventeenth-century France through the development of the postal system in nineteenth-century Britain to the relations between the state and roadbuilding in contemporary Peru, for example. The colonial contexts examined are similarly varied, ranging from the role of photographic practices in the constitution of colonial power in India and the measurement of the bodies of the colonized in French colonial practices to the part played by the relations between museums and expeditions in the organization of Australian forms of colonial rule. These specific concerns are connected to major critical re-examination of the limits of the earlier formulations of cultural materialism and the logic of the ‘cultural turn’. (Publisher)

**Bingham-Hall, J. (2020). Infrastructures within infrastructure: Cultural production in London's railway arches. *Faktur* 3: 55–69.**  
<https://www.researchgate.net/publication/348447594>

Description: This is a story grappling with big definitions—culture and its infrastructures—as they touch ground and take form in small ways, in one backstreet of one neighborhood in London. Like all stories about the connections between things, it is one without a clear beginning or end, in time or in space. But if we must choose a moment to start, then it is with the invention of the steam engine and its use for rail transport. And if we take our present moment as the end, then the conclusion of the story lies in the ways different ecologies of productive activity have found and made different kinds of space within one railway structure in Elephant and Castle, in London, in 2019. The story is about the way one kind of infrastructure creates the conditions within which others can grow, and how the same infrastructures can produce very different outcomes, depending upon who is using them. We are talking here about *cultural* infrastructure: not a specific set of *things*, but an approach to urban planning focused on supporting the cultural life of a city. Of course, defining culture is fraught with problems. Spatial and economic development strategies for cities are often driven by predefined ideas about what culture should be—creative districts full of galleries, shops, cafés, and global cultural institutions that resemble one another the world over. The point of this story is to show that an infrastructural approach could provide the enabling conditions for culture's *production*, without needing to predefine what culture *is*. The moral of this story, if there can be one, is that an infrastructural approach means always looking underneath, behind, and around in order to find out what makes things work.

**Bingham-Hall, J., & Kaasa (2017). *Making Cultural Infrastructure*. London: Theatrum Mundi CIO. <https://researchonline.rca.ac.uk/4614/>**

Abstract: *Making Cultural Infrastructure* starts from an argument that artistic cultures are produced in different modes, impacted in distinct ways by the conditions created by the city. Typologies, networks, economies and infrastructural conditions of urban space create sets of possibilities and constraints that affect the way artists work, and thus the kind of public cultural realm that the city can support. To examine this argument, the report is divided into three sections: Inhabiting Cultural Infrastructure; Designing Cultural Infrastructure; and Conceptualising Cultural Infrastructure.

Inhabiting Cultural Infrastructure investigates three distinct realms of artistic and cultural production: performative, material, and virtual. The research brought together three workshops each convening a set of practitioners defined primarily by one of these modes of work. The focus was on the spatial or infrastructural settings in which the labour of production and development itself takes place, though evidently public-facing institutions featured as far as they are elements in shaping the experience of this labour, and a public language of value. Three sets of conditions affecting the use of production spaces are identified. Firstly, the importance of the immediate architectural qualities of spaces for artistic production. By this we mean whether spaces are visible or audible to or from the public realm; the degree to which spaces can be made messy and inhabited with a personal archive from which to work; and, if in these spaces people work alongside or separate from one another. These kinds of qualities are described as the material conditions of cultural infrastructure, and often remain invisible in city-wide strategies that guide the geographical conditions of new production spaces through distributional planning. Material conditions of artistic production spaces are key to the kind of work they can support, and could hypothetically be guided through planning conditions for cultural infrastructure. Secondly, attention was drawn to the conditions around spaces for artistic production. Conditions such as whether their immediate urban environments are noisy and messy or quiet and sanitised; the density and typology of other nearby commercial and cultural activities; and how they relate to other infrastructures such as housing or transport. These are described as ecological conditions, relating to the way cultural production is understood to be part of and reliant on a network of

flows of materials, people, and activities in the city. Finally, the issue was raised of thinking about the way ideals and regulations are applied to spaces for cultural production, in terms of labour protections or minimum pay. The shaping of these immaterial conditions relate to the role applied to cultural production at a societal level: whether it is seen as a professional or an amateur activity, for example. Together, the workshops demonstrated the necessity to think about the relationships between these sets of conditions when positioning cultural infrastructure as a political and planning priority in the city.

Designing Cultural Infrastructure centres on four hypothetical propositions put forward respectively by the architecture practices Assemble, DSDHA, We Made That, and Haworth Tompkins. We challenged each practice to propose a design approach to cultural infrastructure in response to the evidence-based working paper emerging from the workshops. Overwhelmingly, their tactics were to create planning guidelines or strategies that could play out across the city, rather than to focus on specific forms of space or architecture. For example, one proposition suggested a required 10% redundant, unprogrammed space in all new buildings over a certain size. This slack space could allow for multiple kinds of unforeseen cultural production to take place alongside the intended uses of those buildings, which in turn could shape the particular material and ecological conditions created by those uses. We argue that a non-performative cultural urbanism increases the possibility for artistic creation without mobilising its products for the kind of culture-led placemaking that has been associated with some of the destructive aspects of urban regeneration.

A Language for Cultural Infrastructure builds a framework from the issues raised in *Inhabiting Cultural Infrastructure* and responded to in *Designing Cultural Infrastructure*. It intends to stimulate critical thinking in design and planning strategies supporting cultural production. We argue that conversations around the way infrastructure is provided need a diversified terminology to account for the implications of the social, cultural, and political conditions created by different conditions brought about through design and planning. We propose four broad concepts that contain within them productive tensions. Value refers to whether cultural production is seen as craft or labour. Stability highlights the degree to which infrastructures are temporary or permanent. Determinacy asks whether infrastructures are adapted from found space or purpose-built. Visibility addresses the level of publicness or privacy that cultural production operates within. The way each of these tensions is managed within the provision of cultural infrastructure suggests different design strategies, and has different implications for the kinds of political, economic, and social conditions it creates.

Notes: This provides a thorough examination of artistic and cultural infrastructure in terms of three domains, the performative, material and virtual, based on workshops with practitioners. A bottom-up planning process that can identify interrelated processes, practices, resources, regulations, etc. could yield strong strategies of ‘culture-led placemaking’.

**Blommaert, J. (2014). Infrastructures of superdiversity: Conviviality and language in an Antwerp neighborhood. *European Journal of Cultural Studies* 17(4): 431–451. doi:10.1177/1367549413510421**

Abstract: This article develops an ethnographic approach to ‘linguistic landscapes’, applied to an inner-city neighborhood in Antwerp (Belgium). Linguistic landscapes are arrays of public signs, linguistic as well as non-linguistic, and range from shop windows and professional billboards to handwritten signs and announcements. An ethnographic approach to linguistic landscapes brings out the complexities of superdiverse arenas, such as those of inner-city Antwerp. In the neighborhood examined here, signs index processes of demographic, social and economic change involving older residential immigrants moving up the social ladder because of new, real-estate and commercial opportunities created by the influx of more recent transient migrants as well as of more affluent native Belgian inhabitants. We see how the use of languages, notably of a lingua

franca, 'oecumenical' variety of Dutch, contributes to the perpetual shaping and re-shaping of an infrastructure for superdiversity: a space in which constant change and motion are the rule, in which complexity and unpredictability are rife, but within which important forms of conviviality are being articulated and sustained by means of language choice and language display.

Notes: This paper doesn't directly discuss the theory of infrastructure, but its analysis of a superdiverse neighbourhood shows the social, cultural and linguistic tools, logics, places, etc. that enable social exchange.

'Infrastructure is iconic of the area for which it functions. If the aggregate community is complex and dynamic, so will the infrastructure be. There is not one infrastructure in the neighborhood, there are several overlapping and complementary ones. The neighborhood in its totality can be seen as a complex of infrastructures for superdiversity, and all sorts of delicate interactions and relationships are constructed in and through these infrastructures. This infrastructural dimension, in fact, is probably the 'order' in the 'chaos' of the neighborhood. It is the complex logic that ties together the seemingly incoherent dynamics of the place, the apparently contradictory forces that operate on it and the absence of uniformity it displays' (446). In particular, 'oecumenical Dutch' functions as a lingua franca that can be easily learned. The main source of the approach to infrastructure is Simone's anthropological work in South Africa.

