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Information-Age Landscapes Outside the Developed World

Bangalore, India, and Guadalajara, Mexico

Ivonne Audirac

This article examines two so-called "silicon valleys" located in Bangalore, India, and Guadalajara, Mexico. Drawing its theoretical propositions from the global city literature and the informational/network society framework, it posits that the metropolitan edges of these cites contain new industrial landscapes inserted in a global system of production. This new urban form is dynamically shaped by the location decisions of multinational software and electronics corporations, government entrepreneurial activities, and amenities valued by the "information-age elite." The author examines the local sociospatial implications of this new urban form and discusses the challenges facing these cities, which must balance their local social and environmental responsibilities with the polarizing effects of the global/informational economy.

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Toward the end of the Cold War in the 1980s, the economic map of the world changed from one consisting essentially of the capitalist nations of the First World, the socialist countries of the Second World, and all other nations as the Third World, to a new macroregional triad of trading blocs, namely the European Union (EU), East and Southeast Asia, and the North American Free Trade Agreement (NAFTA) region (Ohmae, 1985). In this new world order, the labels *developed* and *undeveloped* gave way to *more developed countries* (MDCs), *less developed countries* (LDCs), and *newly industrializing countries* (NICs). Urban scholars from a variety of theoretical perspectives such as world systems (Chase-Dunn, 1985; Smith & Feagin, 1987; Smith & Timberlake, 1995; Timberlake, 1985), world city (Friedmann, 1986; King, 1990; Sassen 1991), postindustrial (Berry et al., 1993; Kasarda & Parnell, 1993; Markusen et al., 1999), post-Fordist (Amin, 1994; Moulaert & Salinas, 1983; Storper, 1997), and informational[1] (Castells 1989, 1996; Castells & Hall, 1994)[2] are struggling to elucidate how the sociotechnical and economic restructuring of the last 30 years is affecting developed and developing countries' cities and urban regions. New industrial districts emerging outside the developed world have recently attracted scholarly attention because they challenge the conventional wisdom about urban and industrial development in NICs (Fung Shuen Sit, 1993; Heeks, 1996; Lo & Yeung, 1996; Malecki & Oinas, 1999; Park & Markusen, 1995; Saxenian, 1999; Wilson, 1992). NIC cities strategically positioned in a 24-hour-a-day global production network may also fare better than some MDC cities in attracting hi-tech jobs.

This article examines two so-called "Silicon Valleys" located in India and Mexico that contain new industrial landscapes in a global system of electronics production. It posits that the metropolitan edges of Bangalore and Guadalajara are a new urban form dynamically shaped by the location decisions of multinational software and electronics corporations, government entrepreneurial activities, and the information-age or New Economy elite's valued urban amenities.

Globalization, New Industrial Landscapes, and the Urban Realm

There are several theories about global city formation[3] pioneered by Hall (1966) and Cohen (1981) and subsequently developed by Friedmann and Wolff (1982) and Friedmann (1986), who all posited cities as basing points for global capital operating in the new international division of labor. Friedmann theorized that national policies and cities' history, culture, and, most importantly, integration with the world economy through production and markets, could explain differences among cities and their place in a complex global spatial hierarchy. These ideas were further developed by King (1990), Castells (1989, 1996), and Sassen (1991, 1994), who all asserted that a world economy has existed for several centuries, but that it has been reconstituted repeatedly over time—with the most recent transformation abetted by telecommunications and information technologies.

Sassen's (1991, 1994) now classic and highly influential perspective explains global cities in terms of the central place functions that they perform as financial and producer service centers for a global network of internationally dispersed financial cores and manufacturing sites. It also suggests that edge cities—conventionally viewed as a product of suburbanization or metropolitization—are actually the most advanced urban form of a network of digitally connected dispersed centers. However, Sassen (1994) finds no geographical correlate of these new urban forms in LDCs "where endless urban sprawl appears to be the norm" (p. 94). This perspective focuses on the concentration of urban financial and producer services capabilities and conceives the second component of the global network—dispersed manufacturing sites—as Third World export-processing zones (Sassen, 1991, 1994).

