Disassembling infrastructure space:
Tracing the links between infrastructure, urban space and governance

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Abstract

Assemblages of urban infrastructure are oft considered the banal undergirding of urban-regions. This paper, drawing from research in urban India, suggests that calls for more or better infrastructure—whether water, energy, sewerage, mobility systems or ICTs—can ignore its crucial importance in (re)shaping and (re)producing urban spaces. The paper posits that the long-term ‘lock in effects’—including socio-economic and environmental effects—of infrastructural projects and pathways needs to be carefully considered in relation to urban space and governance.

The paper introduces an integrated socio-technical methodology for exploring the interconnections and disconnections between infrastructure(s), urban space and governance. This ‘disassembling infrastructure space (D-I-S)’ analytics draws upon a troika of approaches—‘walking, rhythming, and talking politics’—to develop an integrated socio-technical methodology for unpacking infrastructure projects.

A D-I-S perspective posits that ubiquitous, seemingly banal, infrastructure(s) assemblages need to be critically interrelated to questions of knowledge, power and space in rapidly changing city-regions. The ‘disassembling’ methodology will be employed in an exploratory investigation of infrastructure projects the fast morphing city-region of Bengaluru (Bangalore), India. The paper, aimed at introducing a methodological disposition, claims that a ‘DIS’ approach can provide critical spatial and governance insights into urban infrastructure projects.

Keywords:
Assemblage urbanism, urban infrastructure, urban governance, spatial methodologies, Indian city-regions, Bangalore / Bengaluru, disassembling methods
1. Introduction: Assembling and disassembling urban infrastructure space

“I’m trying to find my direction home, a question of space, a matter of time, I follow the stars until the first light…”

—from the song ‘Of Space and Time,’ by the band City of Light (2013).

Seeing urban infrastructure(s) as fixed objects across city spaces belies its fluid, co-evolving and malleable nature. Two high profile examples of urban infrastructure megaprojects—one from Asia; and one from America—involving the dismantling of urban freeways in the name of reclaiming the urban commons, serve to illustrate a literal disassembling of infrastructure. Constructed in an era of an unbounded belief in personal freedom when friction free automobility trumped urban livability or ecological sensibility—the first infrastructure disassembly site featured a freeway (originally built in four stages from 1955-1977) above the Cheonggyecheon Stream in central Seoul (Preservation Institute, 2013). The park space now occupying the former highway illustrates the rapidity with which seemingly modern infrastructural visions can become obsolete or outdated. The now ‘daylighted’ Cheonggyecheon Stream and an adjacent linear park were born out of the purposeful government directed destruction in 2003 of a massive freeway assemblage which once stood atop the ancient waterway. Likewise the Central Artery / Tunnel project in Boston involved “the removal of an ageing, unsightly elevated highway” (Barrett and Barrett 2006: 209) and its underground burial (dubbed the ‘Big Dig’) represented a massive (two decade long) project. The burial of a freeway also spurned the creation of a three-mile linear urban park and waterfront revitalization where the (now disassembled) freeway once disconnected residents from waterfront access.

These costly projects although illustrating the (re)creation of publicly accessible green spaces—are also suggestive of how problematic it can be to reclaim urban commons and public natural spaces once lost to ill conceived infrastructural pathways. Both examples also serve as a helpful reminders of the historically contingent and fluid nature of infrastructure. These two examples also underline the important linkages
between the production of urban space and threats to the public commons and livability that are often associated with the assembling of infrastructure. The purpose of this paper is to devise a working methodology that might better assist in figuratively ‘disassembling’ or unpacking our understandings of the spatial and governance ramifications of infrastructure projects. Elaborating on this ‘disassembling’ approach will take us on a journey to Bengaluru, India where rapid urbanization has resulted in a range of novel infrastructure assemblages worthy of further examination.

Assemblages of large-scale technical systems and networked infrastructures have historically transformed urban space—whether ancient aqueducts, sewers, canals; or railroads, freeways and communication networks. With an ongoing confluence of information communication technologies (ICTs) and ‘global cities’ (Castells, 1996, 2003; Sassen, 2001; 2002; Laguerre, 2005) networked socio-technical systems and infrastructure (mega)projects are continuously shaping and being shaped by urban morphologies (Graham and Marvin, 2001; Coutard and Guy, 2007). But just what are contemporary ‘infrastructure assemblages’ and how do they shape spatial practices in city-regions? From water pipes, coaxial cables and pavements to mobile telephone base stations, mass transit subway stations or electrical sub-stations—how might we better examine and build theory about the spatial ramifications of these everyday, yet critical, infrastructural systems? This paper attempts to address such queries by introducing a ‘disassembling methodology’ that may assist in scrutinizing urban infrastructure(s) and uncovering key spatial and governance issues related to such projects. This crosscutting ‘disassembling approach’ will draw from a number of interdisciplinary theories and upon preliminary empirical work at urban research sites featuring urban infrastructural assemblages and local political contestations—particularly in the southern Indian city of Bengaluru (Bangalore).\footnote{This paper draws upon research at urban sites conducted by the authors in 2012 and ongoing in 2013 for the Social Science Humanities Research Council (Canada) funded ‘Assembling Infrastructure Decongestion’ project (Bengaluru and New Delhi).}

The term ‘assemblage(s)’ draws upon actor-network theory (ANT)—an analytical approach for examining the socio-technical co-evolution and ramifications of

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technologies—including how infrastructures are shaped by and shaping of cities (Graham and Marvin, 2001; Farias & Bender, 2010; McFarlane, 2011; Monstadt, 2010). An ANT approach suggests that the development, shaping and maintenance of assemblages of networked infrastructures involve a dance between society and technologies—or what Pfaffenberger (1992) more broadly terms "technological dramas." Infrastructure assemblages, and more particularly assemblages refers to, "complex and heterogeneous assemblies of both social and technological actors, strung out across time and space and linked through processes of human and technological agency" (Graham and Marvin, 2001: 185). Assemblages, as it is employed in this paper, therefore remains inclusive of both 'pipes' (hard infrastructural artifacts) and 'policies' (governance or institutional systems and processes). Law (2004: 41) emphasizes that 'an assemblage'—as an abstract noun—is an active, uncertain and unfolding process, which is "ad hoc [and] not necessarily very coherent." Law (2004: 41) quoting Watson-Verran and Turnbull (1995: 117) add that an assemblage "also has the virtue of connoting active and evolving practices rather than a passive and static structure." "An assemblage," according to Collier and Ong (2005: 25), is "the product of multiple determinations that are not reducible to a single logic." They add that, "the temporality of an assemblage is emergent. It does not always involve new forms, but forms that are shifting, in formation, or at stake." With reference to 'assemblage urbanism,' McFarlane (2011, 206) suggests that: "rather than focusing on cities as resultant formations, assemblage thinking is interested in

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emergence and process, and in multiple temporalities and possibilities. Indeed, assemblage urbanism has focused on critically understanding the workings and management of cities as complex systems, including the role of infrastructure in (re)shaping our understandings of cities including via socio-technical analyses of mobility or telephony systems (Farias and Bender, 2010; Graham and Marvin, 2001). For example, Coutard and Guy (2007: 717) suggest that an assemblage approach treats urban-regions “as an ‘enormous artefact’ where the social and technical are heterogeneously engineered by a range of competing actors and institutions.” An assemblage urbanism approach to studying urban infrastructure technologies suggests that ‘impact assessments’ will be limited at best; and that seeing urban infrastructure(s) as fixed, ordered or stable entities ignores their “leaky, partial and heterogeneous” nature (Graham and Thrift, 2010: 10).

The banal, taken for granted or seeming invisible aspects of seemingly fixed assemblages of urban infrastructure can lead us to ignoring its unreliability, breakdowns, continuous interruptions and perpetual need for repairs, maintenance and improvisation—not only in cities of the ‘global south’ (Graham and Thrift, 2010: 8, 10). This highlights the importance of (re)examining ‘disconnection and disassembly’ (Ibid., 6-8) in urban infrastructure assemblages—a key line of argument linked to the ‘disassembling infrastructure spaces’ methodology developed in this paper. Such an approach also suggests that the ‘malleability’ of urban infrastructure (Furlong, 2010) needs to be an important consideration in its governance. As an example, locally-based civic associations have demonstrated an aptitude for creative and adaptive uses of ICTs for the purposes of local or global activism (Sadoway, 2013).

Urban infrastructures are also crucial to contemporary modern lifestyles and normalized

6 McFarlane (2011: 206) also notes that an assemblage can generally serve “to connote indeterminacy, emergence, becoming, processuality, turbulence and the sociomateriality of phenomena.”

