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Turbulent presents, precarious futures: urbanization and the deployment of global infrastructure

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ABSTRACT

Understandings of global infrastructure within and between cities have primarily focused on two forms: the node and the corridor. Scholarship detailing the extensive growth of these infrastructures focus on standardization to account for the underlying networks configuring urbanization. However, standardization fails to account for the dynamic, contested and geographically uneven process of infrastructure deployment. Four generative concepts focus analysis on the stages of deployment: speculation, delineating, alignment and pivoting. After discussing China's Belt and Road Initiative as the underlying geoeconomic force driving the transformation of these systems, we present an illustrative case of the Central Corridor linking Dar es Salaam (Tanzania) and Kampala (Uganda) as emblematic of urbanization through global infrastructure. Concluding, we argue for a research agenda that places global infrastructure at the centre of how we understand urban transformation amid contemporary political–economic turbulence, one that emphasizes the contingent ways deployment proceeds.

KEYWORDS

infrastructure; corridor; node; standardization; urbanization; capitalism

INTRODUCTION

In May 2017, a train travelled 7456 miles from Yiwu City in Zhejiang province to Barking Terminal in East London, opening a cargo land route between China and the UK (Kentish, 2017). This became a component of the projected US$1 trillion Belt and Road Initiative (BRI) that re-imagines the ancient Silk Road for the 21st century (Sidaway & Woon, 2017; Summers, 2016). The arrival into the North Atlantic of a world-spanning infrastructure from the 'East' can be understood as a technological and territorial reconfiguration of connections, relations and circulations of people, goods and capital amid a turbulent era in global capitalism (Roberts, 2011). The BRI's deployment required extensive spatial, technological and regulatory planning across nine nation-states, including China, Kazakhstan and Poland. To operate successfully, it also needed compatible train- track gauges and track-gauge switching, synchronization of monitoring systems, border controls and new visa regimes, regularized packaging, new lifting technologies and renewed work practices (Chen, 2018). The assembling of this global infrastructure highlights the imperative to standardize a range of different technologies, procedures and land uses.

The logic of standardization was essential for the deployment of this infrastructure, resulting in the trans- formation of urban space along its route, including in London, where, for instance, the Royal Albert Dock changed from a derelict, post-industrial site to a node for Chinese multinationals, creating a hub of 'Silk Road urbanism' in the UK capital (ABP, 2017). The growth of this node, engineered for Chinese firms, signalled the UK's desire to alter trade geographies resulting from the long decline of North Atlantic capitalism (Wallerstein, 1979) and recent turbulence from Brexit (Peters, 2017). This project proceeded alongside China's mobilization of global infrastructure to reorient the world economy, with attendant urban implications territorialized through the BRI's geographical reimagining. The BRI's extension to London generates several considerations. The renovation of Royal Albert Dock, as a node of global infrastructure and a unit of the geographically extended BRI corridor, has proceeded adjacent to ongoing disenfranchisement of residents in East London, where 'despite their sometimes spectacular physical impacts (as in London Docklands), [large-scale redevelopment has] had, at best, only modest success in raising the economic and social well-being of deprived local populations' (Watt, 2013, p. 103). It remains unclear at present whether this example of 'Silk Road' urbanism will offer opportunities and economic development for the sur- rounding communities or contribute to existing techno- logical fragmentation and spatial division across London. What is evident is that, with the deployment of this global infrastructure, the BRI is transforming urban space thou- sands of miles from

China.

A year after the launch of the Yiwu City–London route, authorities in Kampala, Uganda, began to remove structures from the informal neighbourhood of Namuwongo as part of the Central Corridor development project. Financed by the Tanzanian government through a US$7.6 billion loan from the Chinese bank Exim (Tanzania Invest, 2016), this global infrastructure aims to connect landlocked Kampala and its hinterlands via Lake Victoria to the Port of Dar es Salaam, Tanzania, and onward to the surging economies of the Indian Ocean (Central Corridor Transit Transport Facilitation Agency (CCTTFA), 2018b). These transport infra- structures are part of the larger configuration of the Maritime Silk Road (MSR), itself part of China's world- spanning BRI and an attempt to shift the centre of the world economy away from the North Atlantic toward the Indo-Pacific (Summers, 2016). Deploying the systems needed for the operation of the Central Corridor has required diplomatic agreements between the Ugandan and Tanzanian governments, the introduction of an electronic cargo-tracking system, new border facilities and technologies, hundreds of kilometres of new standard-gauge rail- way, rehabilitation of ocean and inland ports, and new export zones (CCTTFA, 2018b).

It also has transformed urban space along the route, including in Namuwongo, as well as in Port Bell, an export zone on the shores of Lake Victoria. The technological requirements and standardization to bring this global infra- structure into operation meant residents living on land within 15–30 metres of the railway track have been evicted from their homes and livelihoods, left facing an uncertain future in the city. Namuwongo was previously claimed by marginalized populations and is now a space in which residents experience first hand how new configurations of global infrastructure take precedence over the infrastructures of social reproduction, built informally over the years (McFarlane & Silver, 2017). A local resident stated before the displacement began: '[The] railway is taking away the land, so many of us will be evicted. Right now, we have no future here because we know any time, we shall be told to leave' (interviewee F, 11 February 2016). As Rao (2014, p. 39) notes, 'To talk about infrastructure is to invoke both the promise of a future as well as imminent trauma.' In configuring the space for global capitalism, life for Namuwongo residents has been made more precarious. Connections beyond the city have been prioritized over residents' everyday needs. The emergence of 'Silk Road urbanism' in London and Namuwongo residents' experiences with the Central Corridor project are but two examples across the Global North and South of the role of global infrastructure within the turbulent presents and precarious futures of urbanization.