Sassen's formulation leaves open the question of how to conceptualize new industrial landscapes found in cities of developing nations, which do not fit the mold of conventional export-processing zones.

The informational/network society framework, which builds on the global city perspective and also synthesizes a broad array of domestic and international scholarly work on regional economic restructuring, offers insight into this question (Castells, 1989, 1996). It conceptualizes new industrial landscapes as primarily urban and as the nodes and hubs of two major types of global network: (1) the network of megacities and large cities with substantial new information-age segments oriented to top financial and managerial flows, and (2), the network of high-tech manufacturing flows. Many networks of the latter type—the outcome of partnerships between multinational electronics corporations and entrepreneurial states—globally interconnect advanced innovation milieux (e.g., Silicon Valley in San Jose, CA), skilled manufacturing sites (e.g., Silicon Forest in Hillsboro, OR), and assembly lines (e.g., Suzhou, China) into 24-hour-a-day, real-time, global production units (Castells, 1996). From this perspective, in addition to conventional export-processing zones, new urban industrial landscapes are emerging in cities of the developing world (for alternative views, see Henderson, 1997; Markusen et al., 1999).[4] Furthermore, an implication of this theory is that rather than edge-city-like development being exclusively an urban phenomenon of MDCs, these urban forms are emerging in cities of LDCs and NICs that are networked into the global New Economy via digital infrastructures and that possess the urban amenities valued by the information-age elite (see also Ruble et al., 1996).

This article builds on Sassen's (1994) characterization of edge cities but posits that new urban edge forms may also be found in cities of NICs as portions of their economy are transformed by the information age. For the sake of brevity, it reviews only three interrelated aspects of Castells' informational/network society approach, which deals with (1) the global nature of the informational economy; (2) the new space of the electronics industry, which epitomizes the workings of global production; and (3) the implications of this process for local urban form and information-age industrial landscapes. This review serves as a theoretical backdrop to the case studies (Yin, 1989) and sheds light on the global/local process that influences information-age restructuring of metropolitan areas in both LDCs and MDCs (see Table 1).

The Informational Economy

What is now called the New Economy is, for Castells (1996), a new techno-economic development paradigm that emerged in the 1980s as the offspring of a happy marriage between a debilitated Western capitalism and a revitalizing information technology (IT) revolution. The new mode of development is no longer industrial but *informational* because it is organized for the production of

information-processing devices (hardware and software) and information and knowledge generation. This new mode of development is at the core of the IT revolution, which is fundamentally an organizational revolution transforming every aspect of society. The leading force in the New Economy is new IT industries, which embody not only new IT-enabled productive capacities but also a new organizational culture digitally spanning local and world time zones and globally coordinating many-to-many virtual and physical production circuits. Castells (1996) calls these webs of firms the network enterprise: "under the conditions of fast technological change, networks, not firms, have become the actual operating unit" (p. 171). Hence, the new global economy is densely networked and deeply interdependent and fundamentally different from a world economy in that it has "*the capacity to work as a unit in real time on a planetary scale*" (p. 92; emphasis in original).

In spite of its instantaneous and global dimension, the New Economy operates asymmetrically through the information-age segments of countries and regions according to four positions in the newest international division of labor: (1) the producers of high value, based on informational (high-tech) labor; (2) the producers of high volume, based on lower-cost labor; (3) the producers of raw materials, based on natural resource endowments; and (4) the information have-nots, reduced to devalued labor. These different positions do not correspond to specific countries, but to cities ("space of places") in LDCs and MDCs that have been woven into the "space of flows" by multinational corporations and state governments via the technological infrastructure of the New Economy (e.g., telecommunication satellite networks, advanced transportation logistics, enterprise resource planning technologies, fiber optic and digital grids, etc.). Moreover, even the poorest economies have small segments connected to the networks of the high-value producers, while "the most powerful economies have marginal segments of their population placed in a position of devalued labor, be it in New York, in Osaka, or in London" (Castells, 1996, p. 147). Thus, through cross-geographic arbitrage—the preferred strategy of global companies in the current transition to the New Economy (see Bryan et al., 1999, for the business community's version)—the informational economy embraces the planet but does so unevenly, polarizing social groups within cities and cities within regions according to their information-age skills and global cost advantages.