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practices. Such forms of knowledge construction or conditioning are vital because they highlight not only the individual’s membership within infrastructures as a ‘community of practice’ but further suggest participation in the ‘modern condition’ or modernity (Star and Ruhleder, 1996). Infrastructures arguably constitute an artificial environment (Edwards, 2003) inhabited by ‘modern’ humans, set apart from pre-modern humans who existed within and therefore at the mercy of nature. Infrastructures, from this perspective, are fluid technostructures that, by artifice, reify the nature / society duality that lies at the heart of the modernist project of domination over nature. A similar view has been powerfully articulated in political ecologists’ work on urban water supply (e.g. Swyngedouw et al., 2002). Edwards (2003: 191) suggests that infrastructures “create both opportunities and limits; they promote some interests at the expense of others. To live within the multiple, interlocking infrastructures of modern societies is to know one’s place in gigantic systems that both enable and constrain us.” Examining the trade-offs and contestations (i.e. who gains and who loses) in infrastructural choices therefore can reveal an otherwise hidden or ‘buried’ aspects of urban (infrastructure) governance and metropolitan spatial patterning.

Part of this paper’s interest is also in better understanding how infrastructure as socio-technical systems can become locked (or stuck) in place creating problematic ‘path dependencies’ (Monstadt, 2010: 1928, 1937), including problematic spatial and environmental trajectories; and producing issues of inaccessibility and inequity (e.g. ‘premium’ network spaces) for critical public goods and services. The latter is an ongoing process in ‘global cities’ that Graham and Marvin (2001) refer to as ‘splintering urbanism’. It is these seemingly paradoxical aspects of urban infrastructure assemblages—including both ‘infrastructure hardware’ (i.e. pipes); and ‘infrastructural software’ (i.e. policies)—and their co-evolution with urban spaces and at polyvalent levels of governance that are of central interest in this paper.

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7 Practices of normalized consumption are currently founded upon being ‘infrastructured’ which indicates a physical connection but also a common knowledge of the operation of a variety of domestic and urban technologies such as water taps, traffic lights, and electric switches.
The role of infrastructure in shaping urban space and in relation to the day-to-day governance and management of city-regions has arguably been underexplored across various urban infrastructure domains (see critiques by Monstadt, 2009: 1925, 1929, 1932). This prompts a number of critical questions. For example, do contemporary infrastructures produce techno-landscapes or ‘infrastructurescapes’ of semi-complete or ‘wasted’ spaces in the urban fabric? What participatory and governance configurations serve the public best in undertaking urban infrastructure projects? Or, who bears the overall socio-economic and environmental ‘costs’ (and ‘benefits’) from urban infrastructure projects in the long term? Is the rise of ‘premium network’ infrastructure and spaces illustrative of the growing political power of urban elites in steering access to and priorities for infrastructure? And what kinds of impacts do infrastructure(s) have on the rhythms of everyday lived city spaces? The need to address such complex questions about how urban infrastructure relates to space, rhythms and governance suggests the need crosscutting methodologies for critically studying infrastructure(s) in city space. This paper suggests that a disassembling (D-I-S) approach to studying urban infrastructure governance and urban space needs to involve walking, observation and careful study of the space, rhythms and polity at infrastructure project sites; including talking to members of communities who have by virtue of their residency become localized actors in the politics of networked infrastructures. ‘Walking – rhythmning – talking politics’ are three key elements of the D-I-S approach that will be further elaborated below.

The remainder of this paper outlines, in four additional sections, an integrated methodological approach for disassembling or unpacking urban infrastructure projects—particularly as it relates to urban space, daily rhythms and multi-level governance. The first part of the paper below discusses urban infrastructure in India and the case of

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8 An ‘infrastructurescape’ (see Gopakumar, forthcoming) as a socio-technical assemblage has important parallels with Actor Network Theory (ANT) (Latour, 2005). These parallels are evident in the heterogeneity of construction materials that are employed and the heterogeneous engineering (Law, 1987) used to assemble both actor networks and infrastructurescapes. Where they diverge is in the explicit perspectival and spatial orientation of infrastructurescapes. The perspectival construct ties the concept of infrastructurescape to the development of ‘scapes’ and landscapes within literature formations of landscape studies, anthropology of global cultural flows, and mobility studies.

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Bengaluru. This portion of the paper suggests that without the appropriate methodological theory-frame that the role of seemingly mundane infrastructure spaces may be ignored in urban spatial studies and theory building. The second section of this paper suggests a crosscutting approach to address the need for methods geared to the study of ‘banal’ infrastructure spaces. The method posited here, disassembling infrastructure space (D-I-S), elaborates upon three dimensions—walking, rhythming, and talking politics—and posits that such an approach can build an integrated picture of the dynamics of knowledge, power and space related to explicit urban infrastructure projects. The third section undertakes a brief set of infrastructural explorations centred upon Bengaluru—examining flyovers, water systems and transit nodes—in order to better understand how a D-I-S approach might be applied for examining specific urban sites. Finally, the paper’s concluding section reviews the importance of better understanding urban infrastructure’s integral links to people and places; and it reviews how a disassembling method can prompt powerful critiques of otherwise of seemingly mundane ‘pipes and pavement’ issues in cities.

2. Urban infrastructure in India and Bengaluru

Urban infrastructure(s)’ can be broadly defined as: urban socio-technological systems and networks, including, but not limited to, water, waste, transportation, energy and information communications technologies (ICTs) (UN-Habitat, 2012: 48; Linton, 2010); as well as the governance and administrative assemblages supporting these large scale socio-technical systems (Miller and Hobbs, 2005; Furlong, 2011; Gopakumar and Gore, 2013). Guy and Coutard (2007:7) synonymously refer to infrastructure and the socio-technical workings of ‘urban technical networks’—and they include: “water and energy supply, transportation, and telecommunications systems.” As systems of public works composed of both technical artifacts and institutional arrangements—infrastructure can be understood as systems or networks that mediate the critical flows which service and constitute modern societies (Edwards, 2003; Linton, 2010), including in contemporary cities.
Current urban infrastructural issues are also closely intertwined with global trends in urbanization. For instance, UN-Habitat’s ‘World Urban Campaign’ identifies the “irreversible transition to a predominantly urban world” which during the coming two decades will see the global urban population shift: “from 50 percent urban to 70 percent” (You, 2010: 6). Arguably urban infrastructure provisions could assist in addressing a number of key issues associated with this rapid urbanization, including: economic growth; mobility; access to health and education; quality of life; steering spatial expansion; improving environmental quality and household living conditions; poverty alleviation; and redressing spatial disparities (UN-Habitat, 2012: 57). The importance of infrastructure in domestic and workplace demand patterns; as well as in flows and movements in the rapidly growing urban-regions—especially in relation to basic needs; for disaster relief and crisis alleviation; for ‘decongestion’ and access to ICTs and information in growing cities; and overall for human development—stands out as a key set of rationalizations driving demands for more and better urban infrastructure.

Urban infrastructure plans, projects and programming can also—as countless cases around the globe have shown—have paradoxical and problematic impacts such as: altering longstanding local knowledge systems; generating project cost overruns; increasing urban inequities and distributional issues, including ‘land grabs’ and forced clearances; increasing environmental and resource inefficiencies; creating long-term technological lock-in and dependency effects; exacerbating land use and urban morphology problems; convoluting public and private benefits, including through corruption or ill conceived public-private partnerships; reducing public participation and local democratic accountability; creating cumulative environmental threats; and increasing challenges in urban governance (e.g. Graham & Marvin, 2001; McFarlane, 2010; Roy & Ong, 2011; Lehrer & Laidley, 2009; Fainstein, 2009; Monstadt, 2009; Goldman, 2011).

To cite just one example of the paradoxical aspects of urban infrastructure, large-scale transportation projects are sometimes understood as potential transformational tools deployed by governments in global city-regions—not only for addressing mobility issues
such as moving people, goods and services inside and between cities—but also as approaches for enabling economic development or urban renewal benefits (Gospodini, 2005). Such infrastructure projects typically feature massive and multi-year public investments, often with intertwining private sector construction and financing mechanisms; sophisticated institutional and project management arrangements; and they have wider consequences beyond the neighbourhood context (Dimitriou et al., 2008). Yet research shows that not only do such infrastructural projects sometimes pose serious spatial, social and environmental consequences, they also can pose problems for the public purse. Here the work of Flyvbjerg et al. (2004) has highlighted the sometimes-problematic public economics of such infra-projects involving the frequent problem of project cost-escalation—apparently regardless of whether the public or private sector was undertaking these infrastructural projects.