We understand global infrastructure as being the connective systems, technological

networks and spaces that support global capitalism's everyday operations, a system that today largely is organized through offices and operational nodes in cities (Sassen, 2011). From airports (Kasarda & Lindsay, 2011), ports and logistics clusters (Carse & Lewis, 2017; Cowen, 2014), rail- and road-transportation corridors, data centres and telecommunications (Pickren, 2018), to pipelines and energy-transmission systems (Bouzarovski, Bradshaw, & Wochnik, 2015), these networks standardize and prioritize connections to faraway regions. Infrastructure networks are where globalized economic circulations – people, goods and information – enter and reconfigure urban spaces, creating, facilitating or exacerbating spatial fragmentations common across cities integrated into global capitalism (Graham & Marvin, 2001).

The new corridors between Yiwu City–London and Kampala–Dar es Salaam, and the emergence of nodes within these urban spaces, highlight the logic of standardization as it transforms cities around global norms, regulations and codes (Easterling, 2014; Schindler & Marvin, 2018). These networks also highlight the shifting, uneven geographies through which the deployment of global infra- structure materializes in particular urban contexts. From the informal, now-displaced spaces of Namuwongo and the rehabilitated Port Bell to a highly connected Chinese enclave at Royal Albert Dock, the deployment of global infrastructure is foundational in the (re)shaping of urban geographies.

The prominence of global infrastructure in navigating uncertain futures is central to explanations of the geographies of capitalism. A report by CounterBalance, a European coalition of non-governmental organizations (NGOs) focused on oversight of mega-projects, has documented hundreds of global infrastructure initiatives in a planetary entanglement, concluding that 'we live in an age of what might be termed extreme infrastructure' (Hilyard & Sol, 2017, p. 1). For instance, the Delhi–Mumbai Industrial Corridor would encompass '23 manufacturing centres, six airports, two power plants, a six-lane highway and 24 new Smart Cities, each planned to house 3 million people' (p. 17). International consultancies such as KPMG promote global infrastructure as the answer to the 'disruption, confusion and uncertainty' of the economy and offer expertise 'across the life cycle of projects – from strategy and financing to delivery and hand-back' (KPMG, 2018). Urban scholars increasingly are engaging with global infrastructure. Kanai and Schindler (2018, p. 2) point to the 'planetary proliferation of cross-border infrastructure networks being built in the context of multipolar, competitive capitalist globalisation'. In an era of rapid urbanization in the Global South and the repurposing of deindustrialized zones in the Global North, research on deployment of global infrastructure between, across and within cities is necessary for understanding how speculative future visions become materialized and configured across urban spaces.

This paper outlines a research agenda to examine urbanization and the deployment of infrastructure across the uneven, turbulent geographies of global capitalism. It is predicated on a critical review of literature on emerging, if disparate, theorizations of global infrastructure and urbanization with the objective of outlining the key research imperatives for urban studies. We define four generative concepts – speculation, delineation, alignment and pivoting – to convey the stages through which global infrastructure deployment proceeds, incorporating, but also exceeding, standardization. With research findings on the Central Corridor in Kampala, extending to the inland port of Mwanza and onward to Dar es Salaam on the Tanzanian coast, we present an illustrative case as part of an ongoing, comparative research project on these techno-territorial systems.

The Central Corridor case explores the deployment of global infrastructure as uneven urban development. Empirically, this paper necessarily expands beyond urban boundaries to trace the extended networks through which infrastructural transformations are produced. Fieldwork involved semi-structured interviews with 20 intermediaries, including planners and policy-makers, alongside relevant policy, economic and spatial analysis of secondary data and documentation. Further research was undertaken specifically in the neighbourhood of Namuwongo with 25 residents to explore the evictions deemed necessary for deployment. This work was guided through a method of investigating and understanding infrastructure as relational (Simone, 2014; Star, 1999). We extended our focus across several spaces encompassed within these initiatives, following the infrastructure networks and connections beyond the individual city, but remaining attentive to contextualizing the local, particular and material impact of global infra- structure deployment on patterns of urbanization. We conclude by outlining an emerging urban research agenda on the deployment in global infrastructure across the urbanization process.

GLOBAL INFRASTRUCTURE: AN URBAN PERSPECTIVE

Debates linking globalization and urbanization remain central to urban and regional studies (Brenner & Schmid, 2015; McNeill, 2017). Extant literature has shown the analytical potential to more thoroughly comprehend these dynamic geographical relations using a focus on the infra- structures through which urban geographies are techno-logically and territorially reordered (Kanai & Schindler, 2018). These infrastructure networks initially standardized the world economy into configurations of North Atlantic capitalism (Beckert, 2015; Williams, 1993). In a contemporary era described by Roberts (2011) as a ‘multipolarity’ and a ‘new world (dis)order’, infrastructure becomes the

materiality through which cities, regions and nation-states seek to engineer existing and future political–economic relations amid conditions of global and urban uncertainty (Zeiderman, Kaker, Silver, & Wood, 2015). From China enacting a counter-hegemonic geography of global capital- ism through the BRI (Chen, 2018; Martin, Tyler, Storper, Evenhuis, & Glasmeier, 2018), to regions such as East Africa configuring emergent techno-futures spanning the Indian Ocean (Newhouse & Simone, 2017), the deployment of global infrastructure acts as a territorial and technological reordering of the existing capitalist system.

We contend that relations between capitalist globalization and infrastructure across cities primarily have been examined within urban studies through two standardized infrastructural forms: node and corridor. Studies on infra- structure and cities emphasize both to account for the ways in which networked technologies configure cities into the expansive, material networks of global capitalism (Easterling, 2014; Schindler & Marvin, 2018). This paper problematizes accounts of the deployment of global infrastructure across urban space. A focus on standardization alone fails to consider the dynamic, unstable and con- tested spatialities involved in deployment. The paper emphasizes uneven processes of deployment within and beyond urban boundaries. To do so, we turn to debates within urban, infrastructure studies that highlight the ever-shifting, contingent and contested geographies of urbanization through its everyday, often-informal (re)mak- ing (Simone, 2004, 2015; cf. McFarlane & Silver, 2017; Rao, 2014) amid the not-uncommon disruptions and interruptions in networked services (Graham, 2010).