With the New Economy has come a new concept of industrial space. The informational economy's network enterprise, such as global production and supply chains, has transformed the notion of factory sites to *manufacturing flows* and reconfigured industrial space into a new hierarchy of innovation and manufacturing. Networks of electronics firms epitomize this spatial configuration, linking silicon places throughout the world. At the top of the hierarchy are research and development and innovation centers (e.g., Silicon Valley in San Jose, CA, and Silicon Gulch in Austin, TX) and advanced manufacturing centers (e.g., Silicon Forest in Portland, OR, or Silicon Mesa in North Albuquerque and Rio Rancho, NM) found in the U.S. and other more developed countries (e.g., Kista, Sweden; Silicon Fen in Cambridge, UK; or Silicon Alps in Carinthia, Austria), while in NICs, new so-called silicon valleys (e.g, Bangalore, India; São José dos Campos, Brazil; Guadalajara, Mexico; Timisoara, Romania; and Suzhou, China) concentrate computer programming, assembly manufacturing, and customized production for final markets.

Information-Age Industrial Landscapes

According to Castells' (1996) network society perspective, new information-age industrial landscapes are likely to be found in any city of the world with segments of its economy oriented to the New Economy's *space of flows*. However, the space of flows depends on three layers. The first layer is the communications network that carries the flow of electronic information, "the technological infrastructure that builds up the global network [and] defines the new space, very much like railways defined 'economic regions' in the industrial economy" (p. 413). The second layer is the nodes and hubs of the networks, such as the cities that form part of the metropolitan network dominating Internet backbone capacity (see Moss & Townsend, 2000). The third layer is the places valued by the informational or New Economy elite. Based on the interplay of these layers, new information-age landscapes share two main characteristics: They are socially and physically segregated and morphologically similar.

While advanced telecommunications link up physically noncontiguous settlements and industrial places that are important to the New Economy's managerial and high-tech elite, real estate markets exclude and spatially segregate new digital landscapes from the urban underclass enlarged by the groups whose labor is made superfluous to the New Economy. Morphologically speaking, information-age landscapes are on the one hand globally oriented and architecturally and symbolically homogeneous, while on the other hand they are locally oriented and strongly spatially segregated, as the information-age elite secludes itself in exclusive, security-controlled residential and leisure-oriented communities. All of these characteristics of Castell's network society are summarized in Figure 1.

Mode of development
Informational; organized for the production of information-processing devices and of information processing itself

Leading industry
Information technology

Major actors
Multinational corporations, national and state governments, and new IT elite

Operating unit
Network of firms

Time unit
Real time, 24 hours a day on a global scale

Spatial structure
Space of flows concentrated in large cities and megacities—the nodes of the informational/global economy; they concentrate the productive informational sectors of developed and developing countries.

The electronics industry epitomizes new industrial space configured along the new international division of labor:

1. research and development and innovation firms and high-skilled fabrication branch plants in MDCs concentrate highest-skilled labor (e.g., Silicon Valley firms)
2. high-volume producers in NICs concentrate semi-skilled, large-scale assembly and testing plants

Informational landscapes
Dependent on the space of flows and three support layers:

1. network that supports the flow of information (e.g., Internet, satellite, ISDN, fiber optic networks, etc.)
2. nodes and hubs of the network (i.e., megacities and large cities) that connect
   a) top financial and managerial flows and
   b) high-tech manufacturing flows
3. places valued by the information-age elite

Sociospatial characteristics of informational landscapes
Polarized along the lines of social dualism (income and spatial polarization); excludes groups whose labor is made superfluous by the informational economy

Sources: Castells (1989, 1996)

FIGURE 1. Characteristics of Castells' informational/network society framework.

