

Technical Experts and the Production of China's Airport Infrastructure

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On a crisp fall afternoon in 2018, I joined a delegation of airport planners, managers, and engineers on a construction tour of Daxing International Airport, a new hub being built sixty kilometers south of Beijing.¹ The group included a dozen employees of a French engineering firm that had developed Daxing's masterplan, as well as an American delegation whose members were eager to establish trade agreements between Daxing and Atlanta, the largest hub in the United States. Journalists from the government's mouthpiece, *China Daily*, tasked with writing a front-page article about the impressions of Daxing's "foreign friends," accompanied us on the journey to Beijing's rural outskirts (Du 2018).

Upon reaching the entrance to the construction site and taking in the airport's vast scale, the delegates let out a gasp. "On your right are the future headquarters of China Southern and China Eastern Airlines," our tour guide announced, pointing to two identical gargantuan office complexes. The bus accelerated onto an elevated highway. Workers squatted along its edges, armed with trowels and buckets of cement. "Here you can see the terminal," the guide continued. "It will be served by four runways and will have a capacity of forty-five million annual passengers. This will increase to a hundred million passengers and seven runways by 2040. OK, we are here."

As we exited the bus, airport staff members led us into a meeting room to watch a short introductory film. The room featured a prominent photograph of Xi Jinping, gesturing approvingly at a scale model of Daxing. The delegates snapped photos of the film with their phones, while the journalists took pictures of the "foreign friends" taking pictures of the film. "Now we will visit the construction site," the guide said. "Please be careful." Airport staff distributed hard hats while the guide shepherded us to an observation deck inside the terminal. "As you can see," she said, "Daxing is shaped like a human hand. Each finger of the terminal has gates on either side. The maximum walking distance to any gate is eight minutes. So it is better than the existing Beijing Capital Airport." The guide bravely continued her presentation, but it was difficult to compete with the scenery (figure 10.1). Dozens of delegates took selfies with the two tied-arch bridges that



Figure 10.1. Aviation professionals visit the construction site at Beijing's Daxing International Airport. (Photograph by Max Hirsh.)

flanked the departure hall below. A French engineer tugged on my jacket sleeve: “Look at these bridges! They are so wide, they could span a river.” To my right, the delegates from Atlanta gazed at a giant Chinese flag hanging from the oculus where the terminal's five piers converged, shaking their heads in disbelief. “This is crazy, man,” one of them exclaimed. “Not what I expected of China. Everything is just so . . . wow. Just crazy.”

Recent scholarly work on China has devoted much attention to policy directives aiming to export a so-called China Model of infrastructure-led development to countries in Asia, Africa, the Middle East, and the former Soviet sphere.² To promote that model abroad, the People's Republic of China (PRC) has directed considerable manpower, technical expertise, and financing to the overseas construction of roads, rails, pipelines, seaports, and airports. These projects aim to drive urban development, economic growth, and regional integration in emerging

and middle-income economies, while at the same time cementing diplomatic ties with China. The scale, speed, and overt geopolitical objectives of these projects have captured the attention of the public, as well as that of policy makers and scholars around the world.

However, less attention has been paid to the origins of that infrastructure-led model, which forms the centerpiece of the Chinese government's Belt and Road Initiative. This chapter addresses that gap by studying the development of China's airport infrastructure from the 1980s to the present. I posit aviation as an insightful lens through which to trace the influx into China of infrastructural expertise from Europe, Japan, and North America during the post-Mao period of Reform and Opening Up. Drawing on fieldwork at airports in Mainland China, Hong Kong, France, and the United States, as well as on interviews with architects, planners, and engineers, I trace the transnational origins of China's infrastructural expertise in order to better understand the processes by which the China Model of infrastructure was subsequently exported (or rather reexported) abroad. By investigating how aviation professionals from around the world collectively created a particular set of airport planning practices, I argue that these midlevel experts played an indispensable role in China's reintegration into the global economy and its reengagement with the outside world. As such, they represent a crucial—and thus far overlooked—source of data for both infrastructure scholars and scholars of China.

With that in mind, the chapter focuses on a series of cooperative research, training, and development programs—organized jointly by Chinese, European, and US transportation agencies, airport operators, and engineering firms—that have fueled the production both of airport architecture and aviation technology on a global scale. By revealing untapped sources of empirical evidence, I ask: What are the spatial, aesthetic, and managerial outcomes of that process? How does it challenge received notions about the pathways of transnational knowledge exchange? And how does it help us to better conceptualize why infrastructure-led urbanization has become a defining facet of the China Model of development?

A note on methodology is in order at the outset. The chapter draws inspiration from historians of technology who devote equal attention to infrastructure's material, social, and regulatory components, none of which could effectively operate without the others (Edwards 2003). I am particularly indebted to Thomas Misa's (1994) analysis of infrastructure's social organization—the people behind the projects—which he divides into three scales: macro (top-level decision-makers), micro (local actors on the ground), and meso (experts and institutions that influence infrastructural outcomes by setting design standards and enforcing technical norms). I draw on ethnographic fieldwork to give voice to those experts—that is,

the architects, planners, and engineers who build large-scale transportation projects.

In the existing literature on Chinese infrastructure, the perspective of these experts is conspicuously absent. That omission can be attributed to the relative invisibility of the specialist firms where they are employed. While corporate architects and state-owned enterprises manage the public face of mega-projects, they rarely come up with the specific planning, design, and engineering guidelines upon which the projects are based. Meanwhile, the niche companies that perform these tasks typically maintain a low public profile and are not widely known outside industry circles. These professionals played a crucial role in the transfer of infrastructural expertise during the post-Mao era. By planning the vast majority of Chinese airports, they guided the development of a cross-border aviation system that critically underpins China's regional integration—and the integration of its goods and people into the global economy.

Engaging with those professionals reveals significant gaps between the theory and practice of infrastructure. As I have discussed elsewhere, scholars often analyze public representations of infrastructure to infer the intentions of its producers (Hirsh 2011, 2016). Yet much of the expert knowledge related to aviation—the nuts and bolts needed to move a project from the concept stage to implementation—is rarely written down. That information is commercially sensitive, and like many precious commodities, it is traded by word of mouth among trusted partners. To really understand how an airport gets built, I would need to get to know the industry from the inside out. I looked for opportunities to engage in the full production cycle of an airport project: participating in airport design competitions, leading workshops for airport authorities, delivering keynotes at industry events, and writing articles for trade publications. I also took part in countless discussions with airport managers, planners, and engineers to better understand the people behind the projects—how they got into infrastructure, what their goals are, and what motivates them to stay in the field.