Global infrastructure and urbanization

Scholarship attendant to global infrastructure concentrates on the ways through which global capitalism becomes territorially, technologically and jurisdictionally materialized. This reordering involves procedures, regulations and standards emanating from global governance regimes such as the International Organisation for Standardisation (ISO) (Barry, 2006; cf. Easterling, 2014). As Timmermans and Epstein (2010, p. 82) assess, these standards extend ‘the infrastructural power of the modern state: its capacity, for good or ill, to penetrate its territories and coordinate social life’. As such, approaching standardization as an urban matter allows scholars to ground the political–economic aspects of global capitalism in space and place. From net- worked services such as electricity, to extractions such as oil, the logic of standardization underpins operation of global capitalism, including the reordering of urban spaces (Brewster, 2017; Danyluk, 2017). The imperative of standardization is implemented through what Schindler and Marvin (2018, p. 299) term a ‘regime of urban control that rests on an epistemology that

understands cities as a multitude of people and things with comprehensible and instrumental relationships that can be known and mapped'. It produces spaces, as Barry (2006, p. 239) argues, 'within which differences between technical practices, procedures or forms have been reduced, or common standards have been established'. Across cities, standardization has proceeded with and through the integration of infrastructures into urban spaces, as well as the construction of a uniformly built environment that historically was driven by the 'centres of calculation' (McNeill, 2017, pp. 97–123): the cities that command and control global capitalism (Sassen, 2011).

Standardization mediates the multiple networks, configurations, circulations and operations of infrastructure (Timmermans & Epstein, 2010). As Carse and Lewis (2017, p. 13) argue, '[s]tandards are integral to the vast, complex and dynamic infrastructures that support modern societies and economies'. Studies show how language, codes, rules and regulations underpin the expansion of cities in the Global South (Datta & Shaban, 2016), including across the 'fantasy visions' of 'smart' urban extensions (Watson, 2014; cf. Datta, 2015; De Boeck, 2011), as well as the repurposing of post-industrial spaces of the Glo- bal North (Wiig, 2016). This urban geography of global capitalism largely has been understood as clusters of repeatable, often generic 'spatial products' (Easterling, 2014) forming a 'recipe' of front and back offices standardized and reproduced through digital telecommunications, logistics clusters, entertainment and shopping districts, and lux- ury real estate. Therefore, examining the emergence of global infrastructure in urban spaces has necessitated a focus on standardization across myriad technologies, service systems, mega-projects and multiple temporalities, rhythms and spatialities of city life. And, as will be dis- cussed in the illustrative case below, technological and territorial reorderings occur as much in the 'ordinary cities' of global urbanization (Robinson, 2006) as in finance capitals such as London that figure so prominently in economic globalization narratives (Sassen, 2011).

Corridor/node: the standardized infrastructural forms of urbanization

We understand corridors and nodes as the infrastructural forms through which global infrastructure is urbanized. Corridors move people, goods and information (Harvey & Knox, 2015). These include trade, transportation and logistics corridors (Cowen, 2014), in addition to buried telecommunications networks and energy pipelines (Bouzarovski et al., 2015). Air and sea corridors also are prominent and manifest themselves on land through their nodal points: airports and oceanic ports (Neilson, Rossiter, & Samaddar, 2018). Urbanization proceeds along infra- structural corridors and within or adjacent to nodes through increasingly standardized built environments replicated worldwide

(Easterling, 2014; Harris, 2013). As of 2017, the Global Infrastructure Connectivity Initiative, a project of the G20, identified 30 newly established or in-planning cross-border trade and transport corridors on or between six continents (Global Infrastructure Connectivity Initiative (GICA), 2017). Hence, the infrastructural corridor also is understood in scholarship as the spatial, for- ward-looking vision of cities, nation-states and regional trading blocs to integrate into specific accumulation regimes, historical conditions and geographical contexts. Corridors are today both 'a common-sense reference in dis- courses of governance and policy-making' (Grappi, 2018, p. 175), that more-so 'organise economies, politics and social life around particular directional priorities' (Newhouse & Simone, 2017, p. 4).

Nodes, in turn, are the spaces where infrastructure net- works come together and concentrate, with the layering or stacking of logistics clusters, as well as advanced business services in central business districts and peripheral, back- office locations. Nodes act as a 'technological zone' (Barry, 2006), translating between and within various global infrastructures, bringing the logics and standardizations of global infrastructure together in particular, concentrated spaces. Extant literature has shown that nodes propagate explicitly for global capitalism and functionally inseparable from the globally integrated infrastructure through which they operate (Chalfin, 2010). These studies have examined how nodes rely on world-spanning networks, and the premium provision of technology that often excludes and fragments surrounding urban spaces (Graham & Marvin, 2001; Olds, 2002). This research has considered how nation-states and individual cities' aspirations for global- economic integration expand to include the state-sanctioned construction of these nodes as newly built cities or urban districts where global capitalism operates outside established territorial constraints (Chalfin, 2010; Easter- ling, 2014). They are the current endgame of global capitalism's desire for a 'frictionless' flow of bodies, goods and information (Enright, 2016) and, as we will discuss below with regard to Kampala, despite the emphasis within the current literature on standardization, are as much defined by what is absent, excluded and outside as by what is included.

The deployment of nodes and corridors as the under- lying urban, infrastructural forms of global capitalism predicate new geographies across the planning and operation of these systems. Deployment may reinforce splintered urbanisms between a global elite and local 'others' through the emergence of premium networks privileging spaces of global capital over the local. The highly uneven reconfiguration of urban technology and territory into infrastructural nodes and corridors relies on a standardization of urban spaces. This incorporates securitization and privatization, integral to how 'frictionless' space is established in particular urban settings. In the megacities of the Global South, such as

Karachi, Pakistan, the node is predicated on creating an enclave of order, stability and operation that requires separation from the perceived danger and violence of the 'other' city (Kaker, 2014, p. 93). In post-industrial spaces of the Global North, inner-city neighbourhoods adjacent to emergent nodes, such as in Camden, New Jersey, also are understood as hostile, meriting algorithmic surveillance and militaristic policing (Wiig, 2018). Nodes often require the expulsion of the 'other' and the possibility of urban violence as a precursor to subsequent inclusion within the multiple infrastructural spaces of global capital- ism (Zeiderman, 2016).