In India, various prognoses of urban gridlock and the resulting economic disadvantage in fragmented cityscapes in the country have been common justifications undergirding infrastructure-led developmental policies. Besides treating Indian cities as ‘engines of growth’ as envisioned in the Jawaharlal Nehru National Urban Renewal Mission (JNNURM)—a massive $11 billion (USD), 7 year (2005-2012) initiative focused on infrastructure-led urban renewal and reforms in 65 of India’s largest cities—a number of high level policies and position papers advocate an infrastructure-led mode of urban development.⁹ The JNNURM initiative and ongoing policy directives from India’s Planning Commission (particularly the Tenth Five Year Plan 2002-2007 and the Eleventh Five Year Plan 2007-12) as well as influential reports, such as the April 2010, McKinsey Global Institute (MGI) report (“India’s urban awakening: Building inclusive cities, sustaining economic growth”); as well as the Indian government-appointed, “High Powered Expert Committee (HPEC) for estimating the investment requirements for urban infrastructure,” (with its 2011 released report, ‘Indian Urban Infrastructure and Services’)—are illustrative of a growing calls for a focus on urban infrastructure at

⁹ In order to access JNNURM funds Indian states and city governments (Urban Local Bodies) have to meet two operational aspects – first, states and cities have to adhere to reform conditions; and second, cities have to requisition for funds for projects that are based, ideally, on a participatory and democratic planning process (Sivaramakrishnan, 2011).
multiple levels of governance in India during the past decade. The McKinsey report (MGI, 2010: 18), for example, warned that current forms of Indian urbanism, “could lead to urban gridlock and decline”—a condition whereby urban infrastructural flows could be overwhelmed and blocked or collapse from sheer physical inability. A number of critics have charged that centrally conceived initiatives and proposals, such as JNNURM, may on the one hand be repairing and (re)making Indian cities more efficient, while on the other hand they may be making cities as less equal and more susceptible to the interests of elites, a new middle class and industrial-commercial lobbies (Banerjee-Guha, 2010; Mahadevia, 2003).

Closely linked to the crisis of gridlock in justifying ‘infrastructuralism’ in cities—as illustrated above—has been the suggestion that urban renewal, economic development or regeneration and project legacies will result in public benefits from investments in urban infrastructure systems and megaprojects. Without such investments, the MGI (2010: 53) suggests that urban decay in India could ensue since, “gridlock will hopelessly compromise productivity, and investors will decide that India’s cities are too chaotic for their businesses to thrive.”10 The language of blockages, network collapse, cascading failures crisis, systemic shocks and gridlock—illustrated in the discussion above—has historically been invoked as part of the raison d’etre for much needed infrastructural investments in cities (Guild, 2000: 281; Little, 2010; Luke, 2010). Indeed, although focusing on the ‘sense of crisis’ invoked by urban breakdowns in India, Sundaram (2009: 3) identifies the ingredients of a perceived ‘urban crisis’ in the western cities and compares this to the situation in post-colonial cities, including Indian: “In the advanced metropolitan centers, a significant allegory of urban crisis has been of infrastructural decline, imaging empty peripheral landscapes of former industrial areas, empty spaces, and abandoned techno-parks of rusted factories all tomb signatures to a now buried modernist era.” By contrast, in the post-colonial era (and cities) he posits

10 Indeed, the implicit danger of troubled ‘investors’ spurned calls by MGI for policy prescriptions to address issues in India’s cities: “The cost of not paying attention to India’s cities is enormous. Today’s policy vacuum risks worsening urban decay and gridlock, a declining quality of life for citizens, and reluctance among investors to commit resources to India’s urban centers” (MGI, 2010: 13).
that: “Productive, non-legal proliferation [of settlements, hawkers, factories, etc.] has emerged as a defining component of the new urban crisis in India and other parts of the postcolonial world” (Ibid., 4). The possibility of infrastructure collapse or gridlock brought is very threatening for societies and for governments for reasons that specify the inseparable link between infrastructure and modernity (Edwards, 2003).

McFarlane (2008a,b) and others have investigated how ‘ordinary’ infrastructures have become imbricated within a spectrum of contemporary socio-political or cultural projects—ranging from the actions of the neoliberal state that seeks to (imperfectly) mould infrastructures in the interest of global capital (Bakker, 2003; Gopakumar, 2011); to communities that employ their infrastructure fabric to mobilize novel arenas of resistance (Appadurai, 2002) or subversive actions (Coelho, 2006). Infrastructure-driven urban development can arguably be understood as being especially burdensome in countries where a combination of colonial histories of discrimination and legacies of post-colonial exclusionary regimes have produced intensely ‘splintered networks’ of infrastructure (Kooy and Bakker, 2008); and more broadly as forms of ‘splintering urbanism’ manifest in socio-technical and socio-economic polarizations within and amongst contemporary global city-regions (Graham and Marvin, 2001). For instance, Graham and Marvin’s (2001) work on ‘splintering urbanism’ (SU) highlights the dangers of entirely differentiated urban (un)realities between haves and have-nots being shaped by asymmetrical infrastructural and informational endowments.11 Such socio-technical perspectives (on cities and networked technologies) can therefore assist in identifying how infrastructure(s) co-produce knowledge, power and urban space.

The SU argument importantly suggests that infrastructural provisions can serve to reinforce or reify existing structural and spatial divisions in cities. Understanding these divisions necessitates conceptually unbundling or ‘disassembling’ urban infrastructure and analyzing distinct elements as part of unfolding, splintered, socio-technical

11 Graham and Marvin’s (2001) work integrate four theoretical strands: large technical systems (LTS); actor network theory (ANT) and cyborgian perspectives; spatial political economies of capitalist urban infrastructure; and relational urban theories (Ibid., 179; 211).
processes that involve global-local (g/local) socio-economic transformations.\textsuperscript{12} ‘Urban splintering’ suggests the loss of universally accessible and affordable publicly controlled utilities and infrastructural systems. And splintering urbanism can potentially undermine of civic life by reinforcing the secessionist effects of, “premium network spaces and their customized array of technology and infrastructure” (Graham and Marvin: 376-377).

Graham and Marvin (Ibid., 392) also contend that high amenity enclaves, science parks, premium spaces and other ‘successionary network spaces’ cannot simply be insulated from the context of ‘wider urban and global environmental issues’ and that premium network spaces are not immune to local and regional problems like: “climate change, sea level rise, chemical and biological pollutants, air pollution, noise, hazards, etc.” This suggests the need for a disassembling approach to examine not only the socio-technical or environmental ramifications of infrastructure(s) in the ongoing shaping of city-regions; but also to identify where and why ‘enclave’ and ‘successionary’ effects are occurring—and how ‘unbundled’ or disassembled infrastructure(s) are being differentially provisioned amongst urban citizens and permanent underclasses.\textsuperscript{13}

Observers of Indian urbanism have also drawn attention to infrastructure project planning modes and funding arrangements (e.g. ‘use it or lose it’ budgeting) that incentives construction-driven fixation at times to the exclusion or detriment of much needed basic urban services (e.g. McFarlane, 2010). In relation to Bengaluru, for example, Goldman (2011: 560) has identified the linkages between ‘world city’ infrastructure-driven agendas and how these frequent utopian project visions are linked to urban governance norms. Part of this process involves what he terms ‘speculative urbanism’ and his research associates this with the hidden costs of rapid infrastructure-

\textsuperscript{12} Graham and Marvin’s works also highlights the importance of understanding situated practices as a means for understanding the ‘socio-technical geometries of power’ (2001: 10-11). Such an approach includes a focus on practices and on ‘strategies of resistance’ on the part of nascent socio-cultural movements, creative activism, coalition-building and civic networking (Graham & Marvin, 2001: 392-403).

\textsuperscript{13} The danger of these enclave effects include entirely differentiated realities of civic life and experiences of the city. For instance, according to Graham and Marvin (2001: 392) one aspect of this condition might be described as: “[t]he experience of urban life for the socioeconomically affluent increasingly becomes an interlinked, cosseted choreography where the networked interconnections of mobile phone, Internet, satellite television, electronic highway, air conditioned car, parking garage, airport, airliner and glocal bypass rail link become ever more seamlessly fused into the rebundled plazas, atria, malls, resorts, gated communities and business parks that they increasingly orient towards.”
led urban renewal including land grabs, speculative profiteering and residential displacements (of informal settlements).

Issues of land grabs and corruption have also been associated with top-down ‘world city’ signature urban mega-project planning—such as the Commonwealth Games projects in New Delhi—which witnessed fast-tracked publicly funded infrastructure improvements for purported long-term public benefits (e.g. Shiva et al., 2011: 74-76). As scholars elsewhere have pointed out, urban megaprojects have historically demonstrated a marked ineptitude at considering social and environmental (not to mention economic) ramifications—14—and increasingly they are illustrative of an elitist drive aimed at ensuring that the latest global city event is able to match its international competitors (e.g. Lehrer and Laidley, 2009).15 Indeed a number of scholars have suggested that the key drivers, motives and beneficiaries of urban infrastructure projects, legislation and largesse in India require ongoing careful scrutiny (Banerjee-Guha, 2009; Goldman, 2011; Mahadevia, 2006; Shiva et al. 2011). It is therefore worthy to revisit the question of whether or not infrastructure-led urban development is actually addressing the basic needs of urban residents in an integrated, coherent manner that supports a just and livable city for all.16 It also remains imperative to question the arguments and commercial motives underlying urban infrastructure visions, agendas, projects, programs and policy prescriptions—since, as Furlong (2010) suggests, there is every reason to believe that infrastructure projects (particularly those that are publicly funded or driven) are, in many respects, malleable.

