Shopping for Sharpies in Seattle: Mundane Infrastructures of Transnational Design

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ABSTRACT
In this paper, we describe the importance of mundane tools for design practitioners in India working with Euro-American clients. Our findings are based on a 7-week ethnographic study of a design firm based in Delhi, India. We analyze some highly-valued tools and software, such as post-its, as infrastructures with both practical and symbolic functions. These infrastructures are made meaningful in the shared practices of a transnational but primarily Euro-American design community. Designers in India employ a number of strategies we call "infrastructure work" to be able to participate as designers in this mold.

Keywords
Intercultural collaboration, infrastructure, design, India

INTRODUCTION
Picture a group of designers. Pens in hand, they stand at a wall covered in multi-colored notes. Such notes reflect ideas, observations, and elements of their design practice. Design as a product and a process emerges through interaction around these elements.

The picture is familiar, and so are the tools. Sharpies and post-it notes are iconic elements of design practice in blogs, books, and brochures. They are taken for granted as part of the furniture of the design process. Indeed, where they are less available (and so less taken-for-granted), this can cause difficulties. In India, where we have studied designers at work, small selections of post-its are available in major cities but pricier varieties (such as large easels) are scarce. Sharpies, during our fieldwork, were nowhere to be found. This unavailability poses practical and symbolic problems for the designers at D-Design, a pseudonymous design firm in Delhi and Bangalore, because these tools of the trade are important, not just for getting the job done but also for shaping its presentation to clients and external partners. Transnational shopping offered one solution. On a recent trip to the US, designers Anand, Ajay, and Neera bought post-it notes, post-it easels, and a handful of Sharpies for the office at home, along with other electronics and books requested by colleagues. Such transnational shopping regularly figured into these designers' practices.

In this paper, we show how everyday practices of transnational work at D-Design demonstrate the importance of mundane tools as important forms of intercultural infrastructure in design work. Further, we explore the forms of active engagement and the implicit assumptions that frame how such artifacts are used in practice. In intercultural collaborations, reaching shared understandings can be a challenge. Mundane tools can reflect shared symbolic assumptions and facilitate working relationships both within and beyond design, bringing D-Design together with clients across the US and Europe.

We understand these tools as a form of infrastructure [6], embedded in practices that span sites and time. Studies of collaborations in ICT4D, distributed work, and intercultural collaboration have already drawn attention to the importance and challenges of infrastructure, such as internet bandwidth and stable power [7]. Researchers have also identified the importance of shared, computational knowledge infrastructures such as databases [2] and coordination systems [24], to enabling work across great distances. The importance of technologies of mobility, such as roads, airplanes, boats, and credit cards, are so taken for granted that they rarely even warrant mention in collaboration research. Those infrastructures that most visibly make globalization possible are those infrastructures most commonly considered in studies of collaboration.

Our research on transnational design collaborations based in India reveals a more expansive and mundane range of infrastructures that are crucial to practicing design work. Such infrastructures carry both practical and symbolic import. Post-its, Sharpie markers, AutoCAD, and steady power are taken-for-granted in US design practice. In India, however, cost and limited availability makes these tools of design practice difficult to acquire and maintain, requiring transnational shopping, internet research, complex forms of lending, and electronics hacking. In this paper, we draw attention to, and account for, the work of acquiring and maintaining technical, social, and, more broadly, material infrastructures that make intercultural collaborations work.

In this work we draw on Bowker's and Star's definition of infrastructure as tools that undergird shared, learned practices [6]. By practices, we mean ways of acting, doing,

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and talking that are learned and enacted socially; practices are particular to the work and situations of the community, and conventional within the community of the inducted. In this view, infrastructures take different shapes and forms as they are folded into different practice communities and adapted to institutional, cultural, and salient historical particularities [17]. Infrastructures materially support and implicitly standardize those practices as people come to depend on them. As practices evolve, the materiality, embeddedness, or political stakes of infrastructures can constrain possible forms of action [6]. Infrastructure, then, can both shape and stabilize practices. When collaborators come together, that state of their infrastructures can enable or hinder collaboration. Relevant questions in such scenarios include: Do collaborators have equal access to shared infrastructures? Do diverse infrastructures at work in different parts of an organization allow knowledge to diffuse? Where is the work to maintain common infrastructure located? And if maintenance work is unequally distributed, how does it become displaced to different points in a collaborative system?

Mundane tools like post-its are infrastructure and the social networks that enable their acquisition reflect "infrastructure work" for D-Design. Recognizing these artifacts for infrastructure clarifies and illuminates their standardized and virtually transparent role in design processes. While not visible as large-scale technology infrastructure, these artifacts are part of a global body of shared, embedded, and legitimized design process and practices. To deviate from these de facto standards of design practice risks legitimacy, professional identity, client confidence, and client convenience. D-Design's infrastructure work is also constrained by available financial capital, mobility, tool availability, and culturally acceptable modes of collaboration. They also collaborate in context of intercultural power relations with clients – power relations that, we will argue, unevenly distribute the infrastructure work that enables successful collaboration.

