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## **Beyond Use:**

### **Alternative Approaches to Urban Infrastructure**

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#### **Abstract**

The Oxford English Dictionary defines infrastructure as “a collective term for the subordinate parts of an undertaking” or the “substructure, foundation”. Urban infrastructure is generally described as submerged technology; it is the material substrate that creates and connects spaces of production and living. It is rarely seen as a site of action or reflection; while infrastructure planning may be contentious, once in place it quickly disappears from view. In this paper, we complicate this conception by highlighting several cases in which infrastructure is “surfaced.” We do not focus on ruptures or catastrophes nor do we move towards an all-encompassing vision of infrastructure. Instead, we emphasize the diversity of infrastructure production and its producers by examining ways in which grassroots actors extend, appropriate, and reconfigure existing systems according to specific requirements under shifting sociopolitical and cultural conditions. In the first part of this essay, we describe our approach to urban infrastructure and explain how it contributes to a burgeoning interdisciplinary dialogue. In the second part, we focus on the bottom-up production and appropriation of urban infrastructures. We describe activists designing and building custom communications systems, artists transforming building facades into platforms for creative expression, and DIY enthusiasts interfacing their own energy harvesting technologies with the grid. Through these examples, we present an image of the city as a vibrant and dynamic place whose material underpinnings are continuously transformed through the interplay of social and material aspects of urban life.

## Introduction

For those of us who live and work in major European and American cities, utility systems are typically hidden from everyday view. We flip a switch and the lights come on; we turn a tap and fill our glass; we plug a device into an electrical outlet. We only pause to consider the technical and social underpinnings for these modern miracles when our monthly bills arrive, or when they cease to function.

Such systems are of course but one of a plurality of possible utility provisioning arrangements. Roman systems of aqueducts and fountains, for example, were central features of the architectural landscape that structured social relations and shaped the patterns of everyday life. Spanish acequias – networks of open ditches built hundreds of years ago and still in use throughout the American southwest are directly managed and maintained by users; in addition to providing water for irrigation and household use they also offer scenic recreation areas for hikers, joggers, and bicyclists.



**Acequia, Albuquerque New Mexico. Source: Photographs: Tad Hirsch.**

In contrast, modern utilities are hidden away and thus rarely seen as a site of action or reflection. While infrastructure planning may be contentious, once in place systems like telecommunications infrastructure, the electrical grid, and water systems quickly recede into the background.

In recent years, infrastructure has begun to emerge as a central site of concern for urban researchers representing a variety of academic disciplines including civil engineering, architecture, urban planning, and anthropology. In reviewing the literature, two themes begin to emerge. First, there is a sharp distinction drawn between the creators and users of infrastructure. While studies of “large-technical systems” like Hughes (1983 in Edwards et al. 2007) situate infrastructure development in specific social and historical contexts (Melosi 2000), they generally stop short of considering how these systems are experienced in everyday life. Similarly, anthropological investigations of the users of power and water utilities (Star 1999, Mainwaring et al. 2004) leave unexplored questions of how these systems come into being – they are presented as an already existing material situation that shapes urban life, but are not themselves altered by their users.

Secondly, there is a tendency to assume a “normal” use of infrastructure in which various water, power, and transportation systems are present but unacknowledged by their users except in moments of crisis or rupture, such as the massive power failures on the east coast of North America in 2003 (Graham & Marvin 2001). Exceptions to the rule are generally framed in terms of ongoing need for repair and maintenance (Graham & Thrift 2007).

In our view, these modes miss the ways that people engage with infrastructure by appropriating, reconfiguring and building systems according to specific requirements under shifting sociopolitical and cultural conditions. While such “extraordinary” engagements represent a relatively small fraction of overall infrastructure use, we would suggest that they are significant both as cultural facts – i.e. they are socially meaningful – and as objects of study that highlight relationships between technologies and people that are often masked in everyday use.

In this paper, we present three conditions that “surface” infrastructure (Star 1999) in ways that existing studies have not captured drawing on our experience as practitioner-researchers: appropriation, augmentation, and secession.