The chapter thus investigates the genesis of China's airport infrastructure through an ethnography of its producers. Specifically, I study how foreign firms interacted with Chinese aviation and urban planning institutions, and how their design schemes were adapted to China's spatial and regulatory norms. I begin by charting the activities of one French engineering firm in order to highlight the multiple ways by which infrastructural expertise entered China during the period of Reform and Opening Up. I expand on this theme by focusing on two specific pathways of technical exchange: development aid and professional training. Finally, the case study of Shanghai Pudong International Airport demonstrates how different sources of design and technical expertise from France, the United States,

Japan, and China coalesced in one very influential project. In the chapter's conclusion, I consider how these findings can stimulate new conceptual and methodological approaches to the study of infrastructure.

Building the Chinese Riviera

In 1989, the French airport authority *Aéroports de Paris* (better known as ADP) hosted a delegation from Hainan at its headquarters in Paris (Le Masson 2017; Tamisier 2017). Previously an administrative region of Guangdong, Hainan had recently been elevated to the status of province by the central government, which also designated the entire island as a special economic zone, or SEZ (Yang 1988). Like other SEZs in southern China, Hainan's output goals focused on export-oriented industrial and agricultural activities, such as mining iron ore and cultivating rubber, pepper, and coffee. But the Hainan SEZ was also established to stimulate China's nascent tourism industry. As Pál Nyiri (2010) has noted, in Maoist China, tourism was seen as evidence of a bourgeois lifestyle and was therefore taboo. But in the 1980s, the government reversed that position through a series of policies that promoted the development of "scenic spots" and encouraged both overseas visitors and Chinese citizens to engage in leisure trips. With its tropical climate and sandy beaches, Hainan appeared to be an ideal place to start. During the spring festival of 1987, the provincial government announced its intention to develop Hainan's Yalong Bay into a "tropical international tourist area" and to allocate considerable resources to the construction of a new airport in Sanya (Hu 2012).

The Hainanese delegation was assigned the undoubtedly pleasant task of traveling abroad to study examples of successful tourism regions. Their tour led them to two conclusions. First, all destinations that they visited relied on aviation to attract large numbers of leisure travelers. Second, they identified the French Riviera as the gold standard of seaside tourism. They were particularly impressed by Nice's Côte d'Azur Airport, which had opened a second terminal in 1987 (designed by ADP). Developing a Chinese Riviera in Hainan, modeled on the French precedent and anchored by a modern airport hub similar to the one in Nice, became the delegation's top priority.

Hence the visit to ADP and the meeting with two of the firm's architects, one a leading figure in French design culture, the other a recent hire in his mid-thirties. Paul Andreu is perhaps best known as the architect of Charles de Gaulle Airport (1974) and for his role in designing the Grande Arche (1989), the striking centerpiece of Paris's La Défense business district. His younger counterpart was François Tamisier, a graduate of the *École des Beaux-Arts* who began his training as a sculptor before transitioning to architecture. Tamisier joined ADP in 1987 to work

on the Grande Arche. Unlike Andreu, Tamisier had no previous experience in airport design. And while ADP had successfully won a contract to build Jakarta's Soekarno-Hatta International Airport, completed in 1985, the company's footprint in Asia remained small. When Hainanese officials invited ADP to submit a proposal for an international airport in Sanya, Andreu and Tamisier leaped at the opportunity.

The goal of the project was to build a modern airport that could welcome international guests and establish Hainan as an attractive vacation destination. The airport was planned concurrently with and sited adjacent to the first Chinese location of Club Méditerranée, the French resort hotel chain. (In 2015, Club Med was purchased by the Chinese conglomerate Fosun. Its headquarters remains in Paris.) Construction for Sanya's Phoenix International Airport broke ground in 1990. When it opened four years later, it became the first Chinese airport dedicated to leisure travel (*Sanya Daily* 2018).

The successful inauguration led to a string of Sino-French aviation projects. Over the past thirty years, ADP has participated in the design and planning of many of China's largest hubs, including Guangzhou Baiyun, Shanghai Pudong, Chengdu Shuangliu, Chongqing Jiangbei, and Nanjing Lukou. Most recently, ADP partnered with Zaha Hadid Architects on the design of Daxing International Airport (Beijing's second hub), whose opening in 2019 was timed to coincide with the seventieth anniversary of the founding of the People's Republic of China (figure 10.2).

This brief foray into the history of one French infrastructure firm demonstrates two key points. First, Hainan is an unlikely point of entry into the Chinese market. Most discussions of cross-border infrastructural investments focus on how they are used to manage urban growth in first-tier cities or, alternatively, how they are deployed to increase industrial production and the extraction of raw materials. With airports, that perspective is problematized by the fact that much of China's initial infrastructural know-how entered the country via Sanya—an airport whose goal was to jump-start a new branch of the economy predicated on consumption and leisure.

Second, Sanya sheds light on a much broader phenomenon. In the post-Mao era, China has made staggering investments in transport infrastructure, developing highways, high-speed rail stations, seaports, and airports at a pace and on a scale that has captivated the imagination of observers both at home and abroad. Some scholars have pointed to the prevalence of engineers among China's ruling elite as one explanation for this infrastructure-oriented approach to economic development (Andreas 2009). Yet few have bothered to ask where the necessary infrastructural expertise that undergirds these projects actually originated.