FIELD SITE AND METHOD

This work draws from ethnographic observations and interviews at D-Design, a 12-person product design and design research firm based in Delhi. Their projects range from several months to several years and entail a broad array of design tasks, including user research to inform product design, shooting and editing design scenario films, creating graphic identities, and designing objects and spaces. D-Design works with a variety of prestigious American, European, and Indian clients. Many at D-Design recognize that intercultural communication is a constant challenge. They describe themselves as crossing different kinds of cultural boundaries on different projects: disciplinary boundaries between business or technical "types" of people, cultural boundaries between Indians and Americans, or institutional boundaries such as between their small firm and big corporate clients. The relevant, salient boundaries emerge and shift in the practice of their work, reflecting Levina and Vaast's [22] accounts of boundary formation in practice.

D-Design is relatively effective at engaging in intercultural collaboration. Their clients include top US technology firms and many have chosen to have multiple contracts with D-Design or have referred other clients to the firm. This makes D-Design's work a useful case study in understanding the processes of making intercultural collaboration work.

D-Design is often hired by international clients as "experts in the Indian context," in the words of designer Neera. This takes a number of forms. Clients often hire D-Design to conduct user research and develop research-based design concepts. During our fieldwork, D-Design was responsible for doing field research on people's everyday water practices, conducting a water filter prototype evaluation, delivering design implications, and designing prototype water filter form factors. For other clients, D-Design organizes and guides research excursions for US product designers or managers developing product opportunities in India. Each project requires establishing a different scope and negotiating unique communication and organizational practices. D-Design might work on a very circumscribed, multi-month project with a single contact person from the client company, or the firm might be conducting research and design in coordination with an array of production partners, funders, and the client-of-record. D-Design will typically assign two or three core designers to each project, and additional designers will join the project as warranted by needs for particular skills or additional labor.

The first author ("the field researcher") participated and observed at D-Design for 7 weeks in Spring 2009, documenting daily work practices on several projects and participating in the work of design as a marginal "intern," preparing documents, helping with filming, and participating in brainstorms with design teams. She spent 5 weeks in the Delhi office, 1 week in the Bangalore office, and approximately 1 week accompanying design researchers in villages as they collected data for the water-filter design project. She also accompanied one design team for two days in the US on a visit with a client in August 2009. She augmented observations with semi-structured interviews with both Indian designers and one of their American clients. We have recorded and selectively transcribed meetings and interviews and collected extensive fieldnotes. We open-coded transcriptions and fieldnotes for themes and we have revisited this data to elaborate and challenge theories developed through this process.

RELATED WORK

We situate our work in studies of materiality in collaboration and organizations. Much of this research has focused on the role of circulating artifacts in collaboration [9, 18]. Another strand of research has investigated the role of groupware, such as databases [24] or knowledge archives [12], in collaboration. Both strands have focused on the kinds of knowledge inscribed into these artifacts and

databases, explaining how they mediate and create tensions in organizational practice. Our research builds on these investigations of knowledge, materiality, and collaboration by through detailed studies of how these tools are acquired, configured, and managed. By extending investigations of technology use to technology acquisition, we ground our descriptions of organizational life in infrastructures, material culture, and economies beyond the workplace – concerns usually bracketed out in organizational studies favoring institutional and historical contextualization. This is particularly valuable for understanding intercultural and distance collaboration since such work often connects highly disparate material contexts.

INFRASTRUCTURE IN PRACTICE

Building on the variety of research on collaboration that emphasizes the importance of infrastructure, we highlight the role of mundane artifacts as forms of infrastructure in professional design work. We also show how, for D-Design, acquiring and maintaining these infrastructures was critical for supporting intercultural collaborations.

Properties of infrastructure

By drawing on Star and Ruhleder's concept of infrastructure [6], we see how tools can become deeply embedded in people's work practice, so familiar and tacitly relied upon to be almost imperceptible in the course of daily activity. Small details of daily life hum along, invisibly bolstered by myriad interlocking supports that render that life possible. Take, for example, a power outlet. Americans expect that plugging into an outlet will reliably provide them 120 volts – and this is generally the case. But the act of simply "plugging in," is made possible by an assemblage of interlinked electrical infrastructures: power plants, land agreements, utility regulation policy, power line maps, energy traders, computer algorithms, and international trade agreements, just to name a few. This seemingly invisible undercurrent of daily life is only made possible by a complex array of people, practices and things working in ongoing collaboration.