## Appropriation: Repurposing Infrastructure for Expression

As noted in the introduction, people are typically unaware of the infrastructures they use. Some groups like skateboarders, graffiti creators and artists bring a different sensibility to their encounters with the city. Instead of ignoring infrastructure, they enter into a creative dialogue of misuse (and some would say abuse) with the ordinary structures of the city. Instead of evaluating the positive or negative outcomes of these practices, we aim to show how they constitute an engagement with infrastructure “beyond use” and how they contribute to the collective image of the city. We draw examples from three groups: skateboarders, graffiti creators, and artists working in urban environments including public spaces.

### *Practices of Creative Misuse*

Both graffiti creators and skateboarders select specific sites in urban areas. In some cases, there are specific requirements such as smooth benches, long stretches of unbroken curbsides, or paint absorbency. In other cases, the remoteness or difficulty of reaching a location and its visibility make it particularly interesting or appropriate. These site selections add new layers of meaning to settings that were hidden or peripheral.

Not only do boarders select sites they also repurpose specialized infrastructure such as railings, stairs, fences, benches, urban furniture and more. Their use of those built elements in sophisticated maneuvers uncovers hidden affordances that were not anticipated by the designers. “Skaters have the knack of taking the blankest spaces, the most mundane features, and making them a stage. (...) In doing so, it disrupts any ‘proper’ logic of function, of transit or bare rationality.” (Tonkiss 2005: p.144) Through these practices, boarders and artists assert their ownership over certain spaces. They temporarily take control of the setting and impacts its future uses.

Like skaters and graffiti creators, artists adopt similar techniques to rewrite urban spaces. In a series of projects in various cities, artists painted helicopter shadows “as deterrents” on pavements in areas of the city with perceived high-crime rates in analogy to war zones. Unlike street markings that typically intend to order, these helicopters led to increased debate about perceived safety versus recorded incidents in urban neighborhoods. They highlighted the irregularities and differences in perception of safety among individuals and various groups. At the same time, the helicopter shadow contextualized often abstract, media discussions about global security in a concrete urban space.<sup>1</sup>

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<sup>1</sup> Vienna, Austria, Helicopter Street-paintings, for a video of the street paintings see: <http://global-security-alliance.com/>



Helicopter in Munich, 2006, Global Security Alliance.  
Source: [http://global-security-alliance.com/program/helicopter\\_en](http://global-security-alliance.com/program/helicopter_en)

Artist collectives such as Graffiti Research Lab (GRL) (<http://graffitiresearchlab.com/>) or Troika (<http://troika.uk.com/about>) design their own systems that facilitate temporary rewritings of urban spaces. These technologies provide a type of infrastructure that can be deployed easily. For example, GRL's Laser Tag or Troika's SMS projector make it easy to overlay images onto large-scale surfaces in urban environments. Rather than focusing on the most difficult-to-reach location as with analog graffiti these artists focus on selecting sites on city skylines or important buildings. The SMS projector allows for a temporary rewriting of signage. GRL's Throwies are individual pixels (LEDs, battery, magnet) that can be home-made and easily attached to any metallic surface in the city. Unlike analog graffiti, however, these systems only work temporarily and at nighttime, but they are an important commentary on mainstream display technologies that are used to "improve" city skylines at night.

There are many other examples of projects that could be discussed in this section. The preceding examples are merely illustrative and particularly appropriate. Some additional examples include: Cineboards 2007 in Rotterdam (<http://www.cineboards.nl/2007/>); Blinkenlights (<http://www.blinkenlights.net/>); activists' spray-painting robots; Playful Parasites ([http://www.rt80.net/portfolio/playful\\_parasites/](http://www.rt80.net/portfolio/playful_parasites/)).



Tram with Throwies. Graffiti Research Lab.  
Source: Excerpt of photograph by  
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Laser Tag on a building façade. Graffiti Research Lab. Source: Photograph by  
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All the groups discussed here construct their interventions from an “image of the city” (Lynch 1960) that differs from the dominant one. The physical and visual characteristics of the urban environment important to them differ from the types of features typical residents notice. For example, they might care about the location of resources such as spray-paint, geographies of surveillance, presence of police, general activity levels, and other characteristics of a location. The visible interventions are just the physical traces of particular engagements with the city. In the process of surfacing the image of their city, artists, boarders, and graffiti creators repurpose infrastructural elements to make their presence in the social and material landscape of the city more apparent. “Tactics of the city might in this way be seen as a kind of spatial slang, a local mode of expression and articulation, an artful way of getting yourself across.” (Tonkiss 2005: p.138) As a result, these practitioners establish a strong sense of ownership over certain spaces even if it is temporally bounded. They engage directly with the material configurations presented to them by the official infrastructure-building entities like city government. Expressiveness here is not a metaphor borrowed from language, but a practice intertwined with the material properties of the city.