**Bryson, J. R. (2007). Arts, dance, cultural infrastructure, and city regeneration: Knowledge, audience development, networks, and conventions, and the relocation of a Royal Ballet company from London to Birmingham. *Norsk Geografisk Tidsskrift/Norwegian Journal of Geography* 61(3): 98–110. doi:10.1080/00291950701553848**

Abstract: The development of new cultural infrastructure has long been part of the urban regeneration toolkit. Cultural infrastructure is incorporated into major urban regeneration projects as part of a proactive entrepreneurial approach to planning designed to enhance a city's overall image. The existing literature on cultural industries concentrates on exploring film and contemporary music and ignores dance. The article explores the development of ballet in England from the 1920s and the relocation in 1990 of one of England's Royal Ballet companies from London to Birmingham. These events required investments in hard cultural infrastructure (provision of facilities, e.g. theatres) and soft cultural infrastructure (audience development). The development of new hard cultural infrastructure must be supported by a process of audience development and knowledge brokers. The establishment of ballet in England and the relocation of Sadler's Wells Royal Ballet (SWRB) to Birmingham were contingent on the articulation of networks of individuals, resources and institutions that had the power and resources to facilitate these developments. The analysis highlights the interplay existing between local and national policies and the ways in which the local can mobilize elites and others to shape the artistic and cultural character of a city.

Notes: This piece may be useful in tracing the hard/soft distinction in cultural infrastructure theory. Of course, the argument is that the two are interrelated, and that investment is required for both. Here soft infrastructure seems to be related only to audience development—at least in the case of the Royal Ballet moving to Birmingham—a shortcoming where cultural infrastructure is seen basically as a site of cultural output. However, 'softer' elements are said to include 'urban cultures, cultural infrastructure and concentrations of creativity and expertise' (98). The whole case is also framed in relation to urban regeneration—citing Florida as usual. Hence, there are actually layers of infrastructure that aren't considered as infrastructure: 'Central to this relationship are the interactions that occur between soft and hard cultural infrastructural investments and, in particular, the tacit and codified knowledge that is acquired by dancers as well as dance audiences. Part of this analysis highlights the interplay that exists between local and national policies and the ways in which the local can mobilize elites, politicians, artists, and others to shape the artistic and cultural character of a city' (109).

Bryson manages to keep the infrastructure discourse within the economic frame and the question of investments, while still considering the human elements, by equating hard infrastructure with capital and soft infrastructure with resource investment. These have a different temporal character: 'These investment types have different temporalities; hard capital investments can occur relatively rapidly, are extremely visible and easily evaluated, whilst soft revenue investments occur over long time periods, represent a process of performer and audience development, are relatively invisible, and are difficult to evaluate' (99).

**Castellote, J., & T. Okwuosa (2020). Lagos art world: The emergence of an artistic hub on the global art periphery. *African Studies Review* 63(1): 170–196. doi:10.1017/asr.2019.24**

Abstract: The global geography of art has changed greatly in recent years. Whereas global art hubs were formerly found only in the West, they now exist in locations all over the world, including Africa. Though some art worlds in Asia and Latin America have been studied in recent times, there is insufficient empirical data on art worlds in Africa. This is a study of the Lagos art world, which shows how an 'art system,' with all of its attendant structures and agents, has emerged in the city of Lagos, Nigeria, in the last few years. Lagos reflects the dynamics of globalization and is building up the art infrastructure and the critical mass needed for a sustainable art world: an ambitious and fast-growing group of young local collectors, an art fair, an international photography festival, regular art auctions, new art galleries, historical and critical publications, a university art museum, symposiums, art foundations, residencies, and competitions. Lagos is becoming not only a 'global city,' but also a 'global art hub.'

Notes: Not much theorisation of infrastructure although interesting to see the components of an art hub within a global system. Uses Becker's 'art worlds' and DeLanda's assemblages to conceptualise this study of art in Lagos. Elements of an 'art system' (Luhmann's term) exist: a Biennale founded in 1989 brought 'knowledge of self, the opening up of knowledge within its formative boundaries, while at the same time keeping its sanctity' (172, citing Ugiomoh 2017); a small but vibrant art market, sustained largely by local patronage. Lagos had the most advanced art scene compared with other cities in Nigeria and also in central Africa, fuelled by wealth generated by 1980s structural adjustment packages. Critical debates around aesthetics and politics could take place; a group of artists under the banner of the Natural Synthesis ideology were able to create works that were reflective of global trends in contemporary art. Strong aesthetic interventions ensured the viability of contemporary art. Young artists produced an exhibition in 2001, *New Energies*, that was able to change the conception of art in Nigeria. Daring interventions were made in areas such as installation art, photography and performance art that were compatible with global trends, that is, 'a post-conceptual turn towards relational and site-specific aesthetics, materialization of installation as an art form, and the acceptance of photography and performance art as valid forms of contemporary production' (183, citing Rojas-Sotelo).

The constituents of an art world (Becker) are 'the result of the theory and practice of its main agents—personal, academic, corporate, institutional, and commercial—and the structures in which they operate. A multiplicity of people and institutions share that space: artists, dealers, gallery owners, historians, private and institutional collectors, critics, curators, journalists, art philosophers, cultural agents, auction houses, museums, biennials, art fairs, art foundations, art competitions and awards, cultural policy makers and administrators, art investors, companies, foreign cultural institutions, and a fast-growing presence on social media and the Internet' (183–4). Lagos has the largest number of artists in Nigeria, well-developed artist training (although more focussed on technical than critical practice), strong commercial galleries including contemporary art galleries, and a strong primary and secondary (resale) art market. Lagos is a 'global city', in the second order of cities behind Johannesburg. Lagos is still peripheral to the global art world but is a recognised art hub in the Global South.

**Centner, R. (2020). On not being Dubai: Infrastructures of urban cultural policy in Istanbul & Beirut. *International Journal of Cultural Policy* 26(6): 722–739. doi:10.1080/10286632.2020.1811249**

**Abstract:** This paper compares how Istanbul and Beirut both attempt to underline their cultural and developmental uniqueness today in contrast to a metonymic menace—Dubai, standing in for spectacular yet supposedly cultureless Gulf cities. Even amid their own speculative construction frenzies that threaten local heritage, Turkish and Lebanese city-shapers assert theirs are ‘real’ cities because they have ‘civilization’ and ‘history’. By addressing their own efforts to build, defend, or oppose physical infrastructures related to local urban culture, Istanbul and Beirut rely on and reassert strategic, phatic discourses that frequently reference Gulf cities as counterpoint. Analysis focuses on how each city crafts a distinctive urban profile via civilizational appeals to historic senses of culture, inflecting infrastructural developments related to bridging (Istanbul) and bordering (Beirut). Historical truisms are deployed with marked flexibility to showcase these cities as ‘not Dubai’. This study offers lessons on the particular worlding of Middle Eastern cities and the role of discourses in the material-symbolic infrastructure of implicit urban cultural policy.

**Chattopadhyay, S. (2012). *Unlearning the City: Infrastructure in a New Optical Field*. Minneapolis: University of Minnesota Press.**

**Description:** Cities are more than concrete and steel infrastructure. But modern urban theory does not have the language to describe and debate the vital component of urban life that is lived on the streets of cities and towns. Swati Chattopadhyay has written a nuanced argument for a new vocabulary of the city in *Unlearning the City*, proposing a way of analyzing the materiality of the urban that captures the ever-changing element of human experience. Urban life is intrinsically messy and usually refuses to conform to the rigid views laid down in much of urban studies theory. Chattopadhyay looks at urban life in India with a fresh perspective that incorporates the everyday and the unstructured. As the first to apply the theories of subalternity for an understanding of urban history, Chattopadhyay provides an in-depth study of vehicular art, street cricket, political wall writing, and religious festivities that link the visual and spatial attributes of these popular cultural forms with the imagination and practices of urban life. She contends that these practices have a direct impact on the configuration and knowledge of public space, and the political potential of the people inhabiting cities. *Unlearning the City* uses the popular culture of Indian cities to question the dominant conception of urban infrastructure and encourage a conceptual realignment in how the city is seen, discussed, and even experienced.