Star and Ruhleder [6] outline eight aspects of infrastructure. These aspects highlight the important role infrastructure plays in enabling and stabilizing shared practices among people via the material world. They entail:

- Embeddedness: Infrastructure undergirds structures, social arrangements, and technologies;
- Transparency: Infrastructure invisibly supports tasks in a *ready-to-hand* fashion;
- Reach or scope: Infrastructure gets used and reused beyond a single site or one event;
- Learned as part of membership: To become a member of a community-of-practice [20] is to learn to take infrastructures for granted;
- Links with conventions of practice: Infrastructures are materially shaped by conventions of practice and, in turn, enable the reproduction of those practices;
- Embodiment of standards: As they are incorporated into a range of practices, infrastructures implicitly standardize aspects of the practice they plug into;
- Built on an installed base: Infrastructures depend on and often align with already existing standards, infrastructures, and forms of knowledge;
- Visible upon breakdown: Infrastructures are visible to people when it stops working in a taken-for-granted fashion.

These aspects of infrastructure help explain why deceptively simple tools and objects might take on intense symbolic and practical value in D-Design's design practice.

A practice perspective

In unpacking and analyzing infrastructure we take a practice perspective. Understanding tools in practice [13, 28] means recognizing that tools are inherently entrenched in larger patterns of behavior – patterns of behavior that are culturally and historically informed. Like approaches of Human-Computer Interaction, ergonomics, and distributed cognition, attention to practice requires detailed investigations of how people orient to and manipulate tools in use. Unlike HCI and ergonomics, however, practice perspectives assume the meanings and forms of tools, as well as the significances and forms of the bodily practices of use, are situated in broader social interactions, including collaborations and broader cultural practices.

Collaborations and cultural practices, in this view, are ongoing accomplishments that are adaptive and dynamic rather than something amenable to general rules or predictive models. Once practices stabilize, they may also become normative or routine [28] but are always subject to evolution [11]. This approach also recognizes that mediated work must be understood over longer periods of time [31] and in ecological contexts [16, 26]. Over time, ongoing social practices and negotiations can make the roles of tools, as well as forms and meanings of cultural and identity boundaries [22, 23], changeable.

Bowker and Star's perspective on infrastructure situates material tools in practice [6]. While the materiality of infrastructures is important, the materiality is not an affordance that has the same effect everywhere. Instead, it becomes meaningful and used in diverse ways by people engaged in diverse activities. Infrastructures are able to span sites and single events precisely because they allow for different kinds of uses and effects while maintaining a thread of commonality across sites. Infrastructures also fix and standardize some dimension of work practice, allowing people to engage it repetitively and unreflectively.

Next, we discuss the importance of tools and infrastructures in D-Design's design work practices, before moving on to a discussion of their tactics for acquiring and maintaining those tools.

THE VALUE OF "GOOD TOOLS"

The daily practices D-Design designers – sensemaking, keeping clients in the loop, and creating deliverables, for example – rely on a number of socially enacted and materially based infrastructures – what designers at D-Design would sometimes call "good tools," "infrastructure," or "platform."

Designers at D-Design saw using "good tools" as key to their design practice. He, Anand, and Neera were riding a train in the US on the way to visit with a client in the United States. On their visit, Neera, Ajay, and Anand tried (with some success) to arrange tours of Google and IDEO, two firms whose practices they respected and from which they hoped to gain inspiration in designing and equipping their own workspace in India. In the US, Ajay felt, "a platform for innovation" already existed: "access to tools or access to knowledge, access to infrastructure that supports innovation – people who want to be innovative." In India, by contrast, Ajay and Neera emphasized that they had to create that "platform" "from scratch."

When possible, many at the firm placed a premium on having *the same* infrastructure that they believed others used abroad, rather than versions available or assembled locally. Upon visiting the US and shopping for office supplies, prototyping supplies, and baubles, Neera quipped, "If we could ship it [products available in the US] all back with us, we would." Ajay interjected:

> "It might be an excuse that we don't have a motivation and discipline to do it for ourselves in Delhi with the stuff we have. That's also true. But sometimes we don't have the time to do so many things."

Getting the same tools that these workplaces relied on offered the promise of emulating those practices with fewer "loose ends." Loose ends materialize in a variety of ways: loose ends might be a misfit between the materiality of the tool to the work at hand; loose ends might be breakdowns in shared practices because of misfits of materiality. More broadly, loose ends are hiccups in the performance of "professionalism" – an aesthetic of practice valued highly at the firm. These dimensions are a selection of how design infrastructures are valued at D-Design. A full account is beyond the scope of this paper.

We now consider infrastructure fit: fit in terms of material suitability to task, fit with shared practices, and fit with professional performance.

Materiality in the work at hand

By materiality, we refer to the physicality of infrastructures in question. Is the object hard or soft? Big or small? Easily disposable? Materiality is not inherent in the object, but instead a feature of the object within embodied social relations [4, 29]. The hardness of wood, for example, is relative to whether it is judged with a drill or a finger. The disposability of a motherboard depends on the relation of the chemicals and metals of the construction to the law and local convention.

The material details of the infrastructure designers choose in daily work practice matters a great deal. The material properties of tools affect designers' abilities to collaborate effectively and engage in broadly shared design practices.