14 Similarly, the utopian notion of ‘slum free cities’ suggests a clash of values between an apparently growing (middle class) aesthetics-driven urbanism (rather than participatory or people first planning) that ignores the ‘messy’, ‘informal’ reality on the ground often of life amongst the poorest residents (Roy and Ong, 2011; Sundaram, 2009). The irony is that sometimes violent urban displacements—in the name of aesthetics—represent short-term urban renewal fixes that rarely address longstanding issues about land use, housing rights and affordable housing provisions, tenure security, participation and institutional failure (Roy and Ong, 2011).

15 Indeed, one wonders if previous lessons have been headed by urban missionaries and visionaries from the failings of another set of spatially oriented reforms in India which sought to couple land use planning and economic development reforms for ‘unleashing economic development’—namely India’s experimentation with Special Economic Zones (SEZ); and its dalliance with urban megaprojects such as the New Delhi Commonwealth Games. For example, Shiva et al. (2011: 7) identifies how India has designated more SEZs than any other nation worldwide and identifies 300 functional SEZs and over 560 approved.

16 Such an approach not only flies in the face of research on slum dwellers which focuses on transformative potential of secure tenure and importance of provisions of basic infrastructure and services to slum residents (UN-Habitat, 2012: 70-75).
From being a pulsating node of technology-mediated global commerce, Bengaluru has arisen as a preferred location for the presence of globally-mobile entrepreneurs who bring visions, ideas and strategies for transforming urban space through interventions into its infrastructures and its associated systems of governance such as systems of management and accounting, and structures of participation, accountability and access to power (Gopakumar, forthcoming). Identified until the 1980s as the ‘Garden City’ and the capital of state of Karnataka, Bengaluru’s transition to India’s Silicon City has been accompanied by a rapid expansion in the spatial extent of urbanization (Audirac, 2003). This transition, though, has not been smooth and the tensions of this transition are most evident even as urban actors flounder in addressing the infrastructure needs of the city. The disposition of a provincial town suddenly overwhelmed with metropolitan problems, (and flailing about in order to resolve these problems), is pervasive in the city (Gopakumar, forthcoming). This arguably has contributed to the development of an urban temperament and an infrastructural temperament marked by incessantly destroying and reconstructing itself and its urban fabric from the fast paced change that has overwhelmed the city. A key aspect of this urban disposition is the relentless search for successful technical solutions. Problem solving with new technologies, techniques, methods often pioneered for the first time in India, are part of this disposition. As the artist Pushpamala proposes:

“At the end of the millennium, Bangalore seemed to illustrate...a small town breaking out with sudden violence into a metropolis. Piles of rubble, dug-up roads, real estate mafias, crime: an indescribable chaos, seemingly shapeless, with incessant destruction and never-ending construction--everything half-built, half-conceived, careering along with a ruthless brashness, but full of vitality” (Pushpamala, 2008).

Part of these unsettling changes are physically evident, such as in the land cover studies of Sudhira (cited in IIHS, 2011: 19) whose work has identified the notable changes in urban land cover resulting the growing urbanized or build-up areas as the Bangalore urban-region has physically and population-wise expanded from 3.4 million
persons in 1992; to 5.7 million in 2001; and to 8.5 million in 2009. Besides shaping urban morphology and land use patterns, these rapid population transformations also according to Dittrich (2007) have resulted in socio-economic and geographic disparities, barriers and fragmentations—in some respects along the lines of the splintering urbanism argument. As the locus of India’s knowledge economy centred on information and biotechnology industries and business process outsourcing, the resulting demographic and economic shifts in Bengaluru have been an important cause for the prominence that personal transport use or automobility has acquired in the city in recent years. Personal automobility is indicated through not only the sheer volume of personal vehicles that drive on Bengaluru’s roads but also asserted through several interlocking social, cultural, and lifestyle preferences. Thus while Bengaluru (in 2010) had 3 million vehicles with its numbers rising at the rate of about 2000 vehicles/day, the growing footprint of the “new middle classes” in public space, urban advocacy organizations, news and media, as well as in urban governance has powerfully emphasized personal automobility (Gopakumar, forthcoming).

This characterization of auto-narratives in Bengaluru has parallels to the challenges that car culture poses for urbanization trajectories in other locations. For example, Dahl (2005) has indentified the downward spiral of increased urban congestion leading to reduced support for mass public transit; and in turn an increased push for private automobility. Notably, Claussen and Sperling (2004, quoted in Dalhl, Ibid.) suggest that: “Only a small minority of people in the developing world own cars and benefit from massive road-building budgets [while] [i]n contrast, the vast majority suffer from increasing traffic congestion, noise, and pollution.” Worth considering in infrastructure planning are the long-term path dependencies and impacts on urban livability from an auto and road infrastructure path dependency. Indeed, as Cervero (2006: 1-2) has suggested, freeway disassembly has recently become an in vogue approach to urban

17 The State of Karnataka reporting on the Census of India 2011 data (Directorate of Census Operations in Karnataka) identified the Bangalore District total population as 9.62 million persons (urban and rural), with the urban component as being 8.75 million persons. It also differentiated between ‘urban agglomerations inside Bangalore District’ as 8.50 million and ‘cities inside Bangalore District’ as 8.43 million persons Bangalore (Bengaluru) District Population Census 2011. Available at: http://www.census2011.co.in/census/district/242-bangalore.html. (Last accessed 16 June 2013).

— This version of the paper is not for quotation —
renewal and that these infrastructural artifacts may soon be seen as relics of a bygone era of urban planning where private automobility was prioritized at the expense of livable cities.

"Freeways stand as monuments to an era when high priority went to 'mobility' – i.e., efficiency of automobile movements, in particular of professional-class suburbanites to good paying jobs downtown. Many multi-level freeways were built, seemingly, without regard to the fact they severed longstanding neighborhoods, formed barriers and visual blights, cast shadows, and sprayed noise, fumes, and vibration on surrounding areas. With the cumulative effects of designing the city for automobility evidenced by continued traffic jams, worsening environmental conditions, and dysfunctional urban districts, priorities are now shifting toward promoting economic and environmental sustainability, livability, and social equity” (Cervero, 2006: 1-2).

This section has identified the paradoxical qualities of urban infrastructural projects and suggested that this is partially related to how such projects are problematized and framed in the first place, including who the perceived beneficiaries of these projects may or may not be—as well as who ultimately bears the long-term costs or impacts of such projects. The section also suggested that the drive for global urban competitiveness is clearly part and parcel of the contemporary Indian—and Bangalorean—official quest for ‘improving’ urban infrastructure. Yet pressing questions remain about who is benefiting from infrastructure assemblages; and also about the gaps in integrated and long-term planning underpinning these efforts. The next section discusses how such questions might be further examined as part of the challenge of designing a ‘disassembling’ methodology. Such an approach seeks to understand the spatial and governance ramifications of urban infrastructure projects.

3. Disassembling infrastructure space (D-I-S): walking, rhythming, talking politics

As was noted earlier in this paper, employing socio-technical approaches in the study of urban infrastructure has become increasingly common in the research literature (e.g. Coutard and Guy, 2007; Graham and Thrift, 2010; Farias and Bender, 2010; Furlong, 2011). What have arguably has been absent in these approaches, however, are the
development of interdisciplinary methodologies and methods that focus on questions about the *links between infrastructure, spatial production and urban governance*—particularly *links to grounded practices*. In addition, there remains a need to interweave into methodological approaches deeper analyses of banal or mundane aspects of infrastructure—including network maintenance, breakdown and improvisation issues. This section introduces a ‘disassembling infrastructure space (D-I-S)’ as a working interdisciplinary methodology that can support analyses and critiques of spatial and governance issues related to urban infrastructure projects.

As the first part of the paper has suggested, one possible pathway for examining urban spatial issues involves examining infrastructural assemblages—that is heterogeneous groupings of humans, nonhumans, artifacts, and organizations (McFarlane, 2011). Following actor-network theory, the task of assembling people and artifacts into the social is understood as ‘heterogeneous engineering’—a process of cobbling together networks composed of actants, both human and non-human entities (Law, 1987). Understanding how urban renewal and infrastructural agendas relate to episodic events of crisis, breakdown and

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18 One interdisciplinary example comes from Monstadt’s (2009) theory-building work that does identify the need for linking socio-technical approaches to interdisciplinary theories about urban infrastructure governance (and his work does focus upon socio-technical approaches, environmental governance and urban infrastructure).

19 In actor-network theory this principle of radical relationality, referred to as generalized symmetry, seeks to construct chains of relations that span social and material realms. Indeed, in the process the social itself comes to be redefined not as a material but a type of connection between things that are glued together by different connectors (Latour, 2005).