Tactical interventions are in stark contrast to professional urban design practice. In their everyday work, most urban planning and design professionals develop infrastructures with one particular function in mind such as work or leisure. While planning has overcome modernist preoccupations with rationalized separation of functions, city spaces are still organized into different zones with specific usage rules and guidelines, e.g. park opening hours. For De Certeau (1984) this approach to shaping urban life is anathema. Tonkiss summarizes: “If strategies of urban design operate through the ordering of space and

vision (...) tactics of urban use are 'non-space', unfixed and unseen. They are skirmishes in the terrain of everyday life." (2005: p.138)

### *"Imageability" and Infrastructure*

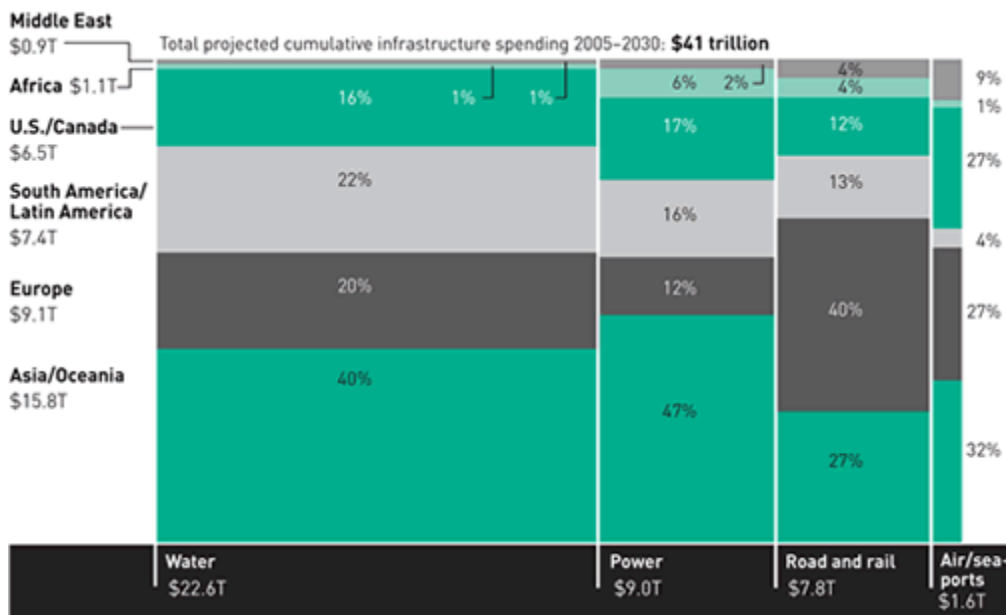
The impact on the visual landscape of the city makes the practices of artists, boarders and graffiti creators available to other citizens. The traces these practitioners leave behind impact the collective image of the city and awareness for infrastructure. Graffiti provide new, albeit temporary landmarks for urban citizens to incorporate into their images of the city. Scratches on urban furniture remind people sitting there that these physical artifacts are designed, built and maintained by someone somewhere. By generating this awareness in other citizens, boarders are contributing to a collective awareness for infrastructure.

The visual impact is powerful and points to the interconnected nature of infrastructural systems. Street lights –often a target for graffiti- depend on the invisible electrical grid. They are powered by electricity or sometimes independent generators to convey highly visible messages in urban contexts. These co-dependencies are part of the often-neglected reality of the systems upon which we rely (Larkin 2004). Larkin's study of pirate media infrastructures in Nigeria is a poignant description of how systems "connect and segment spaces and people" (2004: p. 292) to create a constantly shifting landscape of intersecting infrastructures. The work of these practitioners sits on the borderline between visible and invisible, permanent and temporary and thus makes infrastructures "legible" (Lynch 1960) through its contribution to our collective image of the city.