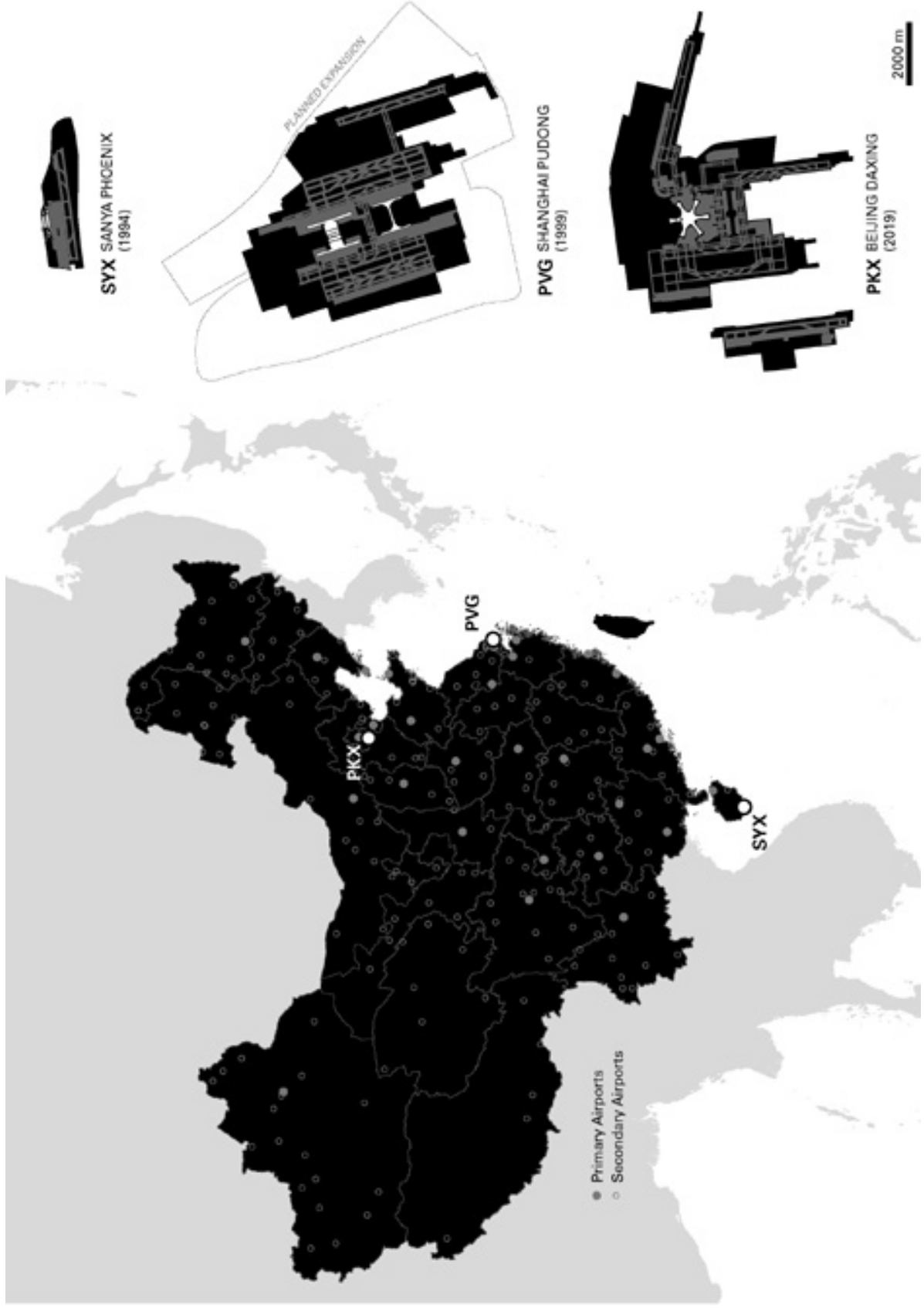


Figure 10.2. China's airport infrastructure. (Map by Dorothy Tang. Made with Natural Earth data.)

When Deng Xiaoping came to power in 1978, China had astonishingly few airfields. They remained under the direct command of the People's Liberation Army until 1980—when, in an effort to introduce a market-driven approach to air travel, the central government separated the Civil Aviation Administration of China (CAAC) from the military. The CAAC subsequently transferred the responsibility for airport operation to local governments, broke up the national airline into several smaller entities, and encouraged the development of private regional carriers to compete with state-run ones (Hirsh 2017). Despite these policy changes, civil aviation was slow to develop. China's airlines had little experience with commercial operations, and airport operators lacked basic knowledge about how to build airports and manage air traffic. In contrast to major hubs in Japan and the West, Chinese airports relied on a single airstrip (except for Beijing, which had two), as Chinese aviation planners did not know how to design a multi-runway system.

Fast-forward to the twenty-first century, when China routinely inaugurates four- and five-runway hubs capable of handling upward of a hundred million passengers a year. These airports are equipped with the latest biometric technologies, integrated with high-speed rail networks, and rolled out at a speed unthinkable in Western countries. During the 2016 US presidential election campaign, Donald Trump drew a comparison between “incredible” Chinese airports and “third-world” American ones to illustrate the growing trade imbalance and technological gulf between the two countries (Munzenrieder 2016). How did China acquire the necessary technical expertise in such a short period of time?

Two Pathways of Technical Exchange

An analysis of the aviation industry reveals two processes by which infrastructural know-how was imported into China during the post-Mao Reform and Opening Up era. The first was a coordinated effort by foreign governments to promote the use of their countries' technical expertise, equipment, and services in China. We can read those endeavors as an attempt to export a particular set of industrial norms, standards, and specifications, using large-scale transportation and telecommunication projects as a vehicle for establishing those norms in the PRC.

An American planner, for example, based on his or her own professional experience, is likely to be most familiar with US design and technical standards and will incorporate those standards into an airport's masterplan. In effect, the introduction of these standards is a form of upstream business development for a range of service providers who produce hardware and software used at airports—everything from elevators, escalators, self-check-in terminals, and biometric devices, to aircraft, airbridges, and air navigation systems. Establishing these norms

in emerging economies is essential for the economic survival of developed nations, whose voting publics grow both weary and wary of major infrastructure investments, and where building new airports from scratch has become rare. Amid stagnating domestic markets, advanced industrial countries depend heavily on the export of infrastructural goods and services to maintain growth. The macroeconomic impact of introducing specific norms and standards early in the design process is tremendous, and governmental agencies go to significant lengths to do so (Bradford 2020).