**De Beukelaer, C. (2019). The social and built infrastructure of cultural policy: Between selective popular memory and future plans. *International Journal of Cultural Policy* 25(2): 140–153. doi:10.1080/10286632.2016.1248951**

**Abstract:** The rise of digital music distribution has caused decreasing returns from CD and cassette sales in Burkina Faso and Ghana. In response to this decline in revenues, artists and their management have been trying to find ways to find other sources of income. One major way of doing this has been through focusing on (live) music performance. Yet this requires built and social infrastructures that are not always present, functional, or put to full use. This paper explores how musicians and music workers make sense of the cultural policies that have shaped and will shape the built infrastructure (concert venues, clubs, etc.) they need. Because the complex links between the built and social infrastructures mean that history weighs significantly on future plans, this paper argues that calls for new venues cannot be the solution to the range of existing issues without engaging more thoroughly with the past.

**Notes:** An article on music distribution in West African contexts that supports the idea of the messy nature of cultural infrastructure (both hard and soft), its makeshift and constantly shifting nature, and the extent that it is enmeshed with ‘digital modernity’ as well as being quite material.

The interrelation of hard and soft infrastructures is foregrounded. Hard infrastructure here includes the built venues (or spaces that can act as venues), regulatory environments, transport, street lighting, music education, etc. But the soft infrastructure of music venues includes the capacities and efforts to create makeshift events in the context of decaying urban infrastructure.

**Debroux, T. (2013). Les territoires créatifs: Quelques notions théoriques et une analyse bruxelloise. *Territoire en Mouvement* 19–20(2013): 40–59. doi:10.4000/tem.2128**

Abstract: For over twenty years, artists and cultural activities have been studied in scientific literature, notably in geography. Because of artists' long-established link with cities and the more recent inclusion of artistic activities into urban development policies, these themes can be conceived of as original keys to apprehend contemporary urban dynamics. A variety of concepts have been formalised to describe the spatial distribution of artists, arts institutions or cultural industries in cities. In this paper, I examine the terms used to characterize these spatial distributions and consider three underlying issues. Then I propose a typology of creative spaces, based on the dimensions of artistic activity (production, creation, consumption) and their character of 'spontaneous' or 'planned' developments. Observing how artists and cultural infrastructures are located in Brussels allows us to question empirically the concentration of artistic activity in this particular city. This empirical attempt opens up new research prospects regarding the formation of creative spaces and their role in contemporary dynamics of urban change in Brussels.

Notes: Article in French. This work is a detailed historical geography of art infrastructures in Brussels. These infrastructures are related to the geography of where artists reside. Spaces with high concentrations of residing artists have similar characteristics in terms of town planning: located near the city centre with a mix of bourgeois houses converted into apartments, combined with former factories or warehouses. Buildings often have architectural qualities that are valued by artists such as large spaces, light and quality of materials, in spite of their dilapidated appearance. The article also examines how the mix of cultural facilities animates areas at different times of the day or night.

**Džupka, P., & M. Gróf (2021). The influence of the new cultural infrastructure on residential property prices. Evidence from Košice ECoC 2013. *Cities* 110: 103047. doi:10.1016/j.cities.2020.103047**

Abstract: The European Capital of Culture (ECoC) has become one of the most significant cultural activities in the EU, aiming to change cities through culture. There is still a broad discussion about how to estimate the impact or influence of cultural activities on a city. There are several approaches which evaluate the benefits of cultural activities and cultural infrastructure. This paper presents a unique opportunity to use the hedonic model for impact estimation of new cultural infrastructure built through the project Košice ECoC 2013. The hedonic pricing model was constructed based on 1157 sales of flats between 2010 and 2018. The final hedonic model was constructed to determine the influence of new cultural infrastructure (Kulturpark barracks) on nearby flats prices. According to this model, the flats in this area a year before the renovation did not show any differences from the average flats in other localities. However, from the beginning of the renovation, they presented above-average prices till two years after the reconstruction. After four years the positive impact of the cultural infrastructure disappears, and the price level of the flats returned to the levels before the reconstruction.

Notes: This study refers to Košice in Slovakia, which was nominated as a European Capital of Culture. The article proposes that hedonic regressions used in modelling real estate prices can be of value in determining the effects of cultural infrastructures on gentrification over time.

**Gallan, B. (2015). Night lives: Heterotopia, youth transitions and cultural infrastructure in the urban night. *Urban Studies* 52(3): 555–570. doi:10.1177/0042098013504007**

**Abstract:** This paper adapts the concept of heterotopia to understand youth transitions through spaces of night-time cultural infrastructure. While youth transitions in the urban night have been well theorised, what these transitions mean for diverse cultural infrastructure provision has received less attention. Drawing on ethnography of a local punk music scene in the Australian city of Wollongong, the paper analyses how the scene was connected to one specific venue, an alternative ‘haven’ in a monopolised night-time economy. Participants revealed a trend of repetitive yet relatively fleeting association with the local scene and venue, at times a site of hedonism and celebration but also enabling grief and rites-of-passage. Temporal elements of heterotopia are developed to interpret the venue’s valued sense of ‘difference’ during active participation, but also long after association with the space. Such transitions are poorly understood, especially in planning and policy debate, influencing the way night-time cultural infrastructure is provisioned.

**Gibson, C., C. Brennan-Horley, B. Laurenson, N. Riggs, A. Warren, B. Gallan, & H. Brown (2012). Cool places, creative places? Community perceptions of cultural vitality in the suburbs. *International Journal of Cultural Studies* 15(3): 287–302. doi:10.1177/1367877911433750**

**Abstract:** This article stems from a project examining cultural assets in Wollongong—a medium-sized Australian city with a decentralized *and* linear suburban pattern that challenges orthodox binaries of inner-city bohemia/outer-suburban domesticity. In Wollongong we documented community perceptions of cultural assets across this unusual setting, through a simple public research method. At the city’s largest annual festival we recruited the general public to nominate the city’s most ‘cool’ and ‘creative’ places, by drawing on a map of Wollongong and telling their stories. Hand-drawn maps from 205 participants were combined in a Geographical Information System and 50 hours of stories transcribed for qualitative analysis. Over 2300 places were identified. Among them were some surprising results: although places known for the arts and bohemian creative industries figured prominently, these were not only in the inner-city but in beachside suburbs with unique cultural histories. Also, a range of affective engagements with place, including unconventional forms of creativity, were described in industrial and blue-collar suburbs. Network topology analysis by place of residence also revealed the extent of localism, as well as specializations and aggrandizements among suburbs. Our conclusions are threefold: first, that ‘creativity’ is relationally situated and linked across all parts of the city; second, that decentralized forms of small-scale cultural infrastructure provision are vital for vernacular cultural pursuits; and, third, that ‘creativity’ is a polysemic and contested category—only ever partially revealing the contours of cultural vitality in the suburbs.

**Notes:** ‘Topological analysis of participants’ suburb of residence versus their identification of “cool” and “creative” places revealed that all parts of Wollongong, as well as other proximate towns, are linked functionally through the cultural life of the city. This is not a micro-geography of inner-city milieu; neither is it a story valorizing suburban creativity as somehow distinct. Rather, it reveals how cultural activities and the contours of people’s everyday affective relations to place are networked across city spaces, from central arts precincts to public housing estates, into hinterlands and leafy suburbs, beaches and national parks’ (293). ‘There were numerous examples of vernacular, amateur, unusual and everyday, unheralded creativity: buskers, choir groups, writers’ clubs, community gardens, markets, fire-twirling, belly dancing, linedancing, bluegrass nights, the local hardware megastore...’ (294).

There can be specialisations and contradictions: ‘There was also evidence of specialization in the city—some suburbs were iconic “cool” places at a regional scale, more so than they were “creative” places, and vice versa. North Wollongong—with a historic pub popular with young people, a scenic beach, student sharehouse scene, cafes and nightlife—was a regional-scale “cool” place, drawing people from across the entire city. That pattern was not nearly so clear for its “creative” topology. Bulli, further north, had a network topology featuring a city-wide spread of creative



rather than cool identifications, with the Heritage Hotel (a historic pub now known as the region's "quality" alternative live music venue), the Illawarra Folk Festival (one of Australia's largest), and the Sandon Point tent embassy—a focus of green/Aboriginal/left-wing/anti-development political struggle for well over a decade' (297).

'At another level are opportunities for dialogue with cultural planners about the spatial distribution of cultural infrastructure. Integration of conventional ethnographic methods and spatial information technologies revealed some of the layered geographies of cultural vitality in the city, suggesting a mix of central-city and suburban affiliations, specialization of some suburbs at the city-region scale, and local pride in place—even in suburbs apparently bland to outsiders. ... There is also evidence here that decentralized, small-scale cultural infrastructure—community halls, writers' centres, youth music studios, art spaces—are highly valued and perform an important function in encouraging vitality and creativity' (299).