20 The focus on the act of assembling heterogeneity presupposes relations that encompass all entities without differentiating the human and the non-human into distinct incompatible domains – a principle that defines Actor Network Theory (ANT).
disaster followed by instances of reactive reconstruction and rehabilitation is crucial in socio-technical frames of analysis. Examining ‘everyday’ instances of infrastructural disruptions followed by equally quotidian routines of repair and maintenance is therefore a key analytical path related to the study of recent urban infrastructure projects in Bengaluru. Another means of understanding infrastructural-driven urbanism and spatial transformations relates to the broader politics of urban development—characterized here as urban infrastructure governance.

Besides the importance of an overall socio-technical direction in examining the co-evolution of infrastructure with urban space and governance all of the methodological tactics suggested in the disassembling approach are driven by a shared interest in streetside or infrastructurescape ‘urban ethnography’ (Kusenbach, 2003); as well as with a social science ‘grounded theory’ outlook whereby in situ observations, inductive heuristic development, constant comparisons and adaptation serve as the backdrop to theory-building (Bryant and Charmaz, 2007). Three crosscutting, interdisciplinary methodological dispositions have been identified as being of importance in the design of a disassembling approach—and each of these is discussed in turn.

First, there is a crucial need for grounding studies of infrastructure in situ. In this respect a fusion of ‘walking work and studies’ (both walking as method; and walkability as a descriptor of space and urban livability) and ‘transect’ walking adjacent to and at the bounds of urban infrastructure hotspot sites can help describe site context, including the diversity of streetscapes and street life. Several examples provide broad guidance here including: Middleton’s (2009) research on mobilities and the temporalities of walking; Wunderlich’s (2008) work on walking and rhythmicity as a means for examining urban design and a ‘sense of place’; distinct considerations about local pedestrian cultures and streetscapes in Asia (Mateo-Babiano & Ieda, 2007); and Edensor’s (2013) work on walking, nature and reflection; as well as a considerations about urban transect approaches (e.g. CATS, 2013) as a means for better understanding diversity in sites, land uses and urban morphologies. These methodological approaches all underscore the importance of observing infrastructural issues from a pedestrian’s perspective—
including disenabled persons, elders, mother’s and children; residents and non-residents—in order to understand site-related linkages to infrastructure. Such approaches suggest that a dissembling infrastructure space needs to walk varied streetscapes to understand the critical interstices amongst infrastructurecapes, the peopled city and nature.

Second, moving beyond the physicality and materiality of infrastructurescapes highlights the need for understanding spatial-temporal shifts (i.e. pre-project and post project urban rhythms) including the variety of flows embedded in site observations. Such methods partially build upon the groundwork undertaken in the previous transect walks and are also part and parcel of research fieldwork including observations and questions posed to local residents, merchants, hawkers, workers and passersby. Here Lefebvre’s work (2004) on ‘rhythmanalysis’ emphasizing the importance of examining divergent spatio-temporal rhythms can assist in disassembling infrastructure space. According to Lefebvre, “everywhere where there is interaction between place, time and an expenditure of energy, there is rhythm” (Lefebvre 2004: 15). Utilizing this definition of rhythm draws our attention to three components in particular: place, time and energy. Thus a rhythm is indicated in particular places, when there are flows, movements or actions; and when there is a process of temporal change indicated through phases of growth, development and decline. Edensor’s (2010) work has identified rhythms identifiable within urban places including: people, somatic, techno-material and socio-natural related rhythms. The techno-material and socio-natural rhythms are particularly of interest in understanding the rhythms of infrastructure flows—but so too are people’s daily practices and self-perceptions related to infrastructural changes. Rhythmanalysis therefore can provides an important set of additional analytical observations augmenting walking sites and helping to build a picture of how urban space is being produced by residents, travelers or merchants—as well as how the rhythms of and in spaces are produced (and altered) by infrastructure projects. This can include tangible patterns (and changes) related to daily traffic and natural flows such as noise, vibrations, water flows, people’s movements, sunlight penetration, to use just a few examples. The combination of understanding how sites and local rhythms are in flux and being
(re)configured by infrastructure projects also needs to attend to the politics of infrastructure governance. This relates to the next methodological aspect of a disassembling approach.

Third, a final set of analytical layers suggested in the disassembly of infrastructure space relates to the political domain at multiple scales and spaces of action—from the local infrastructure site and context to urban-regional, state (or sub-state) and higher levels of governmentality. Here analytical tools such as ‘multilevel’ or ‘polycentric’ governance analyses (e.g. Bulkeley, 2005)—suggest analytical approaches attentive to the ‘politics of scale and networks’ and which can assist in mapping the array of actor-networks involved in shaping (and politicizing) infrastructural assemblages. Comparative approaches for examining the constellation of actors involved in urban infrastructural planning, funding and implementation, as well as the host of distinct agencies and protocols are necessary in these methods; as are considerations about questions modes of governance and about dispositions towards public participation in urban governance (Ng & Hills, 2003; Ng, 2007; Monstadt, 2009). These approaches suggest infrastructure governance in global cities cannot be simply viewed from an economic lens, but crucially need to be scrutinized from social and environmental perspectives.

Empirical work underway at urban infrastructure ‘hotspot sites’ in Bengaluru has served to initially ‘ground’ and to ‘test’ the three-component assembling research approach, including the research tactics that will be further described below. Preliminary investigations initially involved visits to distinct sites in Bengaluru. This work—which started with a brief of comparison of five infrastructure ‘hotspots’—has been linked to ongoing work on the SSHRC-funded ‘Assembling Infrastructure Decongestion’ project.21 In particular, starting in May, 2013—the focus of fieldwork has involved undertaking urban site observations in the Bengaluru city-region at Mysore Road / Vrishabhavathi

21 These five particular sites in Bengaluru were suggested by either Dr. Govind Gopakumar and / or members of the Bengaluru-based environmental organization Hasiru Usiru.

— This version of the paper is not for quotation —
Drain area (MYVRID); Yesvantpur / Indian Institute of Science area (YESIIS); Ex-Tagore Circle / Lal Bhag area (ETCLB); SE Outer Ring Road area (SEORR); and the Kormangla Drain & Bus Transfer Station area (KD+BT). These ‘infrastructure hotspots’ represent sites, socio-technical or infrastructural artifacts and urban spaces where various developments may have triggered a range of project-related socio-political and environmental issues. These particular sites featured infrastructure projects (undertaken or under development) which have derived a portion of their funding—through tripartite cost sharing arrangements—from the Indian central government-funded Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and in conjunction with funding from State and Local government (i.e. State of Karnataka, and Bengaluru’s Urban Local Body [BBMP]), including what are referred to in India as ‘parastatal’ bodies.22 The development of the D-I-S methodology discussed here has also been shaped by discussions in 20 interviews previously undertaken by one of the authors with urban researchers and civil society groups in New Delhi (in March-April 2013).

The overall purpose of the five preliminary Bengaluru site visits and assessments—conducted in May 2013—was three-fold: a) to understand the ‘lay of the land’ and to delineate the spatial extent of various possible infrastructure hotspots for further urban ethnographic investigation; b) to make comparative in situ observations including capturing visual images at the various sites; c) to ascertain salient site features, including: infrastructure domain / type; location in the context of the wider urban region; socio-technical issues; and political or power issues. A basic heuristic (linked to these latter four points) and developed after several initial site visits (Figure 1), identifies a comparative set of site dimensions and serves as a ‘discussion generator’—rather than as a weighted or factor analysis tool.23 The site comparison heuristic prompts consideration for the multidimensional aspects of sites and for noting similarities and

22 Parastatal bodies such as the Bangalore Development Authority, Bangalore Water Supply and Sewerage Board, Bangalore Metropolitan Transport Corporation, Bangalore Metropolitan Land Transport Authority manage most major infrastructure domains in the city.

23 The overall process for undertaking observations occurred during short daytime visits (in May, 2013) and involved two researchers (including the author) accessing the sites by public transit buses and then subsequently walking around the hotspot locales.
differences amongst urban hotspot infrastructurescapes. Discussions about these dimensions also assisted in the prioritization of sites for subsequent investigation. The researchers not only examined the specific infrastructure(s) partially funded by the JNNURM, but also the wider neighbourhood or community contexts in order to understand how and why infrastructure(s) related to the existing residents and the urban fabric; as well as early work on how the projects may have (or may in future) affect(ed) or alter(ed) urban metabolism and daily or natural rhythms. Key site features were identified related to land uses, neighbourhood typology and identifiable issues about relationships between infrastructure and the urban space.

Attempting to bridge the early reflections about infrastructure and space, including from some of the methodological influences noted above subsequently resulted in the development of an integrated, three part ‘dissassembling infrastructure spaces’ (D-I-S) methodology. This concept—designed for application in Bangaluru for in depth infrastructure hotspot studies—is outlined in the remainder of this section.