The technopolitics of infrastructural standards and their use as tools of bilateral diplomacy should not be underestimated (Barry 2001; Mitchell 2002). Introducing these standards during the start-up phase of an emerging industry presents opportunities to influence that industry's long-term development, while at the same time sowing the seeds of intertwined political and financial interests between the sending and receiving nations. In the domain of aviation, Western European nations, along with South Korea and Japan, stand out as the most active participants in that battle. In the Chinese context, France, Japan, the Netherlands, and the United Kingdom have arguably been the most prolific. They deploy a complex constellation of diplomatic entreaties, technical assistance programs, and cultural exchanges in order to advance the financial interests of their countries' planning and engineering firms, airplane manufacturers, and airport and airline operators. These firms, in turn, provide a foothold in China for homegrown products and services from related industries, such as those in the construction, hospitality, and food and beverage sectors.³

The development of airport infrastructure thus serves as a useful lens for studying China's broader reintegration into the global economy in the post-Mao era and its reengagement with its historical enemies. As Deborah Brautigam (2009) notes, beginning in the late 1970s, Japanese, American, and European governments supplied the PRC with advanced technical equipment and training programs, paid for by loans with attractive terms. These financial packages were often disguised as technical aid, with the understanding that this assistance would be used to purchase products and services from the lending country. The regular signing of memoranda of understanding and the professional gatherings that take place to mark those occasions represent the glue that hold these bilateral relationships together.

One example is the Sustainable Airport Areas International Seminar, a conference that I have participated in annually since 2012 (figure 10.3). Organized and largely financed by French government agencies and state-owned enterprises, the conference was initially founded to strengthen international relations and promote knowledge exchange among three of the world's largest airports: those in



Figure 10.3. Delegates at the 2018 Sustainable Airport Areas International Seminar. (Photograph by Max Hirsh.)

Paris, Atlanta, and Shanghai. The choice of cities was not coincidental. These three airports are hubs for Air France, Delta, and China Eastern, respectively—all members of SkyTeam, one of the aviation industry’s big three airline alliances. Beyond the stated purpose to promote the international exchange of ideas, the conference is a place for Chinese clients to network with foreign service providers.

While the event is international in nature, typically half of the attendees are French. They include aviation professionals from Air France, ADP, and ADP’s overseas planning and engineering subsidiary, ADPI. Also attending are representatives of aviation-related start-ups and economic development boards seeking foreign investment in France. Rotating among Paris, Atlanta, Beijing, and Shanghai, the conference has proven crucial for building and maintaining Sino-French relations in the sphere of aviation, while contributing to the coproduction of airport infrastructure and airport-area economic development in France, the United States, and China.

American architects, planners, and engineers often view Chinese projects as an uneven playing field, seeing themselves at a disadvantage compared to their European and Asian competitors. Much to their consternation, the US government has hewn closely to a “let the market decide” mentality, and has not provided

a comparable level of financial and diplomatic support for American firms attempting to enter the Chinese market. Reflecting on his experience working in design competitions in Beijing and Shanghai in the 1990s, Jeff Thomas—the former CEO of the Cincinnati-based aviation planning firm Landrum & Brown (L&B)—recalled: “We faced an uphill battle competing against the Europeans. They got into China before the US. The US first got in after the doors opened with Nixon in 1972. The Europeans were already in there then. They were much more aggressive in going forward and entrenching themselves” (J. Thomas 2017).

Another American airport planner expressed a more pointed critique: “The French go in there and just buy the project. How the hell are we supposed to compete? They cover the design fee and pass the work on to their own companies. It’s corruption, pure and simple. No US administration will ever do that” (Interviewee A 2017).

The extent to which bilateral relations influence infrastructural outcomes in China—and in Asia more broadly—can be inferred from a story that was related to me by a prominent American architect:

The day after we won [a major airport project], I was summoned to the US ambassador’s office. I was expecting him to congratulate us on winning a big competition, maybe offer me a glass of champagne. Instead he was livid.

“Who did you bribe?” he demanded.

I was taken aback. “Uh, I didn’t bribe anyone.”

“Don’t play dumb with me,” the ambassador shot back. “That airport was supposed to go to the French. I know everything that goes on here. Now who the fuck did you bribe?”

The ambassador asked me three more times before he stormed out of the office. He just couldn’t believe that we had won the competition based on our design proposal. (Interviewee B 2017)

These accounts testify to the common perception among US aviation professionals that they face unfair disadvantages in China relative to their European competitors. Yet by focusing exclusively on the subject of aid, these American architects and planners neglect to mention the influential role played by government-backed bilateral training programs—which represent a second significant pathway for the transfer of standards and norms.

The most notable of these programs is the US-China Aviation Cooperation Program (ACP), under which Chinese airport engineers and administrators are invited to the United States for technical training and study tours. Although ACP is funded by the Federal Aviation Administration and the US Trade and Development Agency,

the organization is chaired by the president of Boeing China, and its day-to-day operations are delegated to private firms like Boeing, FedEx, American Airlines, General Electric, and L&B, which organize visits to their own factories and run training programs out of their company offices (S. Thomas 2016). In effect, these training programs are an opportunity for American corporations to introduce their goods and services to a Chinese audience—a pitch meeting, if you will, funded with taxpayer money.

Since ACP was established in 2004, these courses have also enabled US firms to overcome yet another competitive disadvantage: their inability to pay bribes. Several European interviewees described the creative accounting methods that their companies had devised for giving gifts—an essential aspect of doing business in China. By contrast, my US-based interlocutors claimed that stringent federal antibribery legislation prevented them from giving gifts to their Chinese business partners. ACP offered a legal alternative by providing Chinese aviation professionals with all-expenses-paid study tours to the United States—tours which frequently doubled as extended shopping trips (Interviewee C 2017). One senior American airport planner who had hosted numerous ACP delegations confided that it was essential to schedule visits to high-end shopping centers, as well as more mundane runs to Costco, to keep the Chinese participants happy and receptive to doing business (Interviewee D 2017).

The start of the twenty-first century saw a flourishing of American and European aviation education initiatives on Chinese soil, with a French state institution—the *École Nationale de l'Aviation Civile* (ENAC)—once again playing a leading role. Since its founding in 1949, ENAC's primary mission has been to train aeronautical engineers and administrators, and prepare them for a career working for France's airports, airlines, and aircraft manufacturers. Beginning in the 1990s, however, the elite *grande école* took on an additional role: to train Chinese students and, in so doing, to bring up-and-coming aviation professionals into contact with French companies like Airbus and ADPI. While some Chinese students come to ENAC's home campus in Toulouse, the majority are enrolled in degree programs jointly offered by ENAC and partner universities in Beijing, Hong Kong, and Tianjin. In 2007 ENAC and the Civil Aviation University of China founded the *Institut Sino-Européen d'Ingénierie de l'Aviation* in Tianjin, and a larger Sino-French aviation university, based in Hangzhou, is scheduled to open in the early 2020s (Cooke 2019).