**Gokhale, C. (2020). Holistic approach for cultural infrastructure with reference to future smart cities. *E3S Web of Conferences* 170: 05002. doi:10.1051/e3sconf/202017005002**

Abstract: To take the initiative of smart cities to new heights is a responsibility of every citizen. Bona fide progress will be seen when people's approach towards their city will change through awareness and education about the prevalent systems. This paper focuses on improving the cultural aspects of a smart city, especially visually, and on improving governance with reference to the 21st century. A majority of the information deals with the must-haves of smart city, later moving on to more specific problems. In the following paper, evaluation, analysis, ideas, innovative solutions along with comparisons and examples from life have been suggested with a view of enhancing the pre-existent, and further developing the cultural infrastructure of a smart city. This is proposed in a way that will help old traditions and historical heritage keep pace with modernism and other urban developments in the age of internet without changing their essence. This, in turn, will lead to touristic developments. Attention has also been paid to heritage restoration and its methods. Special focus has been given to the aesthetics of proposed, self-designed signage systems of the city. It is hoped that the insights presented herewith encourage greater enthusiasm towards art and encourage appreciation towards the culture and heritage of a smart city. This will add value to the quality of life of its citizens.

Notes: Almost the epitome of a positive planner's view of the uses of cultural infrastructure, which is never 'for itself': 'Smart cities in different parts of the world have started including public art installations, pop arts and street displays. These social and personal endeavours leave individuals with an increased sense of pride, belonging and regard for their city, and, in turn, the public benefits from an increased sense of awareness and understanding' (3).

**Gotthardt, A. (2017). These 15 Galleries Are Putting New Cities on the Art World's Map. *artsy.net Art Market*, 8 Feb. 2017. <https://www.artsy.net/article/artsy-editorial-15-galleries-putting-new-cities-art-worlds-map>**

Notes: Not a theoretical piece, just an illustration of a typical perspective of galleries as arts infrastructure. "The majority of the art world's infrastructure—from galleries and museums to public funding to art criticism and press—is concentrated in a handful of major urban centers including New York, London, Berlin, and Hong Kong. However, this hasn't deterred an increasing number of tenacious gallerists from opening art spaces well beyond the comforts of established art-world hubs, and taking big financial risks in the process. For many, the remote locations have been the impetus.

Their goal: to expose local artists to an international set of collectors and curators, and likewise to bring the international art community into their emerging, at times far-flung, art scenes. For the below 15 galleries, hailing from San Juan to Cluj and Accra to Bangalore, the risks have paid off.

And they are galvanizing their surrounding creative communities and turning the art world's attention to their hometowns in the process.'

Infrastructure here is market-oriented and top-down—'to expose local artists to an international set of collectors and curators', but also recognising the import of 'surrounding creative communities' (which are outside of market infrastructure).

**Grima, S., A. Grima, E., Thalassinou, S., Seychell, & J. V. Spiteri (2017). 'Theoretical Models for Sport Participation: Literature Review.' *International Journal of Economics and Business Administration* 5(3): 94–116. doi:10.35808/ijeba/138**

Abstract: Recent studies have analyzed theoretical models of sport participation. They claimed that sports activities relate to health and happiness and that there are various factors which determine sports participation, be it individual, sociological or psychological. Whilst some countries in Europe experienced an increase in sport activity over the past few decades, others saw a decline in the number of individuals who commit to physical activity. Several models have been constructed to explain and determine involvement in sports, namely 'The Beckerian Approach', 'The SLOTH framework' and 'Green's Model of Sport Development'. These models have unearthed specific important factors, which encourage people to take part in sports activities. These concerned age, gender, time constraints, income and level of education.

In fact, findings have shown a positive and statistically significant relationship between age and frequency of sport participation and as age increased walking increased as well. Education plays an important role as well especially where adolescents are concerned. School was a key contributor to adolescents increased participation in physical activity and more specifically as they transitioned into secondary school.

A successful example is that of Norway where a sport and physical recreation culture is deeply rooted in society and is supported by strategic socio-economic circumstances, high standards of living, equality between genders, abundant sporting facilities, a school system that keenly promotes physical activity, a strong voluntary sports club sector and high levels of parental contribution. Recent research has also focused on the sociological and psychological factors which contribute to increased physical activity. Social networks and friends significantly impact one's decision to take part in sport, while the involvement of parents in sport affects sport frequency in a positive and significant way.

Notes: Infrastructure in sports is conceived in standard economic terms, i.e., as fixed entities linked to funding. Sports infrastructure is defined in 'supply side' terms as 'basic facilities, services and installations serving sports organizations, sports users and other community members providing increased opportunities to all to participate in sport for leisure, training or competitive purposes. Sport infrastructure includes sports facilities (sports halls, sport pitches, playing courts and swimming pools) and sport programmes (operated by sport clubs, commercial providers and city)' (102). Insufficient infrastructure is a barrier to sports participation. Studies show that 'physical activity is positively correlated with the availability of suitable sport infrastructure' (102–103). Distance from infrastructure or the effects of competing infrastructure (e.g., entertainment) could be a barrier to participation. This approach is all rather simple—multi-level modelling can show more layered determinations, for instance that swimming pools are of importance for sport participation in general and that access to sport fields are linked to participation in sport clubs.

**Heywood, L. L. (2011). Affective infrastructures: Toward a cultural neuropsychology of sport. *Frontiers in Evolutionary Neuroscience* 3: 4, 5 pp. doi:10.3389/fnevo.2011.00004**

Abstract: Recently there has been a turn toward considerations of embodiment, cognition, and context in sport studies. Many researchers have argued that the traditional focus on clinical psychology and performance enhancement within the discipline is incomplete, and now emphasize

the importance of athletes' social and familial contexts in a research paradigm that examines interconnections between movement, cognition, emotion, and the social and cultural context in which movement takes place. While it is important that the sport studies focus is being expanded to consider these interactions, I will argue that this model is still incomplete in that it is missing a fundamental variable—that of our evolutionary neurobiological roots. I will use the work of affective neuroscientists Jaak Panksepp and Stephen Porges to show that because sport so clearly activates neural systems that function at both proximate and ultimate levels of causation, it can be seen to serve fundamental needs for affective balance. A neurobiology of affect shows how the evolution of the mammalian autonomic nervous system has resulted in neurophysiological substrates for affective processes and stress responses, and has wide-ranging implications for sport studies in terms of suggesting what forms of coaching might be the most effective in what context. I propose the term cultural neuropsychology of sport as a descriptor for a model that examines the relationships between neurophysiological substrates and athletes' social and familial contexts in terms of how these variables facilitate or fail to facilitate athletes' neuroceptions of safety, which in turn have a direct impact on their performance. A cultural neuropsychological model of sport might thereby be seen to elaborate a relationship between proximate and ultimate mechanisms in concretely applied ways.

**Hoe, S. F. (2020). Laden with great expectations: (Re)mapping the arts housing policy as urban cultural policy in Singapore. *City, Culture and Society* 21: 100339. doi:10.1016/j.ccs.2020.100339**

Abstract: The arts and artists need space to thrive. However, as much of the land in Singapore is state-owned, the finiteness of space—literally and figuratively—remains a key challenge. Yet there is a rich variety of arts infrastructure in Singapore today, from exhibition spaces to performing arts venues and state-subsidised artist studios. This infrastructure comes at a cost—these arts spaces are positioned as policy interventions capable of achieving a broad confluence of cultural, urban, economic and social outcomes for Singapore. This article aims to provide an understanding of how arts spaces in Singapore has been framed and legitimised as a strategic means to pursue multiple policy goals. In particular, this article will focus on the Arts Housing Policy, which was formally introduced in 1985 as an artist assistance scheme that provides subsidised work spaces to artists and arts groups. Over the years, the policy has evolved into an urban cultural policy expected to achieve urban rejuvenation goals. Through tracing the governmental structures and organisational processes behind the evolution of the Arts Housing Policy from an artist assistance scheme into an urban cultural policy, this article will demonstrate how and why arts housing spaces have become encumbered by the institutional layering of potentially incommensurate policy agendas, assumptions and aspirations. This article contends that a micro-level analysis of the bureaucratic structures and processes behind policy development will enable a more nuanced understanding of the tensions and incongruities between local artist needs and urban cultural policy goals in Singapore.