Beyond standardization

Theorizations of the networks underpinning urbanization have long critiqued the role of infrastructure in fracturing the urban landscape into enclaves of premium provision and surrounding spaces, which are proximate, but techno- logically cut off from the globalized economy (Graham & Marvin, 2001). From this perspective, the deployment of infrastructure, even with its underlying logic to standardize the urban materialities of global capitalism, does so in often unpredictable ways. This process highlights the variegated trajectories of urbanization through which global infra- structures are configured (Kanai & Schindler, 2018; Robinson, 2006). Nodes and corridors may facilitate global connections mediating integration into regional economies via premium infrastructure provision, high-tech configurations and emerging smart urbanisms (Wiig, 2018), but they always do so in the context of uneven development (Harvey, 2006). While extant studies on global infrastructure and urbanization have assumed standardization as the outcome of infrastructure deployment (Easterling, 2014), this paper problematizes such approaches within and beyond urban spaces. Global infrastructure and its logics of standardization materialize in different contexts. They are conditional on localized, particular histories and pre- sent-day geographies of uneven development (Barry, 2006). Building on Timmermans and Epstein's (2010, p. 204) call to develop a 'differentiated and symmetrical approach that investigates the full spectrum of positive and negative consequences of standardisation', we contend that deployment of these global infrastructure networks across urban spaces remains far from standardized.

In outlining an urban research agenda focused on the deployment of global infrastructure as uneven and contingent, we turn to other long-standing perspectives from infrastructure studies concerning the shifting ways in which these networked systems operate. Doing so emphasizes infrastructure-as-process, recognizing Easterling's point that '[s]ome of the most radical changes to the globalising world are being written, not in the language of law and diplomacy, but in these spatial, infrastructural technologies' (Easterling, 2014, p.

15). We advance our argument by using an open-ended conception of infrastructure that provides a critical framing to shift analysis beyond the logic of standardization. Underpinning this approach is research on the informal, incremental, peopled or social infrastructures that support social reproduction in cities without universal networked provisions (Rao, 2014; Simone, 2004). As McFarlane and Silver (2017, p. 6) argue in relation to the 'social' infrastructure operating across the popular, informal neighbourhoods of Kampala:

> [Infrastructure is] not just a context or a noun, but a verb: Social infrastructure is made and held stable through work and changing ways of connecting. It is a connective tissue, often unpredictable, anchoring urban life ... across the urban world.

Framing these informal infrastructures in action and as a 'verb' (Simone, 2004, 2015; cf. Graham & McFarlane, 2014; Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2018) demands paying attention to the dynamic spatialities of technological networks. Infrastructure, whether in the everyday context of urban service provision or across the networks of global capitalism, is far from a static set of technologies. Rather, it is an open-ended, contested pro- cess of ever-shifting, in-the-making, socio-technical relations. Graham and McFarlane (2014, p. 5) make clear that '[w]hat's important here is not infrastructure as a thing, but infrastructure as a set of operations'.

The emphasis on infrastructure being unstable and in motion, developed through work on informal urban conditions, is also reflected in studies on disruption of net- worked services (Graham, 2010). Examining how shifting interactions between technology and humans are critical to the operation of infrastructure, these studies have shown the ways in which engineers, planners, users and other actors engage with networks to sustain resource circulations. This work has been critical in showing infra- structure to be fragile, tentative and, as Graham (2010, p. 10) argued, a 'precarious achievement'. Associated work on repair and maintenance processes required to operate across formal and informal networks also has demonstrated infrastructure to be unstable and subject to change (Graham & Thrift, 2007) even as it 'sustain[s] and rework[s] particular forms of metabolic circulation through mundane and everyday practices' (Broto & Bulkeley, 2013, p. 1937).

Taken together, overlapping work on informal everyday systems, disruption, repair and maintenance pushes us toward a conception of infrastructure beyond the logics of standardization and notions of stability and fixity, toward its dynamic material and spatial (re)configuration. In returning to global infrastructure, we draw on these theorizations and shift the scale from which these conceptualizations of infrastructures within cities have emerged toward a focus on the networks oriented toward global capitalism's

relations within, but also beyond, the city. We do so to highlight that global infrastructure is also in motion, requiring various forms of work, labour and tech- nical intervention in its deployment and operation, remaining open to interruption or even failure and breakdown. An analytical vocabulary mobilizing these understandings can assist analysis of the deployment of global infrastructure. Drawing on our literature review and research in Kampala, the Central Corridor across East Africa and the BRI, we argue that deployment should be understood as an extended process that involves four stages through which global infrastructure comes to be configured across urban spaces: speculation, delineation, alignment and pivoting.

Speculation highlights the foundational stage in the deployment of global infrastructure, conveying cities' multiple (often competing) visions and plans to engineer urban spaces toward global capitalism amid waves of geopolitical turbulence and new trade geographies. Speculation in global infrastructure becomes a way for cities to navigate economic uncertainty (Zeiderman et al., 2015). As Rao (2014, p. 40) asserts, 'infrastructure becomes visible as a reformulation that feeds back specific ideas about the future into an urban imaginary'. At this stage of deployment, speculation predicates multiple visions of high-tech, globally integrated urban futures (Datta, 2015; Watson, 2014). This stage of deployment highlights the ways in which various national and urban intermediaries imagine how economics, technology and the urban are integrated through and into global infrastructure. Datta (2015) shows how Dholera, the first of '100 Smart Cities' planned in India, has become a form of speculative urbanization and 'smart' global infra- structure led by the regional state of Gujarat. The term reflects the uncertainties of global-infrastructure deployment and the ways in which, like the everyday infrastructures of informal settlements, envisaged futures remain open to various forms of interruption, contestation, recon- figuration or even failure (Simone, 2004). Attempts at establishing certainty and fixity in urban futures through deployment belie the speculative and inherently risky nature of investment in global infrastructure. Urban histories show how geopolitical turbulence and technological innovation have led to economic and associated infrastructural collapse, perhaps most visibly in former industrial cities. As Simone (2015, p. 155) notes, everyday infrastructures' 'existence is predicated on a risk'. Speculation focuses analysis on the ways in which infrastructure constructs urban futures as a negotiation and navigation through the shifting conditions of global capitalism, as well as residents' everyday lives.