ENAC's initiatives are part of a top-down effort to inculcate French planning practices and integrate French companies and state institutions into all dimensions of airport production in China, including tertiary education. In effect, hundreds of employees of ADP, ADPI, ENAC, and Airbus operate in a coordinated

fashion, each seeking to find business opportunities for the entire French aviation sector. By contrast, American forays into Chinese higher education have been driven by individuals working on behalf of a single company: L&B. Thomas recalls that these efforts advanced primarily through entrepreneurial happenstance:

L&B had a big office in Chicago. A friend of mine introduced me to a Chinese gentleman there. He was living in Chicago, but the family was out of Canton, and they were well connected. He didn't know much about airports, but he wanted to do things, you know? He kind of took us by the hand and tried to help me get into China. He got me in with all the officials in Guangzhou, and through that I met a bunch of people in [Shanghai] Pudong. But we were too late to the party: they'd already made all their choice[s] of the planners and designers [in Guangzhou], and we lost the competition [in Shanghai]. Then at some point he introduced us to the civil aviation university in Tianjin. We put a scholarship program together for next to nothing, and it's one of the best investments in anything I ever made. It was like five or six thousand dollars a year, and it was giving three or four kids a scholarship. Later they divided it up into partial scholarships for ten to twelve kids. But it's created an enormous sense of goodwill. These people are now in middle management at half the airports in China. And L&B helped pay for their education, so there's so much goodwill there. The first guy who got the scholarship was the first mainland employee we hired. (J. Thomas 2017)

This example is notable for two reasons. First, in contrast to the top-down forces and bilateral initiatives that drive European technical aid and professional training programs, relying on a well-connected Chinese middleman reveals a much more informal and entrepreneurial approach to the transfer of infrastructural expertise. At the same time, the role of that intermediary—who married the developmental ambitions of mainland clients with the financial objectives of foreign service providers—suggests an element of historical continuity, recalling the critical role that Cantonese compradors played in the introduction of new technologies into China in the nineteenth and early twentieth centuries.⁴

Building Shanghai Pudong International Airport

A case study illustrates where these different actors and knowledge exchange pathways intersect: completed in three stages between 1999 and 2008, Shanghai Pudong International Airport was developed by Chinese state planning and aviation authorities who relied heavily on technical, financial, and managerial

expertise imported from France, Japan, and the United States. Studying Pudong enables us to better understand the division of labor between them. It also highlights the influential role that Shanghainese models of urban and regional development played during the Reform and Opening Up era. Many of my interlocutors emphasized the city's vanguard status: according to the conventional wisdom among infrastructure planners, once Shanghai builds something, all other airports in China will follow (Goldberg 2017). In particular, Pudong helped introduce a broad range of technical and design standards into the field of Chinese infrastructure planning, while at the same time establishing the terms by which Chinese airport authorities and local design institutes work with foreign engineering and design firms. The collaborative model that Chinese and overseas planners pioneered at Pudong thus had powerful implications for China's aviation infrastructure as a whole.

Before proceeding, it is essential to point out two critical elements of Chinese planning that fundamentally determine the financing, spatial organization, and temporal framework of infrastructure development: the five-year plan and the National Development and Reform Commission. Imported to the PRC by Soviet advisors in the early 1950s, the five-year plan remains the basic building block of China's state-led economy (Xue and Ding 2018). Each plan includes a chapter on transportation infrastructure that summarizes the central government's main objectives for its road, rail, air, and sea networks, and that announces any major changes in the policies that govern the movement of goods and people to, from, and within Mainland China.

The critical element that determines how, when, and where aviation infrastructure is planned, built, and delivered is the National Development and Reform Commission, or DRC. Most of China's airports are owned and operated by municipal governments, which delegate the detailed planning and design work to their city's local design institute. Local officials—particularly mayors and Communist Party secretaries—are thus important decision-makers who influence both the process and outcome of airport development. Yet the real power to develop aviation infrastructure lies with the DRC, thanks to its ability to designate a given infrastructure project as a national-level priority, and to marshal substantial financial and political capital in the process.

It is within this organizational framework that the development of Pudong needs to be understood. In 1996, the Chinese government published the Ninth Five-Year Plan. Anticipating a doubling of China's aviation volume—from fifty-one million passengers and one million tons of cargo annually in 1995, to nearly twice that amount by 2000—the plan called for the development of forty-one major airports across the country (JICA 2001). Along with Beijing and Guangzhou,

the plan prioritized Shanghai as one of China's three international hubs, and it authorized the construction of a new airport to support economic growth in Pudong New Area, arguably China's most prominent showcase for urban development. Shanghai Pudong, as the new airport became known, was aimed to enhance the city's international connectivity, while the expansion of Shanghai's existing airfield at Hongqiao was intended to accommodate the increase in domestic flights.

Bearing those goals in mind, in 1996 the Chinese government commissioned Japan's International Cooperation Agency (JICA) to prepare a masterplan and detailed design study for the new airport, which was to be built on reclaimed land along Pudong's rural eastern coastline. JICA, in turn, assigned that task to Nippon Koei, Japan's largest engineering and construction consultancy, and Nikken Sekkei, an architecture and planning firm (JICA 1997). Both companies offered expert knowledge about airport-led land reclamation, which they had recently gained while building an artificial island, New Kansai Airport, in Japan's Inland Sea (Hirsh 2019). After the study's completion in September 1997, the Chinese Ministry of Foreign Trade and Economic Cooperation and the Shanghai municipal government entered into an official development assistance loan agreement with the Japanese government, administered by JICA. Under the terms of the loan, Japan lent China 40 billion yen (roughly equivalent to USD 330 million) to fund the construction of a four-kilometer runway, a 200,000-square-meter passenger terminal, and a 65,000-square-meter cargo terminal. Crucially, the loan covered the project's foreign currency costs, thereby overcoming the perennial challenge of moving money between China and the outside world.