## Augmentation: Extending Utility Grids

Utility networks like the electrical grid or water systems are often presented as uniform and impenetrable. However, informal connections to these systems abound in developed and developing country contexts. Squatters, informal settlements, rapidly expanding urban neighborhoods tap into these vital services. Often these groups are overcoming socio-political forces that have excluded them from connection in the first place. The World Bank's push for privatization in developing countries in exchange for loans has led to uneven service for many poorer communities. Desai (2002) describes activists' struggles in Chatsworth, South Africa fighting to reconnect water services to poor townships that had been cut off in the course of rebuilding and privatizing the utility.

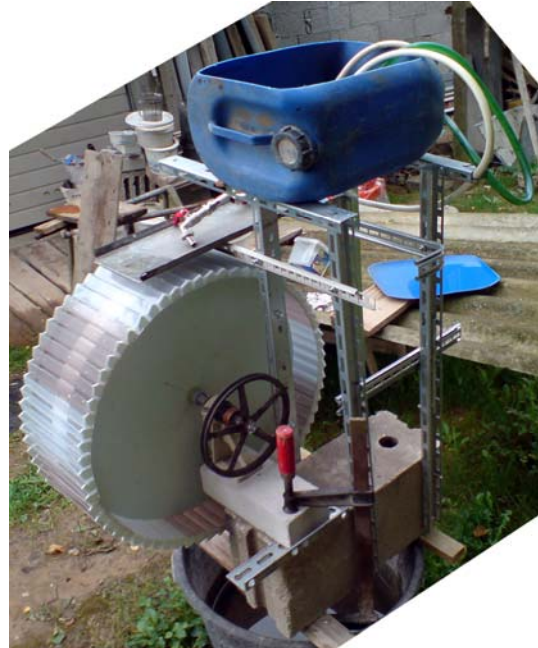
The role of infrastructure in economic growth for countries and cities remains a contested area that is closely linked to debates around privatization and nationalization or large-scale versus local utilities. As Gulyani (2001) shows in her study of the Indian automobile industry electricity should not always be provided by public utilities. In some cases, industry will be more efficient and support more people if it becomes self-sufficient on a smaller scale in response to specific local conditions. In her study, she reminds us that Hirschman (1955) already challenged the notion that infrastructure must precede economic growth. And yet still today discussions around the United States Stimulus Package or debates following the 9-11 attacks in 2001 promulgate the same idea that infrastructure is essential for modernization, growth, and expansion. For example in the table below, Booz Allen Hamilton reports data from various governmental and business sources about the state of infrastructure around the world requiring "modernization". By their accounts, the world is in dire straits.



The Infrastructure Challenge: Percentages of total projected cumulative infrastructure investment needed during the next 25 years to modernize obsolescent systems and meet expanding demand, broken down by region (rows) and sector (columns).

Source: Doshi, V. & G. Schulman, and D. Gabaldon (Spring 2007) "Lights, Water, Motion." Strategy + Business. BAH.

While most people feel alienated or helpless in the face of these reports on infrastructure degradation some groups have more agency in the matter. For example, groups living “off-the-grid” have explored how to become self-sufficient and take their electrical supply into their own hands. (Mainwaring et al. 2004)



**Homemade Waterwheel, Koblenz, Germany.**

**Source: Photograph by Peter Schmitt included with permission of Alfons and Peter Schmitt.**

Others are experimenting with partial self-sufficiency by connecting their own intermittent energy sources such as PV cells, waterwheels or wind turbines.<sup>2</sup> Connecting these multiple systems to each other, however, poses a significant challenge. In particular, intermittent energy sources require grid-tie inverters to connect to the main electrical grid which can present a large cost. Some enthusiasts build the entire system themselves while others buy component parts. Laws and subsidies vary widely from state to state and country to country.

Individual augmentation efforts not only contribute to a shared infrastructure, but they also sometimes damage the system. For example, connecting to the electrical grid without proper safety precautions endangers utility electricians in the case of a power outage. When power failures occur the utility company can disconnect a certain portion of the grid for maintenance work. If a local user has an intermittent source of power connected to the grid there will still be live portions of the network that utility workers cannot shut down or worse may not know about and suffer injury. Another example comes from water-stressed regions where individuals or institutions dig their own wells to avoid fees and regulations further taxing a limited resource. In the short-term, overdrafting an aquifer can lead to water shortages; in the long term, the aquifer may collapse causing permanent damage to the resource.

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<sup>2</sup> Home Power Magazine is a popular source of information for these enthusiasts.  
<http://www.homepower.com/home/> See also Mainwaring et al. (2004).