Delineation highlights the necessary stage of deployment through which speculative visions of global infrastructure are made legible across urban spaces. The rationale of delineation is the reordering of urban spaces to create new nodes and corridors connected

to the established or emergent circulations, flows and material geographies of global capitalism. Delineation conveys the ways in which particular sites, spaces and populations become integrated into or isolated from global capitalism through various forms of planning, zoning and urban trans- formation. Thus, delineation draws attention to the imperative to create 'technological zones' (Barry, 2006) in which multinational firms and industries can synchronize and standardize inputs and outputs through the redrawing of urban spaces. This redrawn city creates new or extended enclaves of global infrastructure. Spatially, delineation defines and subsequently privileges these globally oriented spaces over those left outside – proximate, but disconnected, from global capitalism – spaces that can turn into divergent cities in the shadow of the node or cut off from the corridor. As De Boeck (2011, p. 277) has written on Kinshasa, DR Congo, and its envisaged high-tech node, Cité du Fleuve, this effort, meant to open a 'new era of African economic development', produces a 'new city map [which] will redraw the geographies of inclusion and exclusion in radical ways, and relegate its current residents to the city's edges'. Delineation of global infrastructure shares much with the everyday, incremental household strategies in informal spaces through which infrastructure space is claimed, constructed or produced, even as it remains tentative and at risk of demolition, collapse or mal- function (Simone, 2004, 2015). The term helps show the spatial divisions created through deployment, recognizing that the outside of the node or corridor offers an antithetical vision of urban futures removed from global capitalism, such as in Buenaventura, Colombia, where poor, long- established Afro-Colombian communities face displacement in favour of a Pacific-spanning port expansion (Zeiderman, 2016). Like the other stages of deployment, delineation is an active effort through which the (re)making of boundaries and spaces between the global and local require constant negotiation, redrawing, securitization and attempts at standardization. Again, we draw on scholarship on infrastructures produced by residents in informal settlements in which everyday navigations of myriad challenges demand redrawing of the parameters and capacities of improvised systems (McFarlane & Silver, 2017). Delineation also pushes analysts to consider what it means to experience everyday life both inside the infrastructural flows and apart from these highly structured and standardized spaces of global capitalism.

Alignment highlights the stage of deployment in which an array of different networked technologies are woven together in urban spaces and the ways in which technological, communicative, regulatory or financial components of infrastructure are configured toward new relations with global capitalism. It highlights the multiplicity of different processes in which infrastructure is 'fitted' into existing material assemblages of the global economy through and across cities, much like how residents piece together various

‘heterogeneous configurations’ of service provision in informal contexts (Lawhon, Nilsson, Silver, Ernstson, & Lwasa, 2018). Alignment points to multiple, sometimes contradictory, integrations and standardizations of infrastructural artefacts (rather than the large-scale, collective process of pivoting, discussed below). Carse and Lewis (2017) detail how, to accommodate New Panamax ships with lower underwater drafts, ports worldwide were forced to dredge access to a new, deeper standard or risk losing shipping traffic. This aspect of deployment also offers the counter- notion, to misalign. As Simone (2012, n.p.) cautions, ‘there are no predetermined reasons why things or events should necessarily connect’. Thus, the term also can emphasize how attempts by political actors to use infra- structure networks to connect into new or reconfigured trading relations do not always have intended outcomes. Factors from diplomatic breakdown to climate change to automation predicate new technological responses reach dead-ends or otherwise fail to connect to global economic circulations. Global infrastructures are never singular; they layer multiple networks in place, requiring the coordination of local transport, international connectivity, high- speed telecommunications, security and policing, housing types, scanning technologies, updated systems and programmes etc. Alignment helps analyze global infrastructure in the making by gathering together multiple networks that produce and maintain global capitalism into a cohesive sys- tem of nodes and corridors.

Pivoting highlights the stage of deployment through which multiple alignments create a larger transition and a significant shift in the underlying relations between a city and global capitalism. Pivoting conveys the ways in which these infrastructure networks have acted historically, and in the contemporary era of geopolitical turbulence, as a means through which global trade, city-to-city relations and urban economies can be engineered into new systems. Olds (2002) shows how Vancouver (Canada) and Shanghai (China) used urban ‘megaprojects’ of dense commercial and residential real estate and the integration of international finance industries to pivot underlying economies toward a Pacific Rim geography from the 1990s, creating the conditions in which to advance a new geography of trade. As Gupta (2015, n.p.) argues, ‘infrastructures are often long-term investments. They tell us a great deal about aspirations, anticipations and imaginations of the future, both for cities and nations’. Across the turbulent, contemporary era, the rapid, variegated deployment of global infrastructure shows that many cities are acting to establish new opportunities through the transformation of these networks. However, pivoting may not always be visible in deployment, as cities may seek to strengthen further (through alignment) historic trade geographies, rather than instigate a transformative shift toward new economic relations. Furthermore, attempts to pivot urban economies toward new trade geographies are not always successful, echoing the

everyday survival and livelihood strategies of residents in informal urban spaces in which improvised systems 'operate not separately, but dialectically, shaping one another, placing limits and forging different assemblages of urban life for different residents' (McFarlane & Silver, 2017, p. 469). Nation-states, regions and cities may miscalculate or face contestation and conflict from the deployment of global infrastructure, leaving them on the periphery of new power, circulation and exchange, or facing heightened geopolitical turbulence. Pivoting helps analyze global infrastructure in the making by placing cities, nation-states and their economic ambitions into the layers of connectivity (or disconnection) that weave nodes and corridors over borders and across oceans. Decisions to transform underlying urban economies require investment in new global infrastructures that collectively create the conditions through which a city may shift its historic net- works of trade and investment.