CSCW research has long analyzed how the detailed, material properties of software relate to collaborative work (e.g. [14]). Designers at D-Design appreciate this, choosing software based on the fit to the contingencies of work practices. Even very detailed quirks or unintended featrures of software could become salient in designers' work. Neera, for example, saw Ajay working on a client deliverable in Illustrator. The two are close friends and Neera responded vigorously:

> "Oh god [Ajay] please don't use Illustrator, for god's sake. When you leave – Keynote or something. This illustrator and the linking! I will kill you, [Ajay]!"

Neera knew that Ajay planned to be away from work for several weeks of the project. Based on her prior experiences with Illustrator, she anticipated that an Illustrator document with linked images might break should Ajay transfer the file to a teammate's computer. Small, undesigned, material quirks of software can shape practice [16, 18]. These quirks affected the *transparency* of the infrastructure. In her experiences in creative design work, Neera anticipated infrastructural breakdowns. By negotiating the infrastructure in advance of problem situations, she was engaging in a form of situated infrastructural adaptation.

Tools in shared practices

The materiality of available tools also affects designers ability to engage in broadly shared design practices. Take, for example, brainstorming. Brainstorming is a form of collaborative practice at two levels. First, within the firm, most designers learned how to brainstorm in school – they were familiar with the basic rules of the language game and could adapt it to situational particularities. Brainstorming is also a shared practice transnationally, written about, studied, and practiced broadly in many business and educational contexts. This form of practice has a large *"installed base*," as Star and Ruhleder would call it, *reaching* across many sites of practice [6].

Post-it notes are pervasively used in brainstorming practices, so much so that they have become an iconic representation of it in magazines, blogs, and books. As we noted earlier, however, post-its are less widely available in India than in the US. The following story demonstrates the value of post-its' material specificity in becoming a member of a design community of practice.

At a brainstorm at the Bangalore office, Banita, Kurosh, Denis, and the field researcher gathered to generate e-classroom ideas. Lacking post-its, they began writing ideas on slips of white paper and sticking the slips to the wall

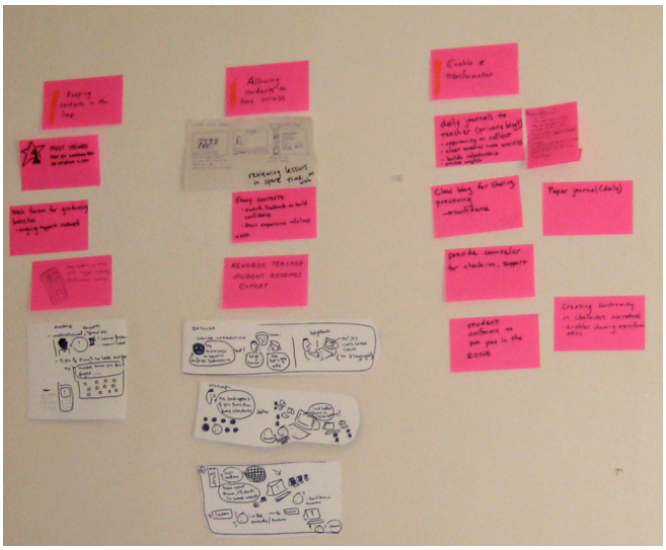

Figure 1: Sorted brainstorm ideas incorporate both slips of paper mounted with tack and post-it notes. Paper allowed for more detailed figures than post-its.

with bits of blue adhesive tack. After some time, they decided that jury-rigging these sticky notes undesirably broke the flow of brainstorming. Banita, a senior member of the team, sent less senior Denis to Staples – the one place on that side of the city selling post-its – to purchase the notes before continuing the brainstorm. Brainstorms then resumed, now mediated by post-its. The post-its subtly changed the form of contributions from more graphical, narrative ideas to ideas expressible in short phrases. (See figure 1.) The group generated post-it contributions at a faster clip than with the previous slips and tack.

In the above example, the materiality of available tools shaped the flow of interaction. Importantly, however, it also broke the flow of a kind of *broadly shared*, symbolic *convention of practice*: brainstorming. To brainstorm with post-its is not only to functionally generate ideas at a fast clip. It is to talk and act like a designer, and to interact as a design team. In performing these recognizable innovation practices, designers leverage these practices' legitimacy.

The post-its are an infrastructure *embedded* in other infrastructures. Selling 3Ms slips of papers in India relies on global distribution infrastructures, infrastructures of global finance, and in this case, a Staples chain store. Broadly, these are the infrastructures of 1990s Indian economic reforms inviting foreign companies into what had been a more planned, nationally-bounded economy.

Another tool, AutoCAD, was similarly central as an infrastructure of professional, collaborative practice. AutoCAD is a widely used software tool for 2-D and 3-D design. It is also a tool that costs approximately one third of a designer's annual salary at D-Design. Despite the cost, however, Rita, a junior designer, explained its importance in allowing the studio to engage in professional design-for-manufacture:

> "We should ideally use AutoCAD when we are, say, manufacturing the product 'cause it's much more accurate and standardized…in the same way manufacturers and engineers use standardized industry processes…Moreover, its just a way of simplified presentation and communication to different parties involved in the product development process."