Given the breadth and depth of possible issues in the city spaces being examined in the ongoing investigation of infrastructure in Bengaluru—an amalgam of mixed analytical methods was opted for—in order to provide a structured, grounded and comprehensive approach for examining infrastructurescapes. These interdisciplinary methods draw-upon a number of social science and urban studies approaches, tools and techniques for studying and theorizing about urban space, including: urban walking and urban transect analysis (CATS, 2013; Edensor, 2013; Mateo-Babiano & Ieda, 2007; Middleton, 2009); rhythmanalysis (Lefebvre, 2004); and polycentric urban governance analysis (Bulkeley, 2005; Ng 2007; Monstadt, 2009). The unique D-I-S approach advocated in this study highlights the necessity of not only examining urban sites and infrastructure(s), but also of identifying the changing rhythmic dynamics of those spaces where the intersection of ‘peoplescapes’ and large scale technical systems are reshaping and reconfiguring sites and spaces (i.e. infrastructurescapes). The concept of ‘disassembling’ therefore identifies with the socio-technical concept of ‘unblackboxing’—in this case applied to the need for tracing and unpacking the linkages between
infrastructure(s), people and nature in urban spaces and its governance. Rather than employing a singular project oriented impacts analysis approach (e.g. such as environmental or social or technological or integrated impact assessments); or a risk analysis (or cost benefit analysis) method; or for that matter a site, project or landscape design analysis methods—the D-I-S approach, suggested here, involves an amalgam of interdisciplinary techniques for studying and disassembling site, space and place. The three core analytical components of the D-I-S working methodology are summarized below:

a. WALKING. This disassembling analytics involves collecting descriptive visual data (sketches, maps, images) across walkable segments (or transects) and walking in order to devise conceptual boundaries defining the infrastructure hotspot site. The aim is to temporarily bound aspects of the infrastructure project and to trace the pathways and contexts of infrastructure(s) projects and their intersections with communities, other socio-technical and natural systems, as well and to illustrate how, why and where infrastructure is altering urban space, streetscapes and local nodes (e.g. housing, businesses, institutions, etc.). This approach also includes relating to needs of diverse groups of local and visiting pedestrians; including issues about walkability, safety and livability.

b. RHYTHMING. This disassembling analytics involves undertaking observations and discussions with residents, merchants, other locals and visitors about socio-technical and environmental ‘rhythms’ on the infra-site, including key human and non-human rhythms (i.e. natural and abiotic systems; as well as technical systems). This work involves observing rhythms, flows and patterns in situ and identifying these in discussions. The aim of this approach is to build a spatio-temporal understanding of infrastructure projects and how this may or may not relate to resident’s personal daily practices as well as diurnal or seasonal cadences. The relations between changing landscapes and infrastructurescapes—before, during and after the infrastructure project(s)—is of crucial importance in rhythming the urban space in question.

c. TALKING POLITICS. This disassembling analytics involves examining the bigger picture of how the infrastructure project has been problematized and justified in political talk, narratives or public discourses—both on and off site. The approach involves exploring how costs and benefits of the infrastructure project in question has been framed and problematized in the accounts of citizens, technicians and politicians. This includes asking political questions about how project visions, plans and risk assessments
were formulated, identified and ascertained; identifying polycentric political actor-networks in project governance at multiple scales of practice (including institutional 'centres of calculation', gatekeepers, checks and balances, etc.). The approach also seeks to understand how community voices and participation in relation to the project(s) were enabled or lacking. Ultimately the focus here is on the multi-scalar politics of very specific infrastructure sites, which in turn can support understanding urban infrastructure governance.

To recapitulate, the ‘disassembling infrastructure spaces’ methodology outlined above suggests an amalgam of the three interrelated approaches: ‘walking - rhythmning – talking politics’ [also see Table 1 for details]. While the ‘walking’ component of the D-I-S approach emphasizes the importance of physical immersion within the space and sites where infrastructure is located, it also suggests a need to discern and identify in situ rhythms as well as uncovering political issues related to infra-governance. Technically this fieldwork approaches suggest heavy involvement with ‘walking the site’ and delineating (and mapping) hotspot boundaries; and it also suggests walking across hotspot transects and devising maps or capturing images of land uses, nodes, issues, local activities, infrastructurescapes, as well as intersections with natural systems.

As suggested above, the 'rhythmning' component of a disassembling methodology posits the need to pinpoint how and why infrastructure projects may be altering peoples' practices or routines in the urban spaces. This process includes exploring rhythms of resident’s lived spaces, work and public spaces; and when and how they move about in, underneath or above infra-projects. Technically this suggests employing tactics to better understand the co-evolution of infrastructure and urban space, such as: chronicling human and natural rhythms, examining key flows and in situ patterns; surveying and mapping site, human and non-human activities and practices; and uncovering altered practices, flows and patterns related to infrastructure interventions.

The D-I-S methodology’s ‘political talk’ component suggests that examining site-related and spatially shaped opinions, debates and contestations about infrastructure—including perceptions by both local (i.e. infrastructure hotspot proximate) and non-local
**Table 1**: Actualizing a ‘Disassembling Infrastructure Space, D-I-S’ methodology (authors)

<table>
<thead>
<tr>
<th>D-I-S Dimension</th>
<th>Operationalization</th>
<th>Realization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Walking</strong></td>
<td>- undertaking a visual transect mapping of diversity along a given walking axis and identifying hotspot boundaries;</td>
<td>- undertaking site and infrastructure sketches and path/ route tracing; map studies; visual studies, including use of short videos or panorama shots undertaken along walks and transects;</td>
</tr>
<tr>
<td>[focus: site]</td>
<td>- identifying key features in the urban fabric—interfaces between abiotic, biotica and cultural systems;</td>
<td>- initiating site observations, interviews and walking pathway observations including sensory observations (visual, aural, olfactory, tactile, etc.); along with adjacency issues for understanding the broader site context.</td>
</tr>
<tr>
<td>a) establishing hotspot boundaries</td>
<td>- corridor and vector mapping of infrastructurescapes and flow variations including critical junctures / junctions;</td>
<td></td>
</tr>
<tr>
<td>b) walking transects</td>
<td>- identifying sacred sites / spaces, housing, institutions, businesses as well as fixed built / land use typologies and transitory spaces;</td>
<td></td>
</tr>
<tr>
<td>c) identifying key nodes</td>
<td>- mapping key natural features: waterflows, vegetation, etc.; and identifying local abiotic/biotic conditions;</td>
<td></td>
</tr>
<tr>
<td>d) mapping surface networks</td>
<td>- identifying long term and recent historical issues, including key current events;</td>
<td></td>
</tr>
<tr>
<td>e) identifying technical systems and actor-networks</td>
<td>- scoping key formal and informal pathways; local users versus non-local users; and zones of contestation where hazards are identifiable;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- highlighting pedestrian safety and accessibility issues; day and night contrasts of pedestrian pathways; formal pedestrian constructions vs. informal routes;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- gauging noise, visual and air pollution variations across the site; identifying zones of comfort, safety and relaxation / livability.</td>
<td></td>
</tr>
<tr>
<td><strong>Rhythming</strong></td>
<td>- pinpointing human and natural rhythms, such as day vs. night activities, infra-project sensory shifts in relation to the infra-project;</td>
<td>- undertaking <em>in situ</em> rhythm studies including activity pattern mapping, interviews with residents and triangulation with observed and official data on traffic, natural systems, weather, noise, air quality and sensory rhythms, etc.;</td>
</tr>
<tr>
<td>[focus: spatial]</td>
<td>- scoping residential, commercial and institutional patterns; and highlighting natural rhythms and their linkages to the infra-projects, such as: weather and daily or seasonal shifts, climatic highlights, vegetation / flora, fauna and/or avian flows;</td>
<td>- identifying key emergent narratives both pre- and post-infrastructure project development;</td>
</tr>
<tr>
<td>a) mapping rhythm zones and key points of analysis</td>
<td>- identifying patterns and variations in flows of pedestrian and vehicular traffic and non-vehicular traffic, including in relation to pre and post infra-project developments and rhythm drivers such as day / night or seasonal changes;</td>
<td>- undertaking</td>
</tr>
<tr>
<td>b) identifying key in situ rhythmic patterns and local flows</td>
<td>- mapping flows of water intake and wastes (including solid wastes); and identifying altered quality and quantity of flows in technical and natural water systems, including in relation to pre and post infra-project developments;</td>
<td></td>
</tr>
<tr>
<td>c) identifying contrasting rhythmic features</td>
<td>- noting activity patterns or use rhythms of semi-nomadic</td>
<td></td>
</tr>
</tbody>
</table>
| Talking Politics  
**[focus: situational]** | - highlighting residents (households and merchants) and visitors concerns / issues related to infra-projects, including the political and technical framing of the project (i.e. problematization, purposes and costs / benefits);  
| - examining media and / or civic contestations, public discourses and debates about the infra-project; and reviewing local and regional socio-economic-eco impacts and studies / justifications of the infra-project;  
| - identifying achievements or gaps in infrastructure project integration and regional integration; identifying relations with other neighbourhood and city-wide infra-projects; and pinpointing linkages to wider debates in the local neighbourhood and in government, civic society and the media;  
| - noting civic participation and consultation vis-à-vis infra-project(s); and highlighting any contested rights (e.g. automobility vs. pedestrian rights) or political issues;  
| - scanning the relations between project and external funding, protocols, standards, etc. in infra-governance and project management (at various levels in ULB, Parastatal, State, Centre).  

| a) undertaking hotspot observations, interviews, situational focus groups and surveys about local issues and political framing of projects  
| b) investigating relevant infrastructure project and official / agency site data via interviews and archival research  

| individuals (including household and informal 'fixed' residents and standing businesses and hawkers; institutional workers and visitors, etc.).  
| interviews and surveys with project managers and/or contractors.  