Using these four concepts can help shift analysis toward the deployment of global infrastructure in urban space as temporally specific, geographically variegated, and reliant on fragile, tenuous economic and geopolitical ties. In turn, this analytical approach highlights how the process of standardization does not inherently proceed in a rationalized fashion: global infrastructure materializes in urban spaces in contingent ways. The terms push scholars to con- sider the (re)making of various infrastructural technologies, networks and systems, as they facilitate shifting urban and national government policies, particularly of trade, connection and financial circulation.

URBAN GEOGRAPHIES OF GLOBAL INFRASTRUCTURE

China's growing role in reconfiguring infrastructure and urbanization reflects the underlying turbulence in the global economy and the uncertain futures faced by cities (Zeiderman et al., 2015). In a vision that counters the historic, North Atlantic hegemony of global capitalism, the BRI has been heralded as the largest infrastructure project of the 21st century, one that is expected to reorder geopolitical and territorial relations. Deployments of global infrastructure illustrate the aspirations of the contemporary Chinese

state: to gain more control over the technologies of global capitalism (Sidaway & Woon, 2017) through integration into overseas financial markets (Töpfer & Hall, 2017), infrastructure investment (Shepard, 2018) and various forms of infrastructural standardization toward Chinese technological and political influence (Hui & Cargill, 2017). From an urban perspective, the BRI also signifies the expanded role of infrastructure in linking heretofore disparate cities, as emergent transnational relations

create new configurations in trade, exchange and circulation. The alignment of multiple infrastructures is predicating spatial demarcations drawn around speculative visions of a Chinese future in which the global order is altered, 'making territory through infrastructure' (Bouzarovski et al., 2015, p. 217). These deployments are accelerating as they inscribe new purpose onto established regions, build new cities and construct infrastructural corridors and nodes. Taken together, these transformative investments illustrate the power behind narratives concerning the 'Rise of China' or the 'Asian Century' (Walton & Kavalski, 2016).

The BRI involves infrastructurally driven, material restructuring aimed at territorial integration within China and new, reimagined trade geographies beyond its borders. First, the 'New Silk Road' (Fallon, 2015; Sidaway & Woon, 2017) is the land-based integration of Central Asian, African and European techno-territorial constellations into the infrastructural orbit of the Chinese economy via six newly assembled rail and road corridors (Eder, 2018; Summers, 2016). Second, the 'Twenty-first Century Maritime Silk Road' strategy is 'targeting the maritime regions of Southeast Asia, South Asia, the Middle East, East Africa and the Mediterranean' (Arase, 2015, p. 24) by building or expanding ports. Proceeding alongside these configurations are intensifications of urbanization, particularly in central Asia (Linlin, Huadong, & Pesaresi, 2017, p. 79), and speculation on the part of cities (and their respective nations) toward China's infrastructural deployment (Barisitz & Radzyner, 2017). It is notable here that China presents an 'infrastructure-led approach to [an alternative] globalisation' in the Global South (Chen, 2018, p. 36), a vision that reaches the Global North as well, primarily Western Europe as illustrated through initiatives such as Royal Albert Dock and the Yiwu City– London train route. We draw attention to the BRI here to preface our illustrative case because, although distinct in location and context, the Central Corridor is deployed in direct and indirect relation to this Chinese infrastructural imaginary.

The Central Corridor: an illustrative case

As a global infrastructure initiative, the Central Corridor's deployment intends to connect landlocked Kampala and its resource-rich hinterlands across Uganda and eastern Congo with the port of Dar es Salaam on the Indian Ocean (other spokes will extend to Rwanda and Burundi). The Central Corridor aims to accelerate the movement of goods to the port from three or four days to 24 hours. It also expects 'to strategically position the Central Corridor as the most efficient in East and Central Africa so as to contribute positively to poverty-alleviation programmes in member states' (CCTTFA, 2018a, n.p.). This deployment takes place in the context of rapid urbanization, accelerating natural-resource

extractions and circulations of financial capital across the surging economies of East Africa. Like other initiatives in the region, these investments belie the aspirations of nation-states to pivot toward Chinese and wider Indo-Pacific economic collaboration and away from colonial-era economic ties to Europe and North America (Newhouse & Simone, 2017). Uganda's stated future vision is predicated on deployment of global infrastructure to reorder the country technologically and territorially for economic growth (National Planning Authority, 2013). In addition to pivoting to Tanzania, the Indian Ocean and the BRI via the Central Corridor, new nodes and extended corridors are planned across Uganda, including a 'hi-tech ICT city', 10 new cities, four international airports, national high-speed rail and a multi-lane road network, all to propel further industrialization and growth of a service and information economy. While still nascent, this deployment is underway. For instance, the US$400 million 'Uganda– China (Guangdong) Free Zone' opened in 2018 with preliminary production consisting of 'fertilisers and industrial bricks for export' (Uganda Free Zones Authority, 2018). Over the coming decade, it is likely that global infrastructure will continue to precede and facilitate economic development. At the same time, this deployment will unevenly transform urbanization in the country unevenly, creating new connections, but also new fractures in the geography.

The Central Corridor's deployment is contextualized within the speculative future urban scenarios configured to emergent networked geographies envisaged through ties to the BRI, particularly its MSR, through the 'transcontinental exchange of manufactured goods and commodities between Asian and African economies' (Lim, 2015, p. 3). Returning to the debates on everyday infrastructures, Graham and McFarlane (2014, p. 19) argue that 'people engage in speculative transactions through which they attempt to anticipate the actions of others'. This understanding can be extended to consider how these calculations are mirrored across the anticipatory networks deployed in response to the MSR through investment in the Central Corridor and associated nodes – ports, free-trade zones and logistical hubs – to 'meet the needs of developing nations across the Indo-Asia-Pacific region' (Green, 2018, p. 1).