The materiality of the tools – the features and computational capabilities – enabled them to produce distinct kinds of design forms. Because these tools were de facto standards *built on an installed base*, designers were able to access knowledge and support from internet sites and from the professional partners and manufacturers with whom they worked. Even more explicitly than post-its, AutoCAD is a work tool that embodies a very expensive, transnational, professional standard.

Next, we examine the role of tools and shared practices in performing as a "professional" at D-Design.

Performing as a "professional"

"Professional" practice figured strongly in work and talk at D-Design, particularly with international clients.

Anand, D-Design's co-founder, described the studio as a "professional services firm." "Professionalism" was something Anand and Ajay both sought to achieve in their work processes and output. Professionalism simultaneously entails staging "professional" performances and identifying as a "professional" by looking and acting like a legitimate design firm. Clients, Anand explained to his team after a client conference, did not want the appearance of confusion or uncertainty. Particularly with American clients, designers sought to demonstrate control over professional practices, processes, and time expectations. With familiar clients, particularly Indians with family or friendship ties to the firm, the designers exercised more flexible professional time and process discipline.

Using "good tools" and engaging in broadly shared professional practices are a key form of professionalism. The practices we have described – brainstorming, modeling in AutoCAD, and laying out documents in Illustrator – are ways of practicing as legitimate and professional designers in a number of ways: dealing with contingencies such as teammate absence, being able to move and talk like a designer, abiding by industry standards, and leveraging knowledge and support available in the community and online. Through these practices designers accomplish professional identities as designers and bind themselves to a broader community of practice [20]. Good tools may not be just a matter subjective identity, or even smoothing collaboration. Boland, Lyytinen & Yoo [5] describe how modeling software allows for new kinds of collaborations between architects and construction contractors, enabling different kinds of buildings. People's relationships with material quirks and textures, then, can be highly consequential for work practices, identities, and output.

Challenges of getting "good tools"

Several designers openly recognize the importance of "good tools," but also recognize the challenges of acquiring those tools in India.

> Ajay: "[You need] good tools – things to equip and outfit your places with, and in India all that stuff is from scratch. Either you don't have it, you can't afford it, or it's not there."

Both Neera and Ajay felt that to practice design in India, they had to great lengths to acquire the proper tools *and* then do the actual work of designing. Ajay explained, "right now, we're trying to do both which is why there's no time, loose ends everywhere, and we're not even doing design work properly." Ajay's team commonly worked 7 days a week to adhere to their American client's timeline.

Designers work around challenges of scarcity, predictability, and cost in equipping their studio.

First, many taken-for-granted tools of Euro-American design trade are scarce in India. We have already noted a number of such tools – post-its and Sharpies. During our field research, designers also went to great lengths, detailed below, to acquire Arduino programming environment tool kits and instructional manuals for prototyping. In some cases, these products are only available in one or two cities in India. In other cases, tariffs made imported products prohibitively expensive.

Predictability also poses a second challenge for designers in India. Power, for example, might go out at the design firm several times a week for durations ranging from a few minutes to a whole afternoon. Designers sometimes speculated that the power would go out during election time as candidates rerouted scarce electricity to usually underserved villages to seek votes. Mac desktop computers, necessary for processor-intensive film editing, rely on consistent power. D-Design's office worked around this unpredictable infrastructure by purchasing UPS power backup units that would supply power when the office lost grid power.

Cost of infrastructure was a third challenge for Indian designers. De facto standard software of professional, international design practice includes packages like AutoCAD, Adobe Illustrator, and FinalCut Pro. These programs could be quite costly compared to designers' annual salaries. Designers worked around the intractable cost of this software by using online BitTorrents or copying the software from other professionals.

INFRASTRUCTURE WORK

Designers at D-Design worked around these challenges of acquiring good tools for design. We call these tactics of acquiring and maintaining such resources infrastructure work. Below, we describe a number of tactics in the repertoire of infrastructure work. These serve to underscore the importance of these infrastructures in doing transnational, intercultural design work. These also underscore the invisible work and resource intensity of walking and talking like a "designer" in India.

Long-distance shopping

Designers frequently shopped across long distances, both transnationally and within India, as a way of acquiring material goods and tools unavailable or less affordable in India. On trips abroad, designers at D-Design bought a range of items for themselves and their coworkers: Spirographs, Arduino materials, Apple laptops, camera lenses, and computer accessories for example. They also took friends' and family members' travel as an opportunity to get tools and other desired items. Between long-distance shopping opportunities, designers researched possible tools through conversations with other professionals and hobbyists, often online, and through web-based research on products. As one designer put it, they have to be very careful about what they choose to buy because there's no return policy in most long-distance shopping.