Through unreported and unmonitored individual practices such as digging wells or connecting power sources to the grid, individuals are endangering an overall infrastructural system. (Hirsch et al. forthcoming)

Smart grid technologies<sup>3</sup> are hybrid systems where utility companies work with their end-users to manage overall system load and reduce individuals' electricity costs at the same time. Each customer programs a desired usage pattern and the meter automatically limits output to the stated levels. These configurations will become even more fine-grained as individual electrical appliances begin to be designed with more control systems for power management.<sup>4</sup>

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<sup>3</sup> Fairley, P. (2008) "A Power Grid Smartens Up: Communications technologies will make Boulder's grid more efficient and environmentally friendly." *Technology Review*. March 20, 2008.  
<http://www.technologyreview.com/Energy/20442/>

<sup>4</sup> For more information on the electricity grid, smart grids and smart electrical devices see Cardell, J. B.  
<http://www.science.smith.edu/~jcardell/>

## **Secession: Creating Quasi-independent Activist Communications Systems**

Contemporary political movements rely heavily on mediated communications technologies to coordinate flows of people, information, and resources. Activist adoption of these technologies is enabled in part by appropriation of commercial services – like Facebook and Twitter – for political purposes, and in part by the innovative work done of movement engineers who create new communications technologies for activists.

Self-styled “radical techies” engage in a variety of activities. They set up “pirate” radio stations and SMS services that allow activists to communicate and coordinate action during mass mobilizations. They establish “independent media centers” – physical locations that provide equipment, technical expertise, and sometimes press credentials to help grassroots journalists create, edit and publish multimedia stories across a variety of media including newspapers, public access television, community radio, and the Internet. They build secure websites through which organizers plan campaigns, coordinate logistics, and disseminate propaganda. They create open source software tools that are shared and adopted by advocacy organizations around the world.

### *Alternative Design*

Projects like these provide the material conditions for the emergence of transnational activist networks that enable and equip urban protest movements around the world. In some cases, they offer new capabilities that are not supported by existing systems and which may predict broader technology trends. For example, the contemporary citizen journalism movement can trace its roots to activist communications software created in the late 1990s, while the concept of micro blogging developed by Twitter was informed by earlier activist SMS projects.

In other cases, activist communications systems replicate existing services. For instance, collectives like Riseup and Mayfirst/People Link provide email, webhosting and electronic mailing list to activists around the world. While these services are hardly unique, they are valuable alternatives to similar offerings by large telecommunications conglomerates, and are created in response to a different set of design criteria than their commercial counterparts.

Activist technology projects often support immediate, short-lived campaigns and events. They are imbued with a sense of urgency stemming partly from the passion that motivates much political action, and partly from the highly contingent environment in which activist projects occur. Activists respond opportunistically to dynamic political, legal, and technical environments. Projects are undertaken in extremely compressed timeframes, with sometimes with no more than a few days or weeks between conception and realization.

The immediacy of activist projects, coupled with a perpetual lack of funding, forces a kind of rough-and-tumble innovation. Activist designers adopt highly fluid processes. They learn to quickly identify and exploit short-lived opportunities. Tactics and technologies are often developed in tandem: plans evolve to embrace new technical capabilities while changing campaign objectives in the midst of a project provoke new design directions.

Design iterations tend to be very public experiments. Activist designers seldom have the time or resources to perform controlled trials. New ideas are developed and deployed very quickly. Evaluation is immediate and unsentimental. If an idea shows promise, it is refined and reused. If not, it is abandoned.

Contending with direct opposition by state, corporate, and non-governmental actors also influences design decisions. Projects often, but not always, privilege quick deployment and replicability over long-term sustainability. Concerns about confiscation and subpoenas lead to minimal data collection and retention policies, and place a premium on protecting users' privacy. Activist communications providers are also less likely to comply with requests for information or cease and desist orders from government agencies or other institutions.