Notes: Not really a theoretical piece, but it looks critically at a cultural infrastructure policy—Singapore was an early adopter of CI policy in 1985—that simultaneously aims to achieve urban regeneration goals, and perhaps succeeds in neither.

**Jones, C. (2001). A level playing field? Sports stadium infrastructure and urban development in the United Kingdom. *Environment and Planning A* 33(5): 845–861. doi:10.1068/a33158**

Abstract: A number of cities in the United Kingdom have recently placed a policy focus on the ability of sports events and stadia to stimulate economic and physical regeneration. Such development is most often justified from a development and regeneration perspective. Under this paradigm, the urban redevelopment which occurs consequent on stadium construction creates benefits which 'trickle down' from property developers, sports teams, and stadium operators to

the wider community—largely in the form of employment growth. However, the attraction of the hallmark events which are (in the United Kingdom) the major revenue stream of the stadium can be reread in the context of the constant competition evidenced between cities and between regions to draw in mobile capital resources via a programme of public subsidy for private business. Under such a paradigm, the potential for the stadium to contribute to uneven development, both within and between cities, is problematic. The author examines the arguments for and against stadium development in terms of the likely effects on the economic and social fabric of the city, and identifies likely winners and losers. The role of mobile capital, political elites, and growth coalitions in driving changes in the structure and use of common space in the urban core is examined with the aid of a case study of Cardiff and the Millennium Stadium.

Notes: Not much reflection on infrastructure theory per se (this is an old paper), but considerations of the infrastructure are more broadly social and political economical, such as ‘how sports developments impact upon uneven outcomes, economically and in terms of access to facilities; whether such infrastructure provides a mechanism for transferring benefit from public to private hands; and whether locally based structures to enable democracy, inclusion, and accountability are able to contend with such one-off massive developments’ (849).

**Kim, A. M. (2020). Can we design for culture? Paradigms and provocations. *Built Environment* 46(2): 39–53. doi:10.2148/benv.46.2.199**

Abstract: While creative placemaking has proved a long-standing paradigm for the arts in city-making strategy, recently there has been a shift towards a cultural infrastructure approach. This article takes critical stock of this paradigm shift, to engage the broader question of whether we can design for culture in the built environment. Conceptualizing creative placemaking within a larger genealogical framework, I argue that this shift might be understood as responsive to some of the limitations and unintended social consequences of the movement: its temporal nature and contribution to cycles of gentrification and displacement.

**Knudsen, B. T., & C. Kølvrå (2020). Affective infrastructures of re-emergence? Exploring modalities of heritage practices in Nantes. *Heritage & Society* 13(1–2): 10–31. doi:10.1080/2159032X.2021.1883981**

Abstract: The French city of Nantes has been heralded for both its creative and complex engagements with the dark heritage of its history as France’s main slave port. In this article we examine the ways in which the colonial heritage has been dealt with in Nantes, arguing that we find here various processes and initiatives which can be understood as expressing or combining what we suggest are four main modes of colonial heritage practice: Repression, Removal, Reframing and Re-emergence. We discuss how the city authorities and local organizations with a focus on colonial heritage have ended the silent repression of the city’s slave trading heritage, and to some extent entirely reframed the city as a center of avant-garde art and culture, e.g., through the 2012 construction of *Memorial to the Abolition of Slavery*. Finally, we critically analyze the domesticating effect of this reframing as well as practices of removal which, by contrast, have been used to reintroduce decolonial antagonism and oppositional struggle into the public space in Nantes. Finally, we investigate whether street performances of *Royal de Luxe* might hold what we term potential for re-emergence; a heritage practice entailing both a reemergent aesthetics able to engage the audience at a bodily and affective level, a re-emergent history able to both articulate the past and energize contemporary struggles, and the re-emergence of a broader field of voices and subjects.

Notes: Relevant to heritage practices. A study of performative heritage in Nantes, once the main French slave port. ‘Mechanical’ infrastructure can become affective infrastructures in the process: ‘[I]n inserting colonial signifiers into a dreamlike, yet highly tactile and nostalgically mechanical spectacle, the world-making of *Royal de Luxe* can also be seen as an aesthetic gesture recalling the

old material and mechanical infrastructure (e.g., harbor cranes) which made Nantes part of the commercial circuit of French colonialism. They now reemerge as affective infrastructure orienting and engaging audiences through their experiential value, ultimately mediating the emotional relationship between the city's past, its reframed urban space and its different audiences' (23–24). Performative heritage activity can 'aesthetically and affectively engage audiences in modes of representation and conversation that facilitate giving voice to a wider field of subjectivities formerly marginalized, invisible or unimaginable' (28).

**Korzun, D., A. Varfolomeyev, S. Yalovitsyna, & V. Volokhova (2017). Semantic infrastructure of a smart museum: Toward making cultural heritage knowledge usable and creatable by visitors and professionals. *Personal and Ubiquitous Computing* 21(2): 345–354. doi:10.1007/s00779-016-0996-7**

Abstract: The Internet of Things (IoT) and Smart Spaces technologies enable development of new information services operating with descriptions of museum exhibits and available cultural heritage knowledge. In this paper, we introduce a smart museum concept where information services are not limited with straightforward provision of record-based description of exhibits, as it happens in traditional museum information systems. The concept is based on services with high intelligence level when additional historical sources can be used to semantically enrich the museum collection, including knowledge acquired from visitors and museum professionals. A museum becomes a cultural space where its semantic layer makes knowledge usable and creatable by visitors and professionals. Our research focus is on applying this concept to the case study of the History Museum of Petrozavodsk State University. A concept prototype is created, as a mandatory development phase of complex systems engineering, to analyze the need, feasibility, and technical approach. The concept prototype follows the smart spaces approach for IoT environments and defines design solutions for creating a semantic infrastructure that transforms a given museum into its smart variant.

**Krajina, Z., & D. Stevenson (Eds.) (2020). *The Routledge Companion to Urban Media and Communication*. New York: Routledge.**

Notes: Some relevant chapters regarding infrastructures:

- 12. Shannon Mattern, 'The City Is Not a Computer: On Museums, Libraries, and Archives'
- 15. Aaron Shapiro, 'Urban Transport and Telecommunications: Dual Forms of the Communicative Skeleton of the City'
- 19. Naomi Schiller, 'Urban Media as Infrastructure for Social Change'
- 25. Peter Campbell and Dave O'Brien, '"European Capital of Culture" and the Primacy of Cultural Infrastructure in Post-Industrial Urbanism'

**Latham, A. & J. Layton (2019). Social infrastructure and the public life of cities: Studying urban sociality and public spaces. *Geography Compass* 13(7): e12444, 15 pp. doi:10.1111/gec3.12444**

Abstract: Libraries, laundrettes, and lidos. Pizzerias, plazas, and playgrounds. Sidewalks, swimming pools, and schools. These are just some of the kinds of spaces and facilities that contribute to the public life of cities. Drawing on the arguments of the sociologist Eric Klinenberg, this article develops the concept of 'social infrastructure' as a way to research and value these kinds of spaces. Social infrastructure helps in recognising the public dimensions of often overlooked and undervalued spaces. It draws attention to the breadth, depth, and textures of sociality that can be afforded by different urban environments. In developing the concept of social infrastructure, this article pulls together four related strands of social scientific inquiry: work on infrastructure; publicness and public space; sociality and encounter and the politics of provision. An infrastructural approach to the topic of public space presents geographers with some productive tools for understanding the public life of cities.

**Lobato, R. (2018). *Netflix Nations: The Geography of Digital Distribution*. New York: New York University Press. doi:10.18574/nyu/9781479882281.001.0001**

Description: Combining media industry analysis with cultural theory, Ramon Lobato explores the political and policy tensions at the heart of the digital distribution revolution, tracing their longer history through our evolving understanding of media globalization. *Netflix Nations* considers the ways that subscription video-on-demand services, but most of all Netflix, have irrevocably changed the circulation of media content. It tells the story of how a global video portal interacts with national audiences, markets, and institutions, and what this means for how we understand global media in the internet age.

*Netflix Nations* addresses a fundamental tension in the digital media landscape—the clash between the internet’s capacity for global distribution and the territorial nature of media trade, taste, and regulation. The book also explores the failures and frictions of video-on-demand as experienced by audiences. The actual experience of using video platforms is full of subtle reminders of market boundaries and exclusions: platforms are geo-blocked for out-of-region users (‘this video is not available in your region’); catalogs shrink and expand from country to country; prices appear in different currencies; and subtitles and captions are not available in local languages. These conditions offer rich insight for understanding the actual geographies of digital media distribution.