Silicon Valleys in Developing Countries: Nodes in the Informational Economy

Bangalore is the fourth largest Indian city and the capital of the state of Karnataka in southern India. Guadalajara is the capital of the western state of Jalisco, the second largest Mexican city, located 600 miles south of the U.S.-Mexico border. Both cities—called by the media India and Mexico's "Silicon Valleys"—are clearly not the newly industrializing countries' version of American high-tech districts. Their position in the international division of labor, recent insertion in the global electronics industry, respective metropolitan populations of five million,[5] and information-age landscapes make them, according to the informational/network society perspective, urban/industrial nodes in the global network of manufacturing flows. Historically, their climatic and geographical conditions have attracted different elite groups. The information-age elite is the most recent such group, including executives and managers of foreign and large national IT companies along with highly paid IT engineers, programmers, and entrepreneurs. These two cities reflect different yet parallel development trajectories taking place in NICs that have tapped into the export-oriented development potential of the world electronics industry. Such potential is critically conditioned by national and state IT policies that are not only supportive of a friendly business climate but also of the outsourcing needs of IT and multinational electronics corporations. The latter, capitalizing on new telecommunications and the cost advantages associated with the international division of labor, eventually shifted focus from subcontracting unskilled cheap labor in conventional export-processing zones to current global integration via production and supply chains made of high-skilled, preferred subcontractors and suppliers (Dicken, 1998; Ernst, 1997).

As suggested by the network society perspective, Bangalore and Guadalajara are urban nodes in the global network of software and manufacturing flows orchestrated by multinational corporations and state governments. Multinational corporations' preferred subcontractors are generally found in cities and regions offering an educated labor force, a certain level of research and development capacity, and adequate outsourcing networks that can meet the multinational corporations' quality and delivery standards. (Dicken, 1998; Kimmel, 1993; Wellenius, 1993). Except for the outsourcing networks, these conditions are a matter of national industrial public policy. However, in the case of Bangalore and Guadalajara, the outsourcing needs of software and electronics multinationals have actually shaped national information technology and electronics industrial policy. Texas Instruments, which installed the first Indian Earth station satellite in 1984, served not only as a prime advisor to the central government's software technology park (STP) program but also as the leader in promoting Bangalore as an off-shore outsource center to American software companies (Kurian, 1997). Since 1991, the STP program has been the backbone of India's software export industry. It provides (Earth station) satellite high-speed communications facilities; generous tax, utility, and environmental regulatory concessions; and fast-track permit approval to foreign companies. Likewise, IBM has played a dominant role in Mexico's computer industry since 1986. In exchange for creating a semiconductor research center in Guadalajara, IBM obtained an exemption from domestic-content regulations that required foreign companies to partner with Mexican firms (Dedrick et al., 1999). Liberated from the national mandate, IBM and Hewlett Packard dissolved their partnerships with Mexican-owned companies and promoted Guadalajara as a manufacturing site to their network of international subcontractors. As the Bangalore and Guadalajara case studies further illustrate, in order to tap into the global space of software and electronics manufacturing flows, the Indian and Mexican national and state governments have been relatively subservient partners of electronics and information technology multinationals.

The characteristics of the information-age landscapes in Bangalore and Guadalajara are summarized in Table 1.

Bangalore, India

History

Bangalore's development into an important node of the global New Economy is not only the result of recent IT policy but also of past decisions made by the British colonial and Indian postindependence ruling elites. Founded in the 16th century, Bangalore developed into a weaving and trading center under Mughal and Maratha rule. Then in 1807 the British founded a separate military town (cantonment) nearby. This town evolved into a major retirement community for senior officers, who chose it for its cool climate and geographic location. The colonial legacy is still visible in the wealthier areas of the city, with its Victorian architecture, whitewashed bungalows, broad boulevards for military parades, public parks, and manicured polo and cricket fields (Stremlau, 1997; Winchester, 1997). Bangalore's colonial sobriquet of "Garden City" changed after independence to "City of the Future" when Prime Minister Jawaharlal Nehru chose it to be the center for defense and scientific

TABLE 1. Characteristics of information-age landscapes in Bangalore and Guadalajara.