Underlying the ways in which the first stage of deployment can be understood as speculative are the competing geopolitical, territorial and infrastructural plans and visions that are emerging in response to the promises of the MSR from various cities and nation-states in the region (Jian, 2018; Lim, 2015). The ambitions of the Tanzanian Export Processing Zones Authority to transform Tanzania into a 'globally competitive country' (Tanzania Invest, 2016) will rely upon this infrastructural reordering of its economy and closer relations with regional partners. For Uganda, deployment provides a speculative, if

calculated, attempt to accelerate the integration of rapidly urbanizing Kampala and its hinterlands into a new infrastructural configuration that can support national economic growth (Ministry of Foreign Affairs, 2017). As the Uganda Vision 2040 plan states, 'Ugandans desire to have world-class infrastructure and services, and modern technology to improve productivity and production' (National Planning Authority, 2013, p. 10). This is reflected among the business community. For example, David Wangi of the Kampala City Traders Association comments in the Monitor newspaper: 'What we need from you is service which is cheaper, faster and efficient. Then our job will be made easy in Kampala' (Nakaweesi, 2017). Therefore, the Central Corridor should be understood as a planned, but speculative, response by the Tanzanian and Ugandan governments to these needs and concerns for development and growth.

Deployment of the Central Corridor as a future-orientated, Indian Ocean-facing infrastructure network has relied on the delineation of new space inside and outside the var- ious cities through which this network will operate. Thus, materializing plans for the Central Corridor will require delineation of new free-trade zones, science and technology developments, information and communication technology (ICT) hubs and other standardized infrastructural 'fantasy' visions (Watson, 2014) within the corridor and across the various nodes. For instance, Mwanza, which Tanzania has designated as a key node in the Central Corridor network, has presaged the prioritization of global infrastructure in the city's spatial planning processes. The first special export zone already is being drawn to the city through land-acquisition processes. Financed by China, construction started across 3500 hectares of urban space within the Usagara and Nyangamango area of the city (Kirwanda, 2014). The delineation of urban space to incorporate these new nodes is crucial to the Export Processing Zones Authority's (2016) objective to transform Tanzania into a 'globally competitive country' (Tanzania Invest, 2016, n.p.), but these infrastructure-led plans also have implications farther west along the Central Corridor in Uganda's capital city.

In Kampala, the railway line connecting the city to Lake Victoria and onward to Mwanza has been repaired and upgraded with financing from the Tanzania government and its Chinese loan (CCTTFA, 2018b). As we high- lighted in the introduction, this railway line travels from Port Bell through the informal neighbourhood of Namuwongo, an area claimed by marginalized populations for many years (McFarlane & Silver, 2017). Deployment of global infrastructure has necessitated the delineation of Namuwongo into space inside the corridor operations, requiring the clearance of existing land uses and the expul- sion of residents (Nambowa, 2014). As a local resident noted, 'Right now, we have no future here' (interviewee Q, 14 February 2016). In one eviction, this meant

‘former tenants [were forced] to relocate and rebuild near a stream that snakes through Namuwongo’ (Ndinawe, 2018, n.p.), showing how delineation elicits violence and subsequent everyday problems that emerge from destroyed everyday systems for those expelled from global infrastructure spaces.

Delineation in Namuwongo draws attention to the ways in which global infrastructure is splintering Kampala and causing problems for residents, despite promises of economic growth and development. It reminds us that ‘the hype surrounding development corridors has, at times, turned a blind eye to the diverse, unexpected and sometimes adverse impacts that corridor development has on different segments of the population’ (Enns, 2018, p. 106). Failure to support residents whose homes and businesses are delineated within global infrastructure space was visible in Kampala, where neighbourhoods are claimed by the state, and no compensation is paid despite the precarious future that dis-placed residents face. As a local opposition politician stated, ‘The future of Namuwongo over the next six months is uncertain’ (interviewee P, 13 February 2016). Despite fears by local communities of state-sanctioned violence, contestation over the deployment was visible. This did not take the form of direct resistance to the corridor’s construc-ion, but rather, during national elections, residents sup- ported opposition parties such as the Forum for Democratic Change. As one resident said, ‘There is no future in Namuwongo if this government is still in power’ (interviewee T, 16 February 2016). Even among those in Namuwongo whose homes have been delineated as lying outside the corridor are anxious about living in such close proximity to cargo-laden trains, triggering uncertainty about their future outside this global infrastructure space.

A range of different infrastructures, technologies and standardization regimes has been configured into an alignment to create the Central Corridor’s larger infrastructure network. For instance, the construction of a standard-gauge railway connecting Dar es Salaam with Port Mwanza, Lake Victoria, a new system of ferries, the expansion and rehabilitation of the inland Port Bell in Uganda and the repurposing of a colonial-era railway line to central Kampala all have been required to integrate their systems into the infrastructure corridor (CCTTFA, 2018b). In Kampala, this alignment has meant reincorporating Port Bell into the region’s transportation networks. This transit hub on Lake Victoria experienced a decline over the past few decades as its technologies became obsolete and its cargo dropped from 600,000 to 10,000 tonnes annually (Muwanga, 2018).

Furthermore, the Central Corridor emerged out of reinvigorated geopolitical relations established to create a cross-border, 1400km pipeline for oil production in Hoima,

western Uganda. Accessing global markets from the port of Tanga, the East African Crude Oil Pipeline likely will carry a total of 2.2 billion barrels of recoverable Ugandan oil reserves and cost US$4.4 billion to construct with oil destined primarily for the China National Offshore Oil Corporation. The deployment of an extractive infra- structure network created the political conditions for further technological and territorial alignment. The twin global infrastructures of oil and wider transport circulation between East African neighbours show how alignment is produced through layers woven throughout cross-jurisdictional material, political and economic collaborations that extend to encompass new techno-territorial and administrative configurations.