Designers sometimes found quirky and surprising tools irreplaceable in their work. Rakesh, a firm principal, requested that a colleague's husband purchase a Spirograph toy for him when the US. An American-funded NGO in Bangalore had commissioned Rakesh to create a logo and letterhead for the organization. Rakesh envisioned a logo that included the interlocking ellipses, suggesting both order and play and familiar to likely audiences, funders, and partners in the US. Spirograph sprockets were the sole way to achieve that shape and Rakesh only knew how to get them from the US.

Getting the tools designers needed to do their work, then, relied on travel, mobility, and the availability of information about products through the internet and word-of-mouth. It also depended on a network of friends and family with sufficient mobility (and, by implication, economic means) to bring supplies back to India with some regularity.

Sharing Software and Media

Designers employed "illegitimate" software and media copying in a number of ways that facilitated their work practices, kept them current with transnational trends in film and music, and maintained their social ties. (In the section that follows, we describe the importance of social ties as an infrastructure.) Copying digital media and software is so much a part of everyday life that we observed people exchanging thumb drives as often as they exchanged cigarettes – and some designers smoked a lot. After several weeks in Delhi, the field researcher came to keep her thumb drive consistently in her pocket so colleagues could give her recommended music and movies, software for work, or interesting documents. This prolific copying and passing of files serves a number of purposes.

First, software copying directly supports the studio as its designers flexibly engage in design practices adapted to client needs and situational constraints. Working with diverse clients requires designers to learn, maintain, and choose from a wide array of software depending on client

preferences and needs. More senior and experienced designers often keep copies of software on storage devices, ready to be copied by newcomers to projects needing to rapidly adapt to and contribute to ongoing work. For example, when the field researcher joined a project to help with documentation, Neera directed her to get the required software from Anand's thumbdrive so the new participant could access and edit the documents in production. Copying allows for rapid integration of new members onto work teams. Such flexibility would be prohibitively expensive given average salaries and revenue at the studio. For instance, AutoCAD cost USD$4000 – one third of a designer's annual salary. Adobe Creative Suite, the package containing staples Photoshop and Illustrator, cost USD$1299. Designers were unable to pass these costs on to their clients in a competitive project bidding process for two reasons. First, other firms would not pass these costs on. Second, clients expected firms to work cheaply, as evidenced by travel per diems budgeted for Indian designers that were far lower than those clients allowed themselves for travel in India.

Second, sharing media and software more broadly is an important means by which designers in India stay engaged with global trends in music and film. Knowledge of these trends was a key to design work, according to Ajay. Ajay explained that experiencing Western music, movies, and film put designers "a step ahead of India's Westernization." Their familiarity with global media cultures supported rapport with Western clients and enabled them to understand those clients' tacit aesthetic expectations. Designers overcame a number of challenges in accessing global media. "Legitimate" releases of music, movies, and software from abroad either lag or never arrive in India. For example, though Indians could purchase an iPod Touch and iPhone legitimately in India, Apple made neither the App Store nor iTunes Music Store available in India at the time of the research. Neera and Ajay also lamented that MTV, which had once shown American and European music videos, had been localized into a Hindi language channel with national programming and music. Several designers independently cited VH1 as important, because it continued to provide music and videos from abroad. In a profession engaged in transnational cultural production, copying software and media directly supported work practices.

Third, sharing media and software reinforced and maintained social ties. Creating these social ties, as we will describe, is itself a crucial form of infrastructure work.

Organizing Social Infrastructure

Trust and social relationships that are "flexibly accountable" are crucial to infrastructure work at D-Design. Designers perceived that colleagues and friends could be trusted and would provide information and help when needs arose. By contrast, unknown actors were assumed to be particularly unreliable.

Getting things done in India means working with known people. "The rule of law isn't very strong so what you get is all about relationships – building rapport," Anand advised the field researcher newly navigting India. Designers prefer established family and friend networks for services and exchange within India. For example, designers called their family and friends to locate potential Telugu language translators for their rural design research. They also tapped into networks of familiars to locate apartments for guests of the firm. By contrast, designers expressed stress and frustration when relying on unfamiliar people, such as brokers for apartments and services. Taxi drivers meant to take designers to the village for research might not show up. Apartment brokers may mislead with impunity about their financial cut or accommodations' amenities. One associate of the firm even had a business venture to build a website meant to register and track broker reputation.

Use of social infrastructure to access information or align resources happened almost *transparently*. During several meetings, questions or resource needs surfaced in the flow of conversation. Rather than noting the need and dealing with it later, designers usually dialed a family member or friend immediately – in the middle of the meeting, sometimes even while running the meeting – to begin resolving the question or need. Designers tacitly assumed that reasonable requests would be granted and this assumption was rarely wrong. The social infrastructure did, however, sometimes rupture, revealing tacit assumptions that kept it working. Kathur, a designer and co-founder in Bangalore, often used the studio's photography equipment for his own shoots, unrelated to client work. He felt that he had donated his own cameras for firm use and, thus, he expected use the firm's cameras. In Delhi, however, Anand suggested camera sign out, in part to prevent equipment loss. This proposed administrative change angered Kathur: "Let people steal a little! It increases their happiness quotient, no? It's about trust." For him, judging practice through accounting violated his normative expectations regarding behavior regulation. Accounting threatened to standardize subtle practices of donation and borrowing and collapse the sense of trust that animated willingness contribute one's tools and equipment to the firm.