Activists' willingness to engage in extra-legal activity also enables unique design opportunities. While virtually all new infrastructure projects "extend and multiply" existing systems (Graham & Marvin 2001), activist communications projects often maintain complicated, even parasitic relationships with existing infrastructure. For instance, posters downloaded from activist websites run on servers and bandwidth appropriated from academic networks are printed and copied on office equipment commandeered by activists with corporate day-jobs, and are distributed through networks of radical bookstores and community centers run by activist squatters in formerly abandoned buildings. In each of these cases, activists appropriate excess capacity in existing infrastructure for political ends without the knowledge or permission of their owners. These projects complicate notions of legality with both pragmatic and ideological considerations: in considering a solution, designers often go beyond legalistic binaries to wonder "can we get away with it?" and "will anyone be harmed if we do?" Additionally, the explicitly social nature of activist enterprises can lead authorities to tacitly allow interventions to occur despite noncompliance with local ordinance or corporate policy, as sympathetic office managers and network administrators choose to turn a blind eye to occasional shortages of copier toner or increases in network traffic.

Operating in the face of often overwhelming opposition also translates into a willingness to take risks. Activists generally expect their communications systems to fail, either through direct interference or technical snafu. Accordingly, designers place an emphasis on creating redundant systems. For example, activists will build websites, low-power FM stations, and SMS broadcast systems all to support a single protest to ensure that information continues to flow, even if one or more of those systems goes down.



Indymedia collective hosting a free radio broadcast in 2004 at Mato Grosso Federal University in Cuiabá, Brazil.

Source: [http://en.wikipedia.org/wiki/File:Indymedia\\_Cuiabá.jpg](http://en.wikipedia.org/wiki/File:Indymedia_Cuiabá.jpg)

### *Visibility*

Activist use of activist communications systems offers a counterpoint to the notions of invisibility and transparency that characterize everyday engagements with infrastructure. The decision to use communications technologies designed specifically for activists, even when “better” (i.e. more technically robust) commercial offerings are available is undertaken self-consciously. Choosing to, say, view and discuss videos on a website hosted by the international human rights organization Witness rather than engaging the same content on YouTube is to choose to engage with an alternate discursive space that is separate from “mainstream” or “official” communications channels. It is an explicitly political act.

As alternate spaces, activist communications systems highlight concerns that are marginalized in mainstream media outlets (Jenkins 2008). They also mark participants as members of an activist community. That is to say, they enable information flows and simultaneously imbue those flows with cultural significances independent of the content of a given utterance or piece of media. They become symbols in their own right, taking on a sort of fragile monumentality. Unlike the Hoover Dam, the

Roman aqueduct, or the Time Warner Building, they are not monuments to state and corporate power. Nor are they expected to endure for centuries, or even decades. They are ephemeral, fleeting testaments to collective agency; their logos stenciled on T-shirts and spray-painted on walls around the world around the world signifying the power of movements and the oft-repeated hope that “another world is possible.”



Graffiti in Bristol, UK

Source: [http://en.wikipedia.org/wiki/File:Bristol\\_indymedia.jpg](http://en.wikipedia.org/wiki/File:Bristol_indymedia.jpg)

## **Conclusion: What is at stake?**

Increasingly, infrastructure figures in public debates in connection with economic recovery packages, terrorism or environmental debates. The popular discourses rarely emphasize the fragility and necessary maintenance infrastructure requires; nor do they highlight the possibilities for local expansion and push-back from different categories of users. The preceding examples of appropriation, augmentation and secession aim to add another view on the interplay of social and material aspects of urban infrastructure.

### *Overcoming User-Designer Divisions*

Through our examples, we aim to overcome ingrained divisions between designers/experts and users. These divisions are not just falling apart at the small-scale individual level. Large-scale industries like the auto-industry in India (Gulyani 2001) are creating their own autonomous, cleaner and more robust infrastructures. What differentiates our work, however, is that we focus on the specific practices or certain groups. Beyond shattering the holistic view of urban infrastructures we aim to demonstrate the potential for shaping systems in more fine-grained ways.

Von Hippel (2005) has been studying end-user innovation for several decades now and he has identified areas such as kite-surfing, hiking goods and more industrial fields such as semiconductors where users have contributed significantly to their industry's reshaping. In infrastructural development, there is no end-user because by definition infrastructures are substrates for other systems. As in activist communications networks the goal is not to build a system, but to ensure more channels of information exchange. What can we learn then about different practitioners intervening and building infrastructures rather than modifying products?

### *Beyond Exaltations of the Ordinary*

In addition, we want to escape the trap of romanticizing the ordinariness of everyday urban life. The daily struggle with urban infrastructure in developing countries, for example, does not constitute a poetic encounter with city spaces. Activists working to build targeted infrastructure are dealing with volatile topics that are not part of mundane, everyday life. At the same time, infrastructure itself can be boring as others have pointed out (Star 1999). How can we then continue to focus on the background instead of the foreground without exalting it too much?