Pudong's planners thus relied heavily on Japanese financial assistance and engineering expertise. Yet when it came to architecture and landscape design, they turned to a different source: France. In 1997, ADP won an international competition to design Pudong's passenger terminal building (T1), whose inauguration in 1999 would fall on the fiftieth anniversary of the founding of the PRC. Planned by a team led by Andreu, T1 rehearses the basic design elements of Charles de Gaulle's Terminal 2F, which Andreu's team was constructing concurrently in Paris. ADP was also tasked with developing a conceptual approach for the entire airport. Tamisier recalls:

When we went on the site for the first time there was nothing: rice land with water and the sea. The plan was to silt up the land in order to create it. We decided to design a very large pond, with the main ideas as the water and the sky. In this way, we tried to bring in Chinese artistic elements. It is a large pond, four hundred meters by four hundred meters, and we used this as drainage. And we brought in the road coming from Shanghai across

the water, to give the experience of taking flight. So the first image of the airport is: it was water, it will always be water. The second theme is architecture as a garden. We used these two elements for urban scenography. We followed the Suzhou Gardens with a yard, walls, and a square. We spoke of Pudong as a very large Suzhou garden. We thought that it was important to work with knowledge of Chinese culture, painting, and landscape arts. In China there are a lot of possibilities to create big areas starting from a small, specific site—for example, in Suzhou, or in the Forbidden City in Beijing. At the time Shanghai was the biggest airport in China. Our proposal had to be of an international standard and totally based on Chinese culture, so we considered the landscape as a very important system. Of course, we provided the standard masterplan, but with a mark: we are in China, and we have to express this. The main idea we used was the garden as a possibility to organize a very large amount of land following the Chinese system of building a plan around the void. (Tamisier 2017)

ADP's role in the construction of Pudong points to both the economic and aesthetic commonalities that connect Chinese infrastructure planners to their French counterparts. As Neil Fligstein and Zhang Jianjun (2010, 47) have argued, China's form of "organized capitalism" bears a strong resemblance to France's model of a coordinated market economy, wherein the private sector is dominated by state-controlled enterprises.

Discussions with my interlocutors at the Paris airport authority appear to support that thesis: several of them made comparisons between China's socialist market economy and France's dirigiste approach to capitalism. One executive at ADP told me that the Chinese "understand our way of thinking. For us, the airport is not just about aviation, it is also about promoting our national interests. There are many similarities between Chinese state-owned enterprises and our own companies. We understand the mentality" (Interviewee E 2016). This attitude helps explain the willingness of the French diplomatic corps to intervene on behalf of French companies, as well as its ability to provide financial incentives (an ability that goes beyond that of most other nations) to favor the outcome of airport design competitions.

But beyond the level of economic policy, Sino-French infrastructural cooperation is bound together by obvious aesthetic affinities, in particular a fondness for large-scale territorial planning based on abstract metaphors. Formalist design concepts, predicated on dubious references to feng shui and purported Chinese design traditions, forge an epistemological connection between the objectives of Chinese government officials and those of French planners and engineers.

This is evident in ADP's conceptual approach to Pudong, and in the rhetoric commonly deployed by Chinese government officials to justify major infrastructure investments. The recourse to abstract formalism was evident at a Sino-French aviation conference held in Beijing in 2018. The event marked the one-year countdown to the opening of Daxing International Airport. In one of the opening speeches, a senior airport executive discussed the formal similarities between the older Beijing Capital International Airport and a dragon. That airport's presence on the eastern periphery, he explained, had thrown Beijing's urban development out of joint. The inauspicious situation would be remedied through the construction of the new airport at Daxing; occupying a site shaped like a phoenix, Daxing would restore balance to the Chinese capital and guarantee the harmonious development of the greater Jing-Jin-Ji region (Kong 2018).⁵

Metaphorical formalism is likewise a common facet of the many follow-up projects that ADP has won as a result of its work at Pudong. One French architect, for example, framed ADP's development plan for Nanjing's Lukou airport as a "modern airport city inspired by the traditional Chinese city" (Leymarie 2018). Its network of gridded streets, bookended by triumphal gates, echoed the "square frame" and sequence of "doors and thresholds" characteristic of premodern Chinese urbanism, while a rectangular water feature, studded with two islands connected via four bridges, referenced the interplay between water and energy and between the real and the reflection of Nanjing's Xuanwu Lake (figure 10.4). A series of circular office towers—set along an axis that one might be forgiven for interpreting as a paean to Ludwig Hilberseimer's vertical city—was in fact a nod

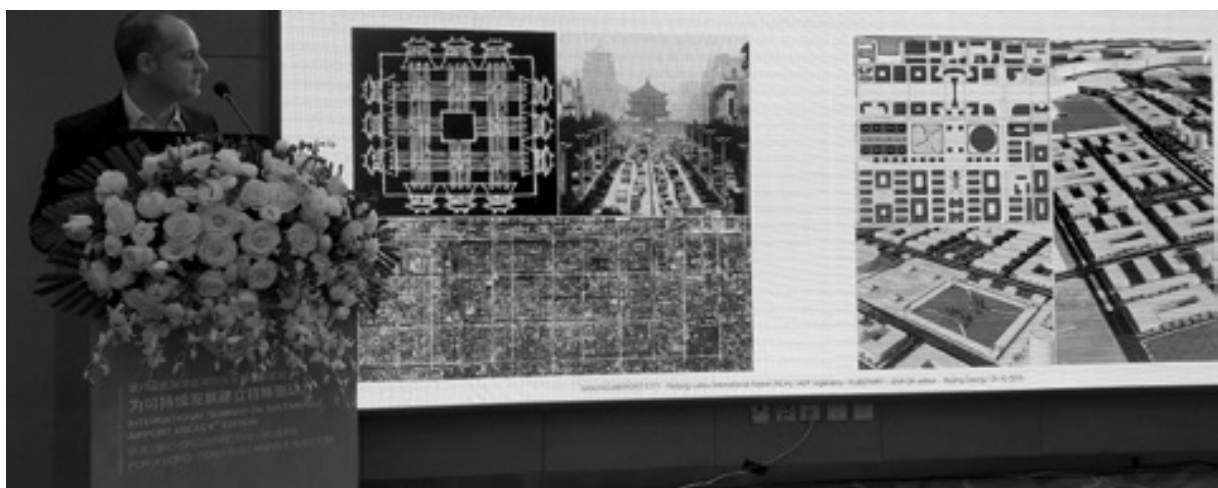


Figure 10.4. A French architect explains the design concept of Nanjing Lukou International Airport. (Photograph by Max Hirsh.)

to the *tanggu*, the traditional Chinese drum, whose rhythm marked the flow of time and bound the past to the future.