Contrary to popular belief, the story of Netflix is not just an American one. From Argentina to Australia, Netflix’s ascension from a Silicon Valley start-up to an international television service has transformed media consumption on a global scale. *Netflix Nations* will help readers make sense of a complex, ever-shifting streaming media environment.

Notes: Examines Netflix’s black-boxed ‘sociotechnical software system’ (35) that obscures the company’s position as a mediator of ‘communication, identity, and politics’ (38). Despite its profile as a global enterprise, the unevenness of Netflix’s access and services can be attributed to differences in regional infrastructure, economy and regulation that shape Netflix into a set of ‘*national media services* tied together in the one platform rather than as a uniform global service’ (184, emphasis in original).

**Macchia, T. (2014). Mediating an invisible relation: Formalizing the exhibition as the linking artifact between curators and visitors. In *PDC ’14: Proceedings of the 13th Participatory Design Conference* (Vol. 2, pp. 229–232): ACM. doi:10.1145/2662155.2662242**

Abstract: The research project presented in this paper investigates the relationship between groups of people (visitors and curators), mediate by Cultural Infrastructure (museum exhibition). We present the conceptual frame of this research, the goals and the expected methodological and theoretical contribution.

Notes: Argues that ‘the concept of Cultural Infrastructure underlines the interrelation among actors, practices, museums as institutions, and artefacts that mediated and influence the actions and the activities in museums’ (229). The research considers the exhibition as ‘a communication media, a channel to equally transfer the knowledge between the two agents’ (231). Using the notion of participatory design (PD) the research focuses on aspects of the design process as ‘a set of intellectual tools to analyze the exhibition’ (231). ‘Understanding infrastructures means to problematize the relations (interaction and communication) between components, background and context’ (230).

**Macchia, T., G. Poderi, & V. D’Andrea (2015). Infrastructuring knowledge in cultural infrastructure: Informal example of participatory design for museum exhibition. *International Journal of Sociotechnology and Knowledge Development* 7(1): 16–32. doi:10.4018/IJSKD.2015010102**

Abstract: This paper discusses infrastructuring as an informal experience of Participatory Design in the context of museums. The authors describe ‘participation’ as an embedded and stable parameter for looking at museums’ sustainability. Their standpoint is that museums develop and encourage knowledge through participative and interrelated relationships among various actors. Thus, the value of participation intersects the concept of infrastructuring, which implies the ongoing feature, the hybridity of networks and the complexity of the context, and consider together human and non-human. Describing visitors’ participation in infrastructuring processes, the authors underline the unprofessional and unplanned stage of design process in order to stimulate new direction on designing museum exhibition and for planning the introduction of interactive technologies in the museum environment.

**Mattern, Sharon. (2014). Library as infrastructure: Reading room, social service center, innovation lab. How far can we stretch the public library? *Places* (June 2014). doi:10.22269/140609**

Some quotes (all emphases in original):

Libraries are infrastructures not only because they are ubiquitous and persistent, but also, and primarily, because they are made of interconnected networks that undergird all that foment, that create what Pierre Bourdieu would call “structuring structures” that support Weinberger’s “messy, rich networks of people and ideas.”

[T]hinking about the library as a network of integrated, mutually reinforcing, evolving *infrastructures*—in particular, architectural, technological, social, epistemological and ethical infrastructures—can help us better identify what roles we want our libraries to serve, and what we can reasonably expect of them.

Now we are seeing the rise of a new metaphor: the library as ‘platform’—a buzzy word that refers to a base upon which developers create new applications, technologies and processes. In an influential 2012 article in *Library Journal*, David Weinberger proposed that we think of libraries as ‘open platforms’—not only for the creation of software, but also for the development of knowledge and community.

Yet the platform metaphor has limitations. For one thing, it smacks of Silicon Valley entrepreneurial epistemology, which prioritizes ‘monetizable’ ‘knowledge solutions.’ Further, its association with new media tends to bracket out the similarly generative capacities of low-tech, and even *non*-technical, library resources.

[The platform evokes] a flat, two-dimensional stage on which resources are laid out for users to *do stuff with*. The platform doesn’t have any implied depth, so we’re not inclined to look underneath or behind it, or to question its structure.

The rest of the article tries to assess the structuring structures of the library: as social infrastructure, its natural affinity with other cultural institutions, and the partnership opportunities that this presents; as a technological-intellectual infrastructure, from its traditional collection to the kinds of spaces that it can encompass (maker spaces, gaming labs—the maker space trend in US libraries was largely introduced ‘from below’ rather than through large funding programs). At the same time libraries can foster critical perspectives on technological innovation, where it is ‘innovation for innovation’s sake’.

Mattern argues a need to foster ‘new critical capacities to understand the *distributed* physical, technical and social architectures that scaffold our institutions of knowledge and program our values’. At the same time, there is a need to ‘sync the library’s intersecting infrastructures so that they work together to support our shared intellectual and ethical goals’.

**Mattern, S. (2016). Infrastructural Intelligence. Words in Space, Jan. 2016.**  
<https://wordsin.space.net/2016/01/01/infrastructural-intelligence/>

Abstract: I begin this paper by describing the growth of interdisciplinary interest in infrastructure and the methodologies and pedagogies employed to cultivate infrastructural ‘literacy’ and intelligence. The proposed consequences and benefits of this intelligence, I explain, include the engagement and emancipation of diverse urban publics, who, armed with new technical knowledge, are potentially empowered to advocate for more just and accessible services, or even construct their own alternative infrastructures. I then examine the urban institutions that both cultivate and collect this infrastructural intelligence; public libraries in particular play a critical role in establishing an urban infrastructural and intellectual commons. I close by proposing how libraries, as part of a larger urban network of knowledge infrastructures, can provide structures and communities of learning, and cultivate forms of intelligence—experiential, dynamic, practice-based—that are uniquely well suited to grappling with our complex, over-determined urban systems.

Notes: Mattern argues that there is an ‘infrastructural awareness’, including a realisation of the materiality of the Internet, of our lifestyle’s ‘Amazonian consumptive appetites ... dependent on ... heavy logistical systems and exploitative labor practices’ and a facing up to ‘precarious infrastructural, environmental, political, and ethical futures’. The effect of ‘making infrastructures visible or otherwise *sense-able* or experiential’ has been to make those systems ‘become *sensible*, comprehensible—and perhaps even manipulable and hackable’. Also, some existing institutions—libraries, for instance—constitute valuable knowledge infrastructures that ‘are simultaneously technical, architectural, social, epistemological, and ethical’ and an important resource for constructing commons. Cultivating infrastructural intelligence can move beyond the deficits of ‘infrastructural representation’, often reifying and functionalist.

**Mattern, S. (2020). The city is not a computer: On museums, libraries, and archives. In Z. Krajina & D. Stevenson (Eds.), *The Routledge Companion to Urban Media and Communication* (pp. 133–142). New York: Routledge. doi:10.4324/9781315211633-15**

Abstract: In this chapter, I will explore the longevity and limitations of city-as-computer scenarios. While contemporary tech companies’ and theorists’ visions reveal their origins in an age of big data and cloud computing, these algorithmic dreams are rooted in earlier reveries. I begin by tracing the history of urban metaphors, particularly that of the city-as-information-processor. Then, moving beyond ‘information’ and its ‘processing’ in creating more generous, inclusive maps of urban information ecologies, I look to other sites and collections—archives, libraries, museums, and repertoires of embodied culture—where urban intelligence is generated, organized, preserved, distributed, and activated. Finally, I reassess the power of these urban metaphors to condition urban design, planning, and administration, and consider alternative epistemological models that are better equipped to encompass the breadth of intelligences embodied in cities.

**Mayor of London (2019). Cultural Infrastructure Plan: A Call to Action. London: Greater London Authority.**

[https://www.london.gov.uk/sites/default/files/cultural\\_infrastructure\\_plan\\_online.pdf](https://www.london.gov.uk/sites/default/files/cultural_infrastructure_plan_online.pdf)

Description: This report explores ways of restoring the cultural infrastructure of one of the world’s great cultural cities. Some actions detailed include an interactive infrastructure map, resources to help people to create cultural spaces, increasing investment and setting up creative enterprise zones.