- implementing interviews with local residents, informal and formal organizations (Resident Welfare Associations and/or local civic organizations) and at the State, Urban Local Body and parastatal level, as well as with the private sector;  
- undertaking relevant infra-hotspot background land use research; infrastructure project and agency site and map data, neighbourhood context data and newspaper archival data.

actors—is of critical importance in understanding infra-governance. Across these distinct analytical components the importance of identifying and examining infra-project framings and problematization, along with *in situ*, or situational issues and contestations during fieldwork, in observations and in comments by local residents, merchants, workers and visitors to the sites remains crucial. Technically this fieldwork research involves the need for probing and tracing residents', merchants and institutional users concerns and linkages to wider civic debates about land use and infrastructure; gauging aspects of decision-making and consultation in relation to the infra-project(s); and identifying the perceived impacts of the infra-project (including how it has been framed and problematized) by various diverse actors during infra-governance processes.
Drawing from initial fieldwork at infrastructure ‘hotspot sites’ in Bengaluru, a repertoire of suggested methodological procedures—including key D-I-S dimensions and suggested operational tactics—for actualizing a disassembling approach is shown in Table 1 below. In addition, given the importance of in situ discussions with various actors a number of ‘disassembling’ concerns have also been featured in suggested ‘model themes’ for interviews, situational focus groups and surveys, as shown in Annex 1. Although a D-I-S approach emphasizes the importance of consolidating a disassembly methodology for hotspot comparisons within a given city (in this case, Bengaluru), the details provided here are intended to serve as ‘working approach’ rather than a hard and fast set of research procedures. This also underscores the importance of researchers devising their own in situ and pilot tested tactics for disassembly methods—potentially linked to the three ‘walking, rhythmning and talking politics’ dimensions suggested here. This approach highlights the importance of locally driven, adaptive designs for research protocols before consolidating and ‘locking in’ a comparative disassembling method in any given investigative city setting. Employing a ‘disassembling approach’ for in-depth studies of infrastructure spaces and governance in relation to Bengaluru will be the focus of the section that follows.

4. Preliminary explorations of infrastructurescapes in Bengaluru

The five initial Bengaluru hotspot infrastructure sites, identified in the previous section, each featured differing types of partially JNNURM-financed infrastructure projects. These sites varied considerably—from the MYVRID site featuring an elevated roadway and an adjacent nullah (drainage ditch) upgrade in the South East of the city; to the YESIIS site in the North East featuring a flyover and (at some distance) a road cut and bridge; or from the ETCLB site in South-Central Bengaluru featuring a now defunct traffic circle with a completed road cut; to the SEORR site in the South-East Bengaluru—along the peri-urban ‘high tech alley’—featuring an elevated flyover roadway; and finally to the South East-Central built up area of Bengaluru at the KD+BT site which featured both a bus hub / transportation centre and a nearby storm
sewer/drainage pipe alongside an existing *nullah*. A detailed overview of initial site visit observations (linked to the heuristic previously identified in Fig.1) provided the basis for comparing the five sites and was accompanied by identification of exploratory issues primarily geared to generating questions about how and why infrastructure projects are being problematized and politicized in Bengaluru. These issues are further elaborated in this section.

Initial fieldwork findings in New Delhi and Bengaluru identified a need to consider a number of salient points that need to be considered in more in-depth infrastructure hotspot analyses. In particular, research interviews in New Delhi highlighted the importance of needing to identify the mix of players—at various governance scales—involved in site-specific projects and shaping issues of funding constraints or blockages, and challenges (or successes) in infrastructure implementation and public consultation.

The initial groundwork at the five infrastructure hotspots sites in Bengaluru also highlighted a number of key considerations for further examination in the next stage of fieldwork—and these in turn will shape how the disassembly methods will be deployed. Broadly speaking these issues included:

- examining the importance of examining relationships between the site-specific infrastructure project (planning, implementation and maintenance) and various scales of governmentality (and governance) from the ULB-level, to parastatal agencies and Karnataka state-level administration; and including JNNURM-funding and protocols as shaped by India’s national government;
- identifying how the rhythm of the hotspot sites continues to be shaped by both longstanding local temporal-historical flows as well as issue oriented political contestations;
- examining who was involved (politically, technically, participatory) in the infra-project formulation and implementation, as well as how qualitative and quantitative costs vs. benefits were assessed and moreover how these infra-projects have been problematized, particularly by the various advocating politicos, authorities, interest groups and agencies;
- exploring *in situ* project concerns such as: the length of time and expenses for project construction;
- understanding infrastructure project framing in an urban regional context, particularly, in terms of possible benefits claimed; and also in relation to their cumulative socio-economic and environmental impacts; and
examining the extent or possible lack of participatory planning and
democratic community consultation mechanisms in place;
• further scrutinizing the maltreatment of mass transit users and pedestrians
in relation to the sites both before and after project construction and
implementation;
• identifying how and why infrastructure projects were integrated (or not)
into their neighbourhoods and with other local and non-local infrastructure
systems;
• examining the roles, reactions and interventions of neighbourhood-specific
groups (e.g. resident welfare associations; temple or religious groups; and
informal and formal merchants and residents; institutions, etc.);
• identifying key issues related to alterations in wider regional socio-
technical flows (i.e. human, mechanical and natural systems), connectivity
or mobility and impacts, such as altered hydrological flows.

In addition, within the context of changing infrastructural priorities, redesign of
transportation projects to establish flyovers, underpasses, “signal-free” corridors,
elevated expressways are some ventures that are seen as facilitating smooth flows of
personal automobility—and the politics, policy antecedents and technical logic behind
such projects merits further investigation. Thus, worthwhile observing at infrastructure
hotspot sites will be decongestive infrastructure rhetoric and policy priorities—such as
the attention given to eliminating vehicular ‘friction’ in automobile and mass transit bus
flows (identifiable for instance on the Outer Ring Road in general and at the hotspot
sites in particular). Furthermore, the ramifications of such infrastructural governance
priorities for local public spaces, streetscapes and pedestrian safety / public health and
movements will need follow-up examination.

More recent follow-up fieldwork employing the three-part ‘disassembling’ approach
(‘walking – rhyming – talking politics’) has also identified a number of intriguing (and
tentative) findings. Five preliminary examples—related to ‘trials runs’ employing a D-I-S
approach at the South Eastern Outer Ring Road (SEORR), or the Agara flyover site in
Bengaluru—have been identified here to illustrate how a disassembly approach can
assist in unfolding urban space and governance issues.

• First, walking with the intent to devise hotspot boundaries enabled wider
regional travels and resulted in the identification of significant hydrological
and development issues relatively near to the infra-project in question. By

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identifying such wider scope land use issues (before geographically focused investigations of the infra-project hotspots) their implications can be inputted into the ongoing site studies and interviews.

• Second, hotspot infra-site walking and rhythmging work helped to identify the wide diversity of housing in relatively close proximity—ranging from two identifiable informal housing clusters to longstanding neighbourhoods (three/four decades old); to publicly-funded residential ‘layouts’ (more recent); and three enclave style, gated, multi-story apartment towers. Various tactics have been devised to meet with these diverse groups—including speaking with local elders, residences / owners associations and residential building managers.

• Third, similar to the hotspot housing diversity, a mix of businesses was identified in initial walking and rhythmging fieldwork—from a traditional cluster of owner-operated shops along a longstanding village main thoroughfare, to a franchise, chain or brand-oriented shops along a more recently developed parallel thoroughfare; and from businesses and offices alongside the flyover; to mobile hawkers who sometimes work in the area. This diversity perspectives on the project needs to be respected and represented in future research.

• Fourth, discussions have been revealing diverse and sometimes divergent opinions about the impacts of the flyover on the local society, economy and environment. Also interesting has been how diverse actors are defining infrastructure and how the specific flyover infra-project is being framed from their own perspective. In the longer term mapping this diversity of views will likely provide a richer understanding of the politics of urban infrastructure.