Finally, the deployment of the Central Corridor can be understood as a strategic response that aims to pivot Uganda's trade flows both globally toward the MSR and region- ally toward an alternative coastal point that reinforces the geopolitical and geoeconomic ambitions of Tanzania and Dar es Salaam, which themselves are pivoting toward China. This global infrastructure offers a way for Kampala to pivot its economy primarily by reconfiguring networked geographies of connection stretching outward to the global economy via the Indian Ocean and MSR. Restricted presently to connections to Nairobi and Mombasa, the assemblage of new global infrastructure toward Dar es Salaam will shift Ugandan circulations and flows of trade, goods, services and people away from Kenya's cities alone. This infra- structural shift in the Ugandan economy toward Dar es Salaam will be noticeable in a series of different urban con- texts across both countries: currently, 90% of Uganda's goods are transferred via ocean voyages to Mombasa (BBC News, 2017), but the new rail linkages to Dar es Salaam will likely reduce this dependence. The Central Corridor will then reinforce urban-economic agglomeration in Dar es Salaam (including of Ugandan trade and industry) through its intensifying role as a logistical node in the Indian Ocean economy. Spillover effects of global infrastructure connection will likely increase the presence of multinational firms across both cities. In Mwanza, the second-largest urban region in Tanzania, the designation of the city as a key component in this speculative deployment of global infrastructure likely will predicate accelerated urban growth and the creation of new nodes explicitly designed with an eye toward Kampala, Dar es Salaam and beyond, rather than the city itself. But the pivot as a stage of deployment is far from certain. The Central Corridor remains in competition with more established regional alignments of various infrastructure networks, including the US$13 billion Kenyan East Africa Railway Master Plan and the port at Mombasa (Sambu, 2008), alongside the Lamu Port–South Sudan– Ethiopia-Transport (LAPSSET) Kenyan mega-infrastructure project incorporating port expansion at Lamu, new highways, pipelines, railways, airports and resort cities (Bremner, 2013). The urbanization trajectories of Kampala, Dar es Salaam and Mwanza remain uncertain, as

their linkages to and beyond each other are deployed through various global infrastructures. Despite the promises that are bound up within the plans, investments and strategic calculations of the Central Corridor, the desired outcomes of transnational, trans-oceanic connection and the attendant economic growth are never guaranteed, even as the infrastructural deployment itself materially transforms cities in the present day. Applying our relational analysis to the illustrative case of the Central Corridor within and beyond Kampala highlights the need to take global-infrastructure deployment seriously, beyond the logics of standardization.

CONCLUSIONS: ADVANCING A RESEARCH AGENDA

The deployment of global infrastructure underpins the (re)making of cities across the turbulent present and precarious future of global urbanization and the global economy. The proliferation of global infrastructure should be taken seriously in seeking to understand how the techno-territorial reconfiguration of cities is predicated on calculated attempts to navigate uncertain urban futures. We began by highlighting the world-spanning ambitions of China and its BRI as it arrived in London, before articulating how deployment of global infrastructure is shifting urban geographies in East Africa. We provided a review of current, if disparate, debates over the prominence of global infra-structure across and beyond cities. We showed that standardization has become a key means through which scholars are scrutinizing global infrastructure as urbanization. We argued that the focus on standardization illustrates the geographies of global capitalism in cities and can be characterized as repeatable, generic spatial products to apply Easterling's (2014) terminology. These infrastructures encompass a myriad of technologies that focus on the logic of managing and maintaining flows of people, goods, capital and information into and beyond individual cities. We highlight the corridor and node as the two crucial infrastructural forms through which global infrastructures are situated across urban spaces, acting as mediators between individual cities and the world economy.

This paper's key contribution has been in arguing that the emphasis on standardization fails to account for the dynamic, often-unstable urban geographies in which various intermediaries seek to embed these infrastructures. We argued that existing analytical tools to examine the urban deployment of global infrastructures overlook how all infrastructures, including global infrastructures, are contingent on unforeseen and uncertain futures. Research on global infrastructures and urbanization must look beyond uniform economic flows and technological forms, and into the material, contextual and uneven geographies within and between cities.

Drawing on scholarship on infrastructure within rapidly urbanizing and informal urban spaces, we offered four generative concepts to convey the unpredictable geographies of global infrastructure deployment. First, we proposed the term speculation to highlight how infrastructure supports cities' ambitions to become or remain central to global capitalism amid new/perceived economic opportunities and turbulence. We argued that the term helps shift analysis toward often multiple and risky attempts to forge new global–local relations through these networks without any assurance of success. Second, the term delineation indicated the ways in which spaces of standardized technology and infrastructure are configured for global capitalism. Delineation also highlighted the ways in which urban space is produced outside these often-unstable relations and the potential for failure in attempts to redraw the city. Third, the term alignment emphasized how adjustments to individual technological, regulatory or financial components are necessary in shifting urban-based infrastructures toward new flows and circulations, and also demonstrated the potential for the breakdown or failure of particular schemes, projects and plans, leading to misalignment and disconnection. Fourth, the term pivoting conveyed the range of different, collective global and regional infrastructures necessary to transform the underlying relations between cities and global capitalism strategically. Building on this position, we argued that the term also conveys the risk of infrastructure failing to integrate new trade relations sought by initial speculation. While we recognize these terms' potential limitations in encapsulating the uneven- ness of deployment worldwide, they provide a useful approach for analyzing global infrastructures beyond a focus on standardization and toward the uncertain urban geographies predicated on shifting global–local relations across a multiplicity of contexts.

The accelerating deployment of global infrastructure across the turbulent present and precarious future of urbanization and the global economy elicits the need for critical conceptual vocabularies to grasp these transformations more effectively. Newhouse and Simone (2017, p. 2) write, 'one of the challenges is the speed of these intersecting changes – in land use and ownership, in the mechanisms of infrastructural investment and in the physical remaking of cities'. This speed of change highlights the difficulty of analyzing these widespread shifts in the scope, scale and pace of deployment underpinning rapid urbanizations and the shifting techno-territorial, urban dimensions of global capitalism. Researching the variegated ways in which such deployments unfold is crucial for those interested in examining the geographies of global infrastructure and urbanization. Critiquing global infrastructure as urbanization prods scholars into moving beyond the focus on standardization and asking what these technologies connect, where they are connected, and for what purposes, that is, for whose needs. Focusing on the expected and unforeseen ways in which such deployments unfold should become a key

area of research for those interested in under- standing the uncertainties underlying urbanization trajectories in the turbulent present and precarious future.

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