**Méndez Cota, G., & A. López Cuenca (2020). Beyond rebellion of the Net: Infrastructural commoning as critical cultural literacy. *Critical Arts* 34(5): 24–38. doi:10.1080/02560046.2020.1779326**



**Abstract:** This article offers a critical interpretation of the recent cultural and political history of artistic engagements with digital technologies in contemporary Mexico, considering some of them in relation to changing notions of cultural literacy under neoliberal globalization. While educational social research in Latin America has its own critical traditions for studying literacy as a social practice embedded in power relations, art theory and criticism in Mexico and abroad have barely raised the question of new media art's specific relevance to questions of literacy. Through a cultural and media studies lens acting as a bridge between art theory and criticism on the one hand, and educational research on literacy on the other hand, this article shows how, during the neoliberal conjuncture, artistic engagements with digital technologies articulated cultural experimentation with grassroots political struggles and mediated wider processes of economic and technological transformation. We suggest that new media art, as a post-autonomous practice in times of transition, introduced questions of digital commoning as concerns for cultural literacy in a broad sense. We argue, however, for a non-instrumental and open-ended *infrastructural* understanding of art's educational role in relation to ongoing historical conjunctures.

**Ovcharenko, S. (2020). Paradoxes of expert approaches to the study of cultural infrastructure: The Ukrainian case. *CES Working Papers* 12(4): 298–321. [https://ceswp.uaic.ro/articles/CESWP2020\\_XII4\\_OVC.pdf](https://ceswp.uaic.ro/articles/CESWP2020_XII4_OVC.pdf)**

**Abstract:** The article reveals the imperfection of ways to use existing approaches to the study of the cultural infrastructure in Ukraine, in particular when we apply methods offered by the UN and the EU as well. The research evidences that both foreign and Ukrainian experts are taking the first steps to ascertain the condition of cultural infrastructure in Ukraine and currently there is no objective complete database. Positive characteristics of different ways of measuring the state of cultural infrastructure are proposed to unite and Ukraine should be considered as the base country for testing scientific research methods, which will facilitate the establishment of scientific cooperation in the field of cultural policy and the coordination of joint decisions for cross-border partnership. One of the additional important parameters for the study of cultural infrastructure is its relevance to the overall political plans for the development of culture in the European community.

**Parke, E. (2015). Migrant workers and the imaging of human infrastructure in Chinese contemporary art. *China Information* 29(2): 226–252. doi:10.1177/0920203X15588170**

**Abstract:** The focus on Beijing's speed of development and the concomitant fascination with the unchecked destruction of hutongs reveal only part of Beijing's urban story. If we consider that migrant workers (农民工) are the 'human infrastructure' that enables the built infrastructure, then grappling with how contemporary artists depict, exploit, and represent this human infrastructure uncovers many previously overlooked stakeholders. Artists reflect, recombine, and reimagine the figure of the migrant worker. However, such artistic interventions, while a critical avenue for addressing the contested citizenship of urban dwellers, are only one facet of the complex visual field of Beijing. Therefore, in addition to these artists' works, I discuss other visual elements of Beijing such as the scrawled phone numbers advertising a variety of services for migrant workers on the surfaces of Beijing's built environment. This unsigned public calligraphic practice is considered alongside the art of globally recognized artists to probe the interconnectedness of urban visual practices, question the targeted constituencies, and examine their reception by a range of urban audiences, revealing the communicative potential of images and text in the urban context and questioning what is at stake for the networks of migrant workers in Beijing that are often invisible.

**Notes:** This is really about infrastructure in art, i.e., artists' engagement with infrastructure.

**Parks, L. (2015). 'Stuff you can kick': Toward a theory of media infrastructures. In P. Svensson & D. T. Goldberg (Eds.), *Between Humanities and the Digital* (pp. 355–373). Cambridge, MA: The MIT Press. doi:10.7551/mitpress/9465.001.0001**

Notes: Parks develops the notion of '*infrastructural imaginaries*—ways of thinking about what infrastructures are, where they are located, who controls them, and what they do. By exploring such topics as the endpoints of cable television systems, the locations of cell phone towers, and the territories of satellite and wireless footprints, I have tried to develop a critical methodology for analyzing the significance of specific infrastructural sites and objects in relation to surrounding environmental, socio-economic, and geopolitical conditions' (355).

Infrastructure 'emphasizes materiality and physicality and as such challenges us to consider the specific locations, installations, hardware, and processes through which audiovisual signals are trafficked' (356). Parks develops an analytical strategy designed to link the cultural analysis of humanities—digital humanities—with insights from engineering, science studies, environmental studies and so on. Parks's gambit is that 'audiovisual media can be read *infrastructurally*—that is, to evoke infrastructures that cannot be reduced to the frame or perceived by one person in their entirety' (370). Her theory of media infrastructures wants to link 'the biophysical resources required to make those acts possible, the sites, materials, and objects that have been organized to move signals throughout the world' (370).

**Pasquinelli, C., & N. Bellini (2015). Case D: The power of soft infrastructure in influencing regional entrepreneurship and innovativeness. In F. M. Go, A. Lemmetyinen, & U. Hakala (Eds.), *Harnessing Place Branding through Cultural Entrepreneurship* (pp. 159–177). London: Palgrave Macmillan UK. doi:10.1057/9781137465160\_9**

Abstract: This chapter aims at framing 'creativity, culture and taste' as soft aspects of knowledge creation and accumulation, and as drivers of innovativeness, a 'fertile ground' for niche specializations for many regions (Camagni and Capello, 2013: 362). Creativity, culture and taste are, in fact, often overlooked in the discourse on innovation in Europe, despite their great potential in geographical contexts that are rich in cultural heritage and cultural diversity. There is a need to reflect on regional innovation and entrepreneurial innovativeness by considering 'cultural inputs' (Amin and Thrift, 2007) as impulses to economic value creation. This occurs in cultural industries that, inextricably based on cultural production and consumption, have an economic as well as a cultural presence in contemporary society (Pratt, 2008). As this chapter will show, beyond cultural industries, an enlarging set of entrepreneurs consciously appropriates and recombines cultural inputs in order to enrich and innovate their products and services. In so doing they produce cultural meanings, symbols and aesthetic values that, as we shall see below, may become part of regional cultural heritage.

Notes: The chapter examines 'Regional Soft Infrastructure' in Tuscany (central Italy) in which cultural entrepreneurs appropriate and recombine their cultural products and services to match and augment symbols and meanings linked to place. This infrastructure is linked to the cultural capital of places, which is deployed symbolically in cultural marketing strategies. RSoI describes a continuously evolving 'platform' of cultural entrepreneurs in a range of cultural and service industries such as food, wine, agriculture and art that interact with and also extend government-sponsored place branding narratives about Tuscany. In the process, a network of co-created images and symbols emerges, both complementing and contrasting with place-branding narratives to suggest an 'other' Tuscany.

**Pipinis, J. (2017). Art as Infrastructure. Unpublished master's thesis, Social Anthropology, Stockholm University. diva2:1040276**

Notes: Pipinis considered two definitions of art from Nicolas Bourriaud. Firstly, art as 'a set of objects presented as part of a narrative known as *art history*' in which art is understood as a category

discursively produced on the basis of an arbitrary assemblage of objects rather than trying to find their common denominator in terms of their intrinsic features or conditions of their production and consumption. Secondly, art as ‘activity consisting in producing relationships with the world with the help of signs, forms, actions and objects’ (ibid.) or, more economically expressed, ‘art is a state of encounter’. The latter is too wide to discern exclusively artistic activity, but it positions art as something intrinsically social. Pipinis combines the two in his definition of art as ‘activity consisting in producing relationships with the world with the help of signs, forms, actions and objects, discussed within the discursive formation of art’ (17).

Concerning infrastructure, Pipinis draws on Larkins’ notion of infrastructure moving ‘goods, ideas, waste, power, people, and finance’ (19). In positioning his own definition in between materialist and more abstract functions of art, Pipinis draws together ‘Gell’s view on art as “unrecognized technical system” for social reproduction (but not reproduction alone!), Morphy’s acknowledgment of art as sufficiently distinct category for people to allocate objects to, Svašek’s processual view on “aestheticisation” of objects as art, Schneider’s endorsement for studies of agency of art through interdisciplinary approaches, Becker’s mapping of social embeddedness of artistic production and Bourriaud’s definition of art as a discursively formed set of objects and techniques for production of relations. From other works I take note of suggestions to art’s social functions pointing, *inter alia*, towards identity marking, cross-generational knowledge transfer, social reproduction, stabilization of collectives, expressions of power and authority, innovations etc.’ (18).