This social infrastructure can also serve as financial infrastructure through which money is transmitted across national boundaries. For example, Rita asked Anand to purchase a laptop for her in the US. Rita's father transferred money in India to Anand's account so that Anand could use his bankcard at the US Apple store. Once in the US, however, the Apple Store rejected Anand's Indian bankcard. After an hour trying to call his Indian bank to clear the transaction, Anand finally borrowed funds for the laptop from a trusting American associate. Upon returning to India, he bank transferred the money from Indian ICICI bank to Wells Fargo to repay the loan. In another case, the field researcher seeking to rent an apartment in India had to give an Indian associate in the US USD$300. That Indian associate then had a family member in Delhi pay an apartment broker in Delhi to secure the flat. Such high-stakes chains of familiar debt and lending enable

transnational infrastructure work. Familiarity and trust enable the social infrastructure to support design work. This social infrastructure is *embedded*, underlying other infrastructures such as finance channels. Participation and proper use is *learned as a member* of a community. This work of cultivating trusted, stable social ties, then, shares properties of Star and Ruhleder's [6] infrastructure.

DISCUSSION

Design work is intercultural in several ways. First, designers often bridge different disciplines, such as product management, engineering, and sales. Second, D-Design works with clients from different countries. Third, professional design history is usually identified as a set of European and American practices developed in relation to industrial mass production [27]. While many designers in India cite roots in both Euro-American and Indian crafts [25, 30], many we encountered in India also experienced Euro-American design institutions and communities as powerful arbiters of legitimate design work and talk. In order to practice design in Delhi in a transnational professional space and market, designers at D-Design are forced to shape their own professional practices, tools, and infrastructures to be amenable to, recognizable to, and legitimate to others in this intercultural space.

A second shift

The work that designers put into equipping themselves as legitimate designers can amount to a second, unacknowledged shift they work to make accomplish intercultural collaboration.

Intercultural collaboration can require mutual adaptation [3]. "To meet someone halfway" suggests that two parties come to a compromise where each walks some distance to meet at a point that belongs wholly to neither. Such practices of negotiation and compromise are part of building shared practices on distributed, intercultural teams – whether those practices constitute a shared culture or a trading zone for limited, tactical exchange [19]. The work of coming to a common place, however, is not necessarily evenly distributed. Building a shared basis for collaboration takes work and D-Design takes on a bulk of that work.

Some at D-Design describe the work of building the infrastructure for doing design as creating "the platform." The platform includes the tools, workspaces, and the local social scene of creative people that, in their view, facilitate good design work. These new infrastructures of design work are built atop, and entangled within, existing infrastructures of material goods and social relations. Ajay and Neera, in particular, explained the work of building "the platform" as a necessary precondition to the work of actually designing – a kind of "second shift" [15]. Recall Ajay explaining the challenges of getting good tools *and* doing design in India: "right now, we're trying to do both, which is why there's no time, loose ends everywhere, we're not really even doing design work properly."

This imbalance manifests not only in infrastructure work, but also in the way the designers speak about language on the project. Broadly, Indian designers at D-Design see themselves as working hard to translate clients' wishes and accommodate their needs. While D-Design explicitly wants to be in a position of negotiating with clients and offering them expertise, they feel that they have to engage within the clients' frame of expertise. Anand explained, after a client presentation with Anand, Neera: "It's like a trojan horse. We speak their language but say what we want to." Ajay later elaborated their goal as "not to be a sell out but speaking [the client's] language." In their attempts to accommodate each client's language, infrastructures, and practices, D-Design shoulders the burden infrastructure work and performs a valuable but somewhat invisible service – allowing their client to continue as they are.

The second shift falls to D-Design for several reasons. First, because D-Design is a professional services firm, their clients' preferences, needs, and trusted practices hold great sway in negotiations over collaboration style and work process. Put simply, clients have the money. Additionally, clients represent future work. The client's have both financial and social capital that D-Design needs to sustain its business.

We speculate that clients' unfamiliarity with contingencies in Indian planning is another force in shifting the burden of adaptation to D-Design. In hiring D-Design, American clients unfamiliar with Indian contexts likely take for granted that relevant infrastructures for doing design work are similar across cultural contexts. One American client told the field researcher that he hired D-Design because they "just get it," glossing tacit assumptions about what getting it looks like. D-Design team members, at times, communicated differences in Indian work circumstances on the project blog, telling of dusty roads, heavy traffic, translators cancelling at the last minute, and police checkpoints delaying village visits. Contingencies, however, pose challenges for project expectation setting. Clients request bids for design work that state a timeline at the outset and select design studios based in part on those promises. European and American clients, according to Ajay, are particularly stringent about meeting contractual obligations. Budgeting time for unknown contingencies in a competitive bidding process, however, is difficult, particularly when the client does not understand the reality of on-the-ground work in India. For designers at D-Design, working 7 days a week, sometimes 18 hours a day, to meet project deadlines proved preferable to pressuring the client to shift their expectations.