French designers evinced a talent for engaging with two countervailing tendencies typical of the late-twentieth-century Chinese client: a hunger for foreign designs as a way to demonstrate China's modernization and ascendance, coupled with patriotic homages to tradition (many of them dubious) that deliver that modern infrastructure in a Chinese register. Firms like ADP, however, proved less adept at adapting their design schemes to the practical needs of the burgeoning Chinese aviation market. They underestimated, in particular, the rapid growth in air traffic that quickly rendered their initial designs incapable of accommodating the volume of passengers at one of China's largest hubs. Between 2001 and 2006, the number of passengers flying in and out of Pudong more than quadrupled (JICA 2001; CAAC 2007). Halfway through the Tenth Five-Year Plan, ADP's original scheme for four small terminals and two runways already appeared quaint. Rather than commit to the second phase of the French masterplan, the Shanghai Airport Authority decided to look for other approaches by using two tried and tested techniques: the international design competition and the overseas study tour.

At the height of the Reform and Opening Up era, international design competitions played a key role in the modernization of China's cities and urban infrastructure. They were a relatively quick and cheap way to amass vast amounts of knowledge and ideas from top global thought leaders. Thomas explains:

The Chinese process . . . is an intelligent way of dealing with airport design. By law they have to bring in a foreign expert into any of these big infrastructure projects. That's weakening now, but when we first arrived you couldn't get anything built without it. So the competition process was the way they brought the ideas of lots of people together. And the Chinese are good at sucking people's minds, and it was a way of picking people's brains. So if you brought in world-renowned experts into the room, and asked them to put their ideas onto the wall, you're buying all their ideas—basically when you give them a fee for competing, you can pick and choose what you like and learn a lot. (J. Thomas 2017)

In 2004 the Shanghai Airport Authority held a competition for a new terminal area masterplan and for a conceptual design for a second terminal. At the midpoint of the competition, the authority sent an overseas delegation to Cincinnati, the headquarters of L&B. Hundreds of airports around the world have been planned out of L&B's Cincinnati home in a suburban office park just off Interstate 71. Li Dirun, the delegation's leader and chairman of the authority, was eager to meet

with Thomas. Although he had failed to win any Chinese competitions, Thomas had established a reputation in mainland aviation circles as an entrepreneurial enfant terrible. Through an interpreter, Thomas and Li discussed alternative arrangements for Pudong's future. Thomas briefed the delegation on L&B's experience in transforming Chicago's O'Hare International Airport, which had undergone a major expansion in the 1980s following the deregulation of the US aviation industry. He argued that the Midwestern behemoth, which served a massive domestic market and functioned as a critical intercontinental gateway, was a more appropriate reference for Shanghai than European hubs like Charles de Gaulle, where domestic traffic was negligible. Moreover, he contended that O'Hare's Midwestern sense of scale—with its generous proportions and ample runways—should be transferred to Pudong to meet the demands of a Chinese aviation market that was growing at breakneck speed. L&B subsequently won the competition. In place of ADP's four smaller terminals, the L&B plan envisioned a “concentrated terminal complex” nearly triple the size of the existing one. Along with a third runway, the new terminal was completed in 2008 (figure 10.5).

Pudong's genesis illuminates the key strategies and processes by which Chinese planners developed aviation infrastructure—and infrastructure more broadly—in the post-Mao era. In particular, an analysis of the Shanghainese hub reveals how Chinese clients deployed three key tools to achieve their development goals: bilateral aid, international design competitions, and overseas study tours. Much like their Hong Kong and Singapore counterparts a generation earlier, mainland infrastructure planners eschewed dependence on a single source of knowledge, talent, or capital, choosing instead to pick the brains of expert engineers, planners, and architects trained in Japan, Western Europe, and the United States. In the 1990s, these three regions represented the most advanced aviation markets in the world. By learning about the evolution of Narita, Charles de Gaulle, and O'Hare from the experts who built them, Pudong's leaders effectively amalgamated the best practices of mature airports, accrued over decades, and used that collective global wisdom to create a twenty-first-century air hub for Shanghai.

Rethinking the China Model

Transportation mega-projects have been analyzed in a variety of academic disciplines through the prism of infrastructure's symbolic value and its use as a political tool. This is not without reason: particularly in developing countries, transportation infrastructure is an easily decipherable index of technical progress and economic development, and of effective stewardship by political elites (Khan 2006). It also operates as a shorthand to explain complex geopolitical relationships, as governments deploy



Figure 10.5. The second phase masterplan for Shanghai Pudong International Airport. (Photograph by Max Hirsh.)

transportation infrastructure both as physical manifestation of bilateral ties and as confirmation of its socioeconomic benefit. As Cole Roskam (2015) has noted, Maoist cadres positioned infrastructure projects as material demonstrations of the PRC's solidarity with developing nations in the Third World, in contrast to the exploitative practices of the capitalist West. Echoes of that infrastructural diplomacy reverberate outward from China in the present day, as the construction of rail and port facilities

manifests intensified economic and diplomatic ties with countries across Africa, Asia, the Middle East, and the former Soviet sphere.

Less apparent, however, is the influx of infrastructural knowledge and design standards into China over the past half-century. While Chinese leaders are eager to promote the export value of a China Model of infrastructure development, they are less forthcoming about the foreign origins (from Europe, North America, and Japan) of that expertise. For better or worse, the China Model represents a globalized, state-of-the-art snapshot of how infrastructure is designed, built, and financed today. However, the China Model cannot accurately be described as a homegrown product, given its hybridization of foreign expertise from multiple sources.

The case of Pudong—like the many Chinese airport projects that followed—sheds light on the relative strengths of each planning culture's design approaches. Through international design competitions and overseas study trips, China's aviation planners cherry-picked what they perceived to be the best attributes of the world's top aviation markets: airfield planning, structural engineering, and long-term infrastructural aid packages in the case of Japan; a no-nonsense approach to terminal design from the United States that emphasizes the demands of a mass domestic flying public; and an aesthetic sensibility from the French that privileges national traditions and abstract formalism.