Pipinis condenses these strands into a conception of art *as* infrastructure (not the infrastructure for art): it is an ‘unrecognized technical system (of no less than artworld-magnitude) aestheticizing encounters into artistic states enabling social distinctions, reproductions and innovations’ (18).

**Pirvu, I.-D., & F.-C. Goldbach (2017). Cultural infrastructure in Arges County. *Ovidius University Annals: Economic Sciences Series XVII(2): 294–299. <http://stec.univ-ovidius.ro/html/anale/RO/2017-2/Section%20III/26.pdf>***

Abstract: Cultural infrastructure is the ensemble of institutions offering cultural services and products (museums, theaters, cinemas, etc.). The purpose of this article is to find out what is the equipment of the cultural institutions, the resources made available and the cultural services they offer. The result of this research demonstrates that cultural institutions in cities and municipalities, although they do not have special headquarters or extraordinary facilities, manage to carry out a multitude of activities: literary circles, choruses, fanfare, folk ensembles, folk music performers, folk musicians and instrumentalists valuable, diverse and quality festivals.

**Revko, A., M. Butko, & O. Popelo. (2020). Methodology for assessing the influence of cultural infrastructure on regional development in Poland and Ukraine. *Comparative Economic Research: Central and Eastern Europe 23(2): 21–39. doi:10.18778/1508-2008.23.10***

Abstract: The aim of the article is to characterize the level of the region’s diversification according to the cultural component of social infrastructure based on grouped statistical indicators. This paper uses Perkal’s synthetic ratio method to characterize the level of cultural infrastructure development in Ukrainian and Polish regions. The analysis, conducted between 2010 and 2017, concerned cultural organizations such as libraries, theaters, concert organizations, museums, cinemas, art and sports schools, and was based on regional data of Polish and Ukrainian public statistics. It was found that the primary barriers to access to cultural infrastructure are inadequate funding, disability, geographic remoteness, disparities in education, and material living conditions. The determinants of modernizing cultural infrastructure in the region are defined.

**Salomon, D. (2016). Towards a new infrastructure: Aesthetic thinking, synthetic sensibilities. *Journal of Landscape Architecture* 11(2): 54–65. doi:10.1080/18626033.2016.1188574**

Abstract: What is the relevance of aesthetics and sensibility for infrastructure? Drawing on the ideas of Jacques Rancière, Susan Sontag, and Gregory Bateson, the historical example of Frederick Law Olmsted, and a number of contemporary case studies, this essay argues that the value of aesthetics and sensibility lies in their ability to conceive of and produce infrastructural projects that are an integrated, multifunctional part of the landscape, rather than something isolated from it.

It is argued that such an understanding of infrastructure is increasingly important, as the interdependent social, environmental, economic, and political problems it is asked to tackle—for example, the issues associated with rising sea levels—cannot be solved using its traditional techniques of isolation and optimization. Rather, they demand the synthetic techniques and products produced by aesthetic practices such as landscape, architectural, and urban design.

Notes: Architects have thought of infrastructure in instrumental ways, e.g., ‘Stan Allen’s canonical “Infrastructural Urbanism” (1998), [where] Allen touted infrastructure’s utility and instrumentality, positioning it as an efficient and productive model for creating architecture and landscapes while ignoring its aesthetic impact’ (55). Salomon proposes to de-hierarchise the conception of infrastructure to use aesthetic thinking that ‘untethers infrastructure from its utilitarian roots’, making it easier to ‘accommodate different functions, scales, and audiences’ (64) in a larger design. The perspective remains that of the individual designer/architect.

**Skaggs, R. (2020). A networked infrastructure of cultural equity? Social identities in the missions of local arts agencies. *Journal of Arts Management, Law, and Society* 50(6): 319–334. doi:10.1080/10632921.2020.1845890**

Abstract: Increasing attention to cultural equity in the arts focuses on the power of the arts to address social inequity. Many also recognize that arts organizations must attend to these issues in their organizational practices in order to promote equity and disrupt historic power structures. Local Arts Agencies’ (LAAs) structural position as key regranters of federal and local funds makes them a key site of inquiry into the sector’s approach to cultural equity. This research asks: How is attention to individual social identity dimensions of cultural equity patterned in mission statements of LAAs? Of the 55 LAAs analyzed, 26 have a mission statement that includes attention to cultural equity, and of these, 17 list specific social identity groups to which they attend. Empirically, the article presents network visualizations and tabled co-occurrences of social identities toward the goal of understanding the clustering of social identity in the missions of LAAs. This study contributes to understanding how LAAs are considering identity-specific dimensions of equity in the missions of their organizations, trends in the patterning of these priorities, and identify the structural underpinnings of cultural equity in institutional priorities among LAAs in the United States.

**Stevenson, D., & L. Magee (2017). Art and space: Creative infrastructure and cultural capital in Sydney, Australia. *Journal of Sociology* 53(4): 839–861. doi:10.1177/1440783317744105**

Abstract: Creative activity and cultural facilities are routinely touted as markers and facilitators of successful cities and societies. This view is underpinned by the assumption that they contribute to local economic growth, foster a positive city image, and enhance urban quality of life. Creativity and the consumption of art are also well established as markers of social and cultural status, while access to, and the physical distribution of, cultural resources are also embedded in, and reinforce, forms of social difference. Understanding the intersection of the social and the spatial in the consumption and distribution of culture is important to both cultural and urban sociology. Using Sydney, Australia, as a case study and drawing on the findings of a major national study of cultural

consumption, the article engages with the influential work of Pierre Bourdieu on the reception of art and the differential propensity of various social classes to go to art galleries and to appreciate art, to highlight social and spatial concentrations and fault-lines in arts participation. It also points to important theoretical and empirical nuances, including a weakening of the nexus between socio-economic class and cultural consumption that is occurring at the same time as the links between forms of cultural capital—education and art consumption—appear to be strengthening.

Notes: There is no explicit defining of infrastructure. It is tied to class and cultural capital on the one hand, and to the structure of cities on the other. At the same time there is an implicit insistence on expanding the understanding of infrastructure beyond consumption towards what enables creativity, the ‘creative infrastructure’.

**Tribillon, J., & J. Bingham-Hall (2020). L'essor de la notion de cultural infrastructure urbaine. Ou quand la « culture » devient un investissement comme un autre. *Journal des Anthropologues* 4–5(162–3): 47–64. doi:10.4000/jda.9933**

Abstract: This article critically studies the emergence of ‘cultural infrastructure’ in the United Kingdom and, more specifically, London. By tracking the etymological, political and intellectual journey of ‘infrastructure’ and the different ideologies that have mobilised it, the authors reveal a peculiar vision of ‘culture’ and of the character of the ‘artist’ in the city, encapsulated by the notion of ‘cultural infrastructure’. This vision is adopted by cultural ‘megaprojects’ as symbols of modernity and of the instrumentalization of ‘culture’ as leverage for economic policy. It marks the emergence of a quantifiable approach to culture, which is meant to have an ‘impact’ and to be accompanied by a range of metrics. The emergence of ‘cultural infrastructure’ also crystallises a new relationship between local authorities and private sector stakeholders, where the former have lost their power of initiative and have to remain limited to encouragement, communication, and also the production of research and hard data.

**Turner, F. (2009). Burning Man at Google: A cultural infrastructure for new media production. *New Media & Society* 11(1–2): 73–94. doi:10.1177/1461444808099575**

Abstract: Every August for more than a decade, thousands of information technologists and other knowledge workers have trekked out into a barren stretch of alkali desert and built a temporary city devoted to art, technology and communal living: Burning Man. Drawing on extensive archival research, participant observation and interviews, this article explores the ways in which Burning Man’s bohemian ethos supports new forms of production emerging in Silicon Valley and especially at Google. It shows how elements of the Burning Man world—including the building of a sociotechnical commons, participation in project-based artistic labor and the fusion of social and professional interaction—help to shape and legitimate the collaborative manufacturing processes driving the growth of Google and other firms. The article develops the notion that Burning Man serves as a key cultural infrastructure for the Bay Area’s new media industries.

Note: See the Burning Man website: <https://burningman.org/network/about-us/>

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