Broader lessons about infrastructure

Understanding the role of mundane infrastructures at D-Design illuminates several general facets of infrastructure.

Visible infrastructures

First, being in India shows us how infrastructures need not be invisible to their users in order to work. Far from invisible, designers and staff in India exert ongoing effort

to acquire battery backups and tools abroad. Infrastructural invisibility is a privilege of a division of labor where those in keeping the infrastructure in working condition are not those who rely on it on a daily basis. This division of infrastructural labor is not universal across cultural settings. In this Indian design firm, we saw first hand how the tactics and practices of those who do not experience infrastructure as ready-to-hand in the ways that those in Western, corporate or research settings often do (i.e. [6, 24, 26]) Maintaining infrastructures taken for granted at centers of organizational power can be a significant source of time and effort in remote teams. This is the invisible work of making intercultural collaborations work, particularly when power and authority to grant legitimacy is unequally distributed in the collaboration [17].

Symbolic infrastructures

Second, we draw attention to the ways in which infrastructures are not only functional but also symbolic. Though infrastructure has primarily been analyzed in functional and phenomenological terms, we suggest that infrastructure can also symbolize characteristics of those who use them. Bowker and Star hint at symbolic dimensions in their research on infrastructures. For example, they explain how authors of the Nursing Interventions Classification (NIC) originally omitted "leech therapy" because it did not look and feel like a scientific intervention [6:66]. Such symbolic aspects of infrastructure – of allowing people to look and feel right – have not been emphasized in infrastructure research. Here, we argue that hard-to-get tools of design not only link designers in India to broader communities of professional practice, but that using "good tools" makes them feel able to do recognizably high-quality work.

Alvesson has found doing *recognizably* high-quality work is a challenge for knowledge workers more broadly. Knowledge work, he argues, is highly ambiguous [1]. Among knowledge workers, it is already difficult to assess work quality when workers are perceived to be experts – how can a less expert collaborator judge an experts' expertise? Alvesson argues that knowledge workers diffuse the tensions of these ambiguities by symbolizing their competence and legitimacy through practices not directly related to their work product, including dress, forms of talk, and other identity and consumption practices. In intercultural settings, however, such signaling strategies can be particularly challenging where cues of competence might differ. For designers at D-Design, connecting to ideas in the broader global design community is not only a way of gaining process knowledge and skills. It is also a way of learning how to walk and talk and dress enough like a designer to inspire confidence. The value of using "the same tools" as American designers speaks to how the functions of a tool – its reliability, its qualities – cannot be disentangled from symbolic associations with those tools. Our investigation of infrastructure work suggests that symbolic performances are an important aspect of infrastructures of collaboration, particularly when global, professional cultures are taken into account.

Social infrastructures

Third, we draw attention to social infrastructure, or the ways in which social relations created both within and work and in broader life become practical resources for work. Social infrastructure work in India is sometimes invisible and other times maligned, treated as a flaw in cultural character. Management and development literature has sometimes called this "nepotism" or "cronyism" (see [8]). Social infrastructure work, however, begins to suggest that these modes of sociality can be seen as investments in value and support, not only as a source of functional work support but also as producing the broader forms of social life beyond work. Anthropologist of Egypt Julia Elyachar argues that informal economies of favors and obligation to kin can be seen as legitimate and even positive forms of sociality and community even as they evade observation by the state or by capitalist forms of accounting [10]. Social infrastructure, then, is not simply a workaround until more formal infrastructures are put into place. Nor is social infrastructure unique to India, though practices for producing it will vary. Several CSCW researchers have noted the importance of invisible social networks [26] and "human infrastructure" [21] in getting work done in American organizations.

CONCLUSIONS

A post-it note and a highway would seem to have little in common. However, we've seen that the simple post-it note, and a number of other often forgotten tools, objects, become central to the professional practices of legitimate design work. By using Star and Ruhleder's notion of infrastructure, we have argued that these tools are embedded, invisible in practice (*to some*), and shared in collaboration. D-Design actively acquires and maintains the mundane infrastructures we have described as a way of bridging the worlds of urban India to the professional worlds of their clients in the US and Europe. Tools that become infrastructure in this way are a key to understanding challenges of intercultural collaboration.

While the assumption of much research on intercultural collaboration is difference, we see how daily practices in a Delhi design firm are organized around acting as their international clients expect. These designers' access to films, design blogs, and travel gives them knowledge and material resources to understand and accommodate clients who largely take their own knowledge and practices for granted. This consumption of design tools also becomes a vehicle for participating in a broader, transnational community of design practice. We suggest that material practices and their symbolic meanings are a rich site for understanding issues of negotiation, access, and power in intercultural, organizational life.

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