That division of labor—wherein the French provide the artistic vision, the Americans offer a cost-effective customer experience, and the Japanese deliver the engineering and financing—is undeniably stereotypical. Whether it was brought about by Chinese preconceptions or instead confirms them is up for debate. Either way, that decidedly multilateral approach is how Chinese decision-makers imported the most redeeming qualities of different cultures, and combined them into a China Model of infrastructure development that is adapted to the temporal framework of the five-year plan and to the organizational structure of China's urban planning institutions.

That conclusion leads us inevitably to a rather delicate question: what, then, is uniquely Chinese about the China Model? A review of China's recent aviation history offers a few clues. In contrast to the overseas precedents upon which they are based, airports built in China in the twenty-first century distinguish themselves in three critical areas: speed, scale, and subsidies. If they are able to win the support of the Development and Reform Commission, the mayor, and the local Communist Party secretary, Chinese aviation authorities can execute large-scale infrastructure projects at an unparalleled pace, because they can dispense with consulting and placating local stakeholders. They also face little pressure to demonstrate a credible return on investment, and when a new airport fails to attract

interest from airlines because they do not consider potential routes to be commercially viable, local officials can quickly offer financial incentives—for example, by waiving aeronautical charges (Hié 2017). Chinese cities are hungry for international connectivity, and they are willing to pay for it. At most the world's airports, stakeholder engagement, profitability, and route development are both essential and time-consuming processes. Their absence or relative insignificance in China helps to explain that country's advantage.

China's municipally owned airports likewise distinguish themselves through their scale, thanks to local governments' ability to commandeer vast amounts of land. Over the past decade, airports in China have been progressively reconceptualized as multifunctional "airport economic development zones," some spanning more than a hundred square kilometers (Cao 1999, 133). In effect, local governments no longer build just new airports, but rather entire "airport cities." Chinese infrastructure planners take these temporal and spatial conditions for granted, but they are difficult—perhaps even impossible—to replicate outside China. The lack of attention to critical governance issues, along with the inability to artificially manufacture what is known in the transport industry as throughput, helps us understand why many Belt and Road Initiative infrastructure projects struggled to get off the ground or became mired in the vagaries of local politics.

Conclusion

Let us revisit two questions that I posed at the outset of the chapter. First, how does the production of China's airport infrastructure challenge received notions about the pathways of transnational knowledge exchange? And second, how can this investigation stimulate new conceptual approaches to the study of infrastructure?

First and foremost, more research is needed that links the economic framework of multilateralism to its spatial and material outcomes in the built environment. Infrastructure can serve as an insightful vehicle for investigating how multilateral relations thrive, both in periods that valorize open markets and open borders (as was the case in the late twentieth century, when China reemerged as a global power) and in times marked by resurgent nativism and protectionism (such as the current era).

I have emphasized the previously overlooked role of midlevel experts as agents of transnational exchange. These architects, planners, and engineers collectively design infrastructural systems that enable the movement of goods and people between cities and across continents. Yet they are also crucial actors in the transfer of ideas and information. Modest by nature, they possess a diplomatic acumen

that enables them to collaborate across cultural, linguistic, and ideological divides. Martin Reuss (2008) has pointed to engineers' negotiating skills, rather than their technical proficiency, as the key driver of successful infrastructure projects. That is doubly true for projects in which engineers must reconcile imported norms, standards, and values with indigenous ones. Attempting to strike a balance between "cultural preferences, economic requirements, environmental protection, and various sociopolitical issues at all levels of government," engineers must effectively "mediate the incommensurable."

My study of Chinese airports expands on Reuss's understanding of engineers as negotiators by drawing attention to their role as stealth diplomats and agents of multilateral exchange. Many of my interlocutors first visited China at a time when few foreigners had either the desire or the permission to do so. As we enter a new period of great-power confrontation and isolationism, those same planners and engineers continue to work on Chinese projects, acting as crucial intermediaries at a time when voting publics, and many world leaders, are questioning the benefits of international cooperation.

Most studies focus either on how infrastructure projects meet the aims of governments and economic systems, or on how those projects are received by local constituents on the ground. These two vectors of analysis correspond, respectively, to what Misa (1994) has termed the macro and micro scales of infrastructure's social organization. By contrast, this chapter has focused on what Misa calls the meso scale: institutions whose influence derives from their ability to establish technical standards, and whose impact on infrastructural outcomes is neither as ephemeral as that of micro-level users, nor as enduring as macro-level power structures.

Moving forward, infrastructure scholars would be wise to pay more attention to those meso-scale institutions and the individuals who populate them, for they possess enormous amounts of untapped data that can help us better understand how infrastructure is produced. Attending to that meso scale of influence presents a welcome opportunity to escape the confrontation between top-down and bottom-up modes of inquiry—an unhelpful duality that has divided infrastructure scholars into two competing camps that no longer appear capable of engaging with, or learning from, one another.

Notes

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2. See, for example, Arase 2015; Chan 2018; Godehardt 2014; Kaczmarek 2017; Lim et al. 2016; Miller 2019; Murton and Lord 2020; Oh 2018; Sidaway and Woon 2017; Sternberg, Ahearn, and McConnell 2017; Summers 2016; Yu 2017.

3. These insights are based on five interviews with Dutch and French engineers in The Hague, Paris, and Rotterdam in January 2017 and December 2017. Due to the sensitive nature of the topic, the interviewees have been de-identified.

4. In the nineteenth century, foreign firms seeking to conduct trade in China depended on the services of compradors: middlemen, often hailing from Canton, whose value lay in their ability to bridge the cultural and linguistic barriers that separated outsiders from potential business partners in China. Employing compradors was an effective means for foreigners to quickly overcome their lack of *guanxi*. It was also an effective way for Chinese businesspeople and local officials to gain information about technical and managerial innovations taking place abroad (Abe 2018; Lee 1991).

5. Jing-Jin-Ji refers to a state planning policy enacted in 2014, which seeks to create a socioeconomically integrated mega-region encompassing Beijing, Tianjin, and Hebei Province.

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