• Fifth, the few in depth interviews that have been conducted to date have provided rich personal perspectives on the changing rhythms and histories of the flyover site, such as: narratives about the loss of an iconic and focal point ‘village’ tree; identification of noise impacts on adjacent high end enclave residences; impacts of the flyover on local hawkers and informal economy businesses; awareness that a fixed location business has felt compelled to relocate because of dust, sound, visibility and other concerns associated with the infra-project; and suggestions that the flyover project may have been conceived as an approach to preventing the excessive deaths or injuries to roaming cattle. Clearly additional discussions and interviews will build a deeper understanding of how infrastructure projects can shape (and alter) community and spatial rhythms.

Besides the wide-ranging personal narratives about a particular infrastructure project—in this case the ORR / Agara flyover—the D-I-S approach has helped to trace the linkages between a flyover infrastructure project within pre-existing heavily splintered spaces. In the process the D-I-S tactics provided a window into the broader urbanization
processes underway as Agara village is being subsumed by the larger Bengaluru city-region (essentially a ‘village in the city’). While these urbanization processes clearly pre-date this infrastructure project, examining the relationships between the infra-site and city that is becoming in relation to identifiable changes in rhythms around (above, below and beside) the flyover provided a site-specific window into spatial and governance forces shaping urbanization in Bengaluru. In this respect comparing the disassembly-driven findings at this site to others infra-hotspot sites across the city-region will be of interest in the longer-term. Another key aspect to keep in mind, as Gopakumar’s forthcoming work suggests, is that despite an overt city-centrism in infrastructure governance, solutions in Bengaluru are typically proposed and imposed from the state level. This underscores the importance of researchers avoiding a focus on local infra-project sites only (i.e. infrastructural myopia) but rather continuously exploring how issues raised in site-specific walking and rhythming are related to the broader politics of infrastructure—as a D-I-S disposition posits. Therefore the empirical linkages between site, space and situation—emphasized in a disassembling methodology—reminds us of the fluid nature of infrastructure projects, including how their political ramifications continue to reverberate in time and across urban space. The final section below reviews the rationale behind a disassembling approach and highlights a number of tentative conclusions.

5. Tentative conclusions: disassembling urban infrastructurescapes

A ‘disassembling approach’ to understanding urban infrastructure takes a distinctly socio-technical take on cities and the networked technologies. Such an approach emphases the flux and fluidities embedded within urban infrastructure systems, and in examining how conduits, roads, transit and telephony may be shaping the morphology, trajectory and possibly path dependencies in the future city-region. In this respect disassembling methods for unpacking the spatial and governance trajectories of infrastructure suggest that the city and its systems are ‘perpetually becoming and unfolding.’
Besides its foundations in socio-technical theories and linkages to interdisciplinary walking, rhythming and governance methods, the disassembling infrastructure space (D-I-S) method outlined in this paper has been informed by early fieldwork observations and preliminary findings at various ‘infrastructure hotspots’ in Bengaluru, India. A D-I-S approach has suggested three crosscutting steps for understanding and assessing infrastructurascapes: *walking, rhythming and talking politics*.

Walking as a disassembling research practice sets in motion action, sensory inputs, and exploratory interests in possible pathways and transects. A walking approach provides a ground level understanding of infrastructure sites and surroundings. More instrumentally walking is linked to an array of methodological tactics for systematically assessing and comparing sites and ‘splintering’ urban space.

Rhythming on the other hand can support empirical studies of the forces within and beyond sites and help to bridge spatio-temporal influences within, above, below and beside an actualized infrastructure project. The temporal component of rhythmanalysis is crucial since it suggests the need to continuously revisit project histories, local knowledge systems, narratives of real or imagined past rhythms and flows—and it suggests juxtaposing these remembered spaces with those of present day spaces shaped by infrastructural project(ed) rhythms. Besides historical and engineered socio-technical rhythms, natural (abiotic and biotic) rhythms of and in an infrastructurescape can also serve as reference points for identifying and understanding novel emergent local patterns and tendencies.

Talking politics, as a disassembling tactic examines site-specific contestations and contested rhythms to identify competing narratives about infrastructure projects. This research practice is focused on the fluidities of knowledge, power and space in infrastructure governance—and by necessity it invokes multiple scales and actor-networks in its analysis of how sites relate to spaces, scapes, regions and beyond.

A D-I-S approach emphasizes a socio-technical mode of analysis in understanding how infrastructure (and decongestion issues and agendas) is both (re)shaping the urban
landscape (both in the long and short term) and also (re)shaping actor-networks—from local residents and infrastructure users; to contractors and developers; from politicians and technicians, to environmental groups and residents associations. The ongoing infra-hotspot site investigations—being undertaken in Bengaluru—are highlighting the importance of further examining who conducted decision-making, what criterion were employed in deciding upon projects, how the projects were problematized, what trade-offs were identified (and whose agendas won out); as well a need to situate projects in a wider regional contexts. Furthermore, given the incentives to act in addressing the purported infrastructure ‘crisis’ how might the voices and interests of local residents be strengthened given existing apparent institutional constraints on public participation? Understanding infrastructure assemblage framing in the larger urban regional context also needs to be related to issues of cumulative socio-economic and environmental impacts in Bengaluru and beyond.

These are just some of the issues uncovered in employing a disassembly perspective to examine spatial and governance issues related to urban infrastructure. A D-I-S approach has highlighted the importance of bundling spatial and governance issues in examining urban infrastructure(s). In part this evolves through a process of layered visual observations, interviews and off site research; and it part is expected to evolve through snowballing of issues, patterns and themes—embedded in the repetitions intentionally embedded within the ‘walking, rhythmning and talking politics’ approach. The D-I-S approach has therefore been designed to revisit sites, to go over old ground, to revisit earlier questions; and to perhaps reveal seemingly hidden issues, reflections or voices that may not be evident in an early cursory walk or talk. Such a methodological disposition emphasizes understanding how infrastructure is both reshaping the urban landscape (both in the long and short term) and also how various actor-networks are being reconfigured by urban projects. The disassembling infrastructure space approach therefore has been designed to (re)discover diversity and to deepen dissonant and discerning analyses of what might be otherwise thought of as ordinary, everyday infrastructurescapes.
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References


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Annex 1. Model themes for interviews, situational focus groups & survey questionnaire

Assembling Infrastructure Decongestion—A SSHRC-funded research project (2013).

[A] Introduction

We [introduce names] are researchers working on an investigation of urban renewal, infrastructure transformations and decongestion in Bengaluru. This investigation is a project of Dr. Govind Gopakumar of Concordia University in Canada. Our research is with a not for profit publicly funded university and this study or our work has no commercial interests.

Your interview will be treated as confidential—and your name is not needed. We would like to ask you 10 questions and if possible to record your responses on paper (and/or digitally). If you are not able to answer a question, or don’t feel comfortable about answering, please don’t. You can also end the interview at any point in time. Your responses will assist us in better understanding issues about urban infrastructure in Bengaluru and so if you choose to assist us, we would like to thank you for taking the time. Finally, we hope to publish our findings in academic studies about urban renewal and infrastructure work. Do you understand our project and do you feel comfortable in taking some time for this interview? Do you have any questions for our research team?

[B] Questions

The focus of our questions today is about the infrastructure development at _______________ [clearly identify site(s)/ location(s) of project(s)].

1. First, there is no need to tell us your name, however, we would like to know a little about you.
   a. Identify. Gender [ M / F/ Trans] ; Age Group [ youth ~18-40 / middle age ~40 - 65 / elder ~65+]
   b. What is your current occupation or work?
   c. Where is your main residence or housing located and how far relative from where we are now? [identify rough location of interview]

2. On an average day how often are you in this neighbourhood? Where else in Bangalore do you live or work on an average day?

3. Talking about the infrastructure development we mentioned [repeat project name], what do you feel was the main purpose of that project? Do you feel the project achieved its objectives or aims?

4. What are the main ideas that come to mind when you hear the word “infrastructure”? How would you define “infrastructure”?

5. Can you tell us more about your perceptions of the __________infrastructure project. In particular:
   a. What are this project’s strengths and weaknesses in your opinion?
   b. Along the same lines what are some of the positive benefits and the negative outcomes or problems with this project?
   c. Did this project have any notable economic, social or environmental impacts?
   d. Has this project changed the rhythms (e.g. daily activities, sounds, flows, practices) of people or nature in this area in your opinion?

6. Do you know about any controversies or contestations about this project? If so can you discuss briefly.
7. Can you identify some of the important long-term needs in your community or neighbourhood (or in this area)?

8. Are there any other important land use; infrastructural or environmental issues in this area or neighbourhood that you would like to tell us about?

9. What are your views on the role of public participation in the governance or decision-making about infrastructure in Bengaluru?

10. Are there any other issues or concerns you would like to tell us about?

[C] Thank you for taking the time to assist with our research