### *From Contingency to Agency*

We are trying to identify practices that have particular social and material configurations where infrastructure plays a role beyond use. While scholars in STS and other disciplines have uncovered in great detail the contingencies present within large-scale systems they do not provide a view with the intention to intervene in these complex webs. As practitioners, we care a great deal about the role of the overlooked designers who contribute to different infrastructures and engage in their own form reflective practice (Schön 1983).

## References

- Certeau, M. de (1984, 1988) *The Practice of Everyday Life*. S. Rendall, transl. Berkeley, Los Angeles, London: University of California Press.
- Dourish, P. and G. Bell. (2007) "The Infrastructure of Experience and the Experience of Infrastructure: Meaning and Structure in Everyday Encounters with Space." *Environment and Planning B: Planning and Design*. Vol. 34, 414-430.
- Edwards, P. N., and S. J. Jackson, G. C. Bowker, C.P.Knobel. (2007) *Understanding Infrastructure: Dynamics, Tensions, and Design*. NSF Report.  
[www.si.umich.edu/InfrastructureWorkshop/documents/UnderstandingInfrastructure2007.pdf](http://www.si.umich.edu/InfrastructureWorkshop/documents/UnderstandingInfrastructure2007.pdf)
- Graffiti Research Lab (GRL). <http://graffitiresearchlab.com/>
- Graham, S. and S. Marvin. (2001) *Splintering Urbanism: Networked Infrastructure, Technological Mobilities and the Urban Condition*, London: Routledge.
- Graham, S. and N. Thrift. (2007) "Out of order: Understanding maintenance and repair." *Theory, Culture and Society*, No.3, May 2007.
- Greenfield, A. (2006) *Everyware: The Dawning Age of Ubiquitous Computing*. Berkeley, CA: New Riders. Voices That Matter.
- Gulyani, S. (2001) *Innovating with Infrastructure: The Automobile Industry in India*. New York: Palgrave.
- Habraken, J. (1998, 2000) *The Structure of the Ordinary*. Cambridge, MA; London: MIT Press.
- Hippel, E. (2005) *Democratizing Innovation*. Cambridge, MA: MIT Press.
- Jenkins, H. (2008) "From Rodney King to Burma: An Interview with Witness' Sam Gregory (Part Two)", (website) available from <http://civic.mit.edu/blog/henry/from-rodney-king-to-burma-an-interview-with-witness-sam-gregory-part-two>. Accessed on 6 May 2009.
- Larkin, B. (2004) "Degraded Images, Distorted Sounds: Nigerian Video and the Infrastructure of Piracy." *Public Culture*. 16 (2): 289-314.
- Lynch, K. (1960) *Image of the City*. Cambridge, MA; London: MIT Press.
- Mainwaring, S. and M.F. Chang, K. Anderson. (2004) "Infrastructures and Their Discontents: Implications for Ubicomp." *UbiComp 2004: Ubiquitous Computing*, 418-432.
- Melosi, M. V. (2000) *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present*. Baltimore: Johns Hopkins University Press.
- McCullough, M. (2003) *On Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing*. Cambridge, MA: MIT Press.

Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books.

Smail, D. L. (1999) *Imaginary Cartographies: Possession and Identity in Late Medieval Marseille*. Ithaca and London: Cornell University Press.

Star, S.L. (1999) "The Ethnography of Infrastructure." *American Behavioral Scientist*, Vol. 43, No. 3, 377-391.

Stilgoe, J. (1998) *Outside Lies Magic: Regaining History and Awareness in Everyday Places*. New York: Walker and Co.

Tonkiss, F. (2005) *Space, the City and Social Theory: Social Relations and Urban Forms*. Cambridge, UK; Malden, MA: Polity Press.

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Susanne Seitinger is a PhD student in Prof. William J. Mitchell's Smart Cities group at the MIT Media Laboratory where she also completed her Masters in 2006 on children's animated playground props. She is interested in the benefits of thinking holistically about urban development and new technologies. Her current research focuses on urban public spaces and lighting systems. Susanne's background is in urban planning (Master in City Planning from MIT 2004) and architecture (Bachelor of Arts in Architecture from Princeton University 2001).