Characteristic	Bangalore	Guadalajara
Post–Cold War development strategy	• Export-oriented industrialization • Trade liberalization • Technology parks to attract foreign direct investment	• NAFTA-lead export-oriented industrialization • Intensify foreign direct investment in computer, telecommunications, and electronics manufacturing
Informational landscapes	Bangalore's metropolitan population: 5 million (unofficial); 4.67 million (official estimate for 1995[a])	Guadalajara's metropolitan population: 5 million (unofficial); 3.8 million (official estimate for 2000[b])
Major actors	• Texas Instruments • Indian Tata companies • Karnataka Industrial Areas Development Board	• IBM • Mexican industrial partners • Jalisco Economic Promotion Secretariat • American Chamber of Commerce of Guadalajara
Predominant flows and informational infrastructure	• Direct software services through "body shopping" • On-line services transmitted via satellite, ISDN, and fiber optic networks to international clients (primarily in the U.S.) on a 24-hour-a-day basis	• Manufacture of computers and computer and telecommunication parts for U.S. original equipment manufacturers • 24-hour-a-day global quick concept-to-volume manufacturing • State of the art broad-band fiber optic network
Global advantages	• On-site (body shopping) services: 70% of U.S. costs • On-line services: 40% of U.S. costs[c] • U.S./India geographical 12-hour time zone difference	• Approximately 50–60% of U.S. costs • Proximity to markets in the NAFTA region
Spatial division of labor	• Considerable high-tech software engineering (design) • Majority: lower-skill testing and coding done by male programmers	• Some high-skill process engineering • Majority: low-cost, high-volume manufacturing done by female workers
Network of firms	Multinational subsidiaries, Indian spin-offs, and subcontractors	Multinational subsidiaries and their domestic and foreign subcontractors and specialized suppliers
New industrial space	IT corridor comprising many one-man software shops to a couple of ultramodern, gated, self-contained, "work-live-play" exurban technology parks	Various industrial parks located at the fringe of the city
Amenities valued by information-age elite	• Climate • Victorian legacy of public parks and broad boulevards • Universities and technical institutes • Educational, health/fitness, retail, and recreational facilities inside high-tech parks	• Climate • American-style gated residential communities with golf courses and country clubs • American-style suburbanization with shopping malls, convention centers, big-box retailers, and private schools • Universities and technical institutes
Dual landscapes	Technology parks surrounded by squatter communities compete for land and provision of urban infrastructure	• Squatter settlements compete with the IT industry for land • Reinforcement of a historical pattern of east/west socioeconomic spatial segregation

a. Bose (1998) b. Comision Nacional de Poblacion (2000) c. Heeks (1996)

research. Today, Bangalore's science and technology infrastructure harnesses four universities and over 300 colleges, including polytechnic schools and research and industrial training institutes. The well-known Indian Institute of Management, along with major public enterprises such as Hindustan Aeronautics, Bharat Electronics, Hindustan Machine Tools, and the Indian Space Research Organization, are visible manifestations of India's Cold-War strategy to make Bangalore the center of Indian defense and aerospace research and development and electronics production (Fromhold-Eisebith, 1999; Stremlau, 1997).

A Node in a 24-Hours-a-Day Global Production Network

After trade liberalization, many IT multinationals (Texas Instruments, Motorola, Hewlett Packard, Digital, IBM, AT&T, 3M, NCR, Siemens, Novell, Oracle, and others) established subsidiaries in Bangalore, lured by the abundant supply of engineering and skilled manpower and the city's quality of life. A host of important Indian startups and spinoffs, particularly in the software industry, have also put Bangalore on the world map. As of 1997, the total IT sector comprised over 500 companies. Many of these are one-man shops, but over 160 were officially registered as software technology parks (Fromhold-Eisebith, 1999), with estimated total software exports of $7.28 million in 1994 (Hanna, 1994). In 2001, the sector grew to a total of 923 firms with software exports of $1.55 billion (Department of Information technology, Government of Karnatka, 2002). Even before liberalization, the most profitable aspect of the software export industry involved a business practice of sending programmers to work abroad. In 1994, this business accounted for 70–80% of the industry's export revenues (Hanna, 1994). The practice, called "body-shopping," consists of subcontracting Indian programmers to U.S. companies on an hourly rate. This is the equivalent of routine, low-risk, low-value-added high-tech software assembly. The Indian firm typically performs low-level computer software coding and debugging without providing any design or advanced software engineering input. The practice, widely criticized, contributes to a steep brain drain, since many Indian programmers do not return home. One of the objectives of India's IT policy has been to respond to this problem and to nurture U.S.-Indian software production partnerships organized on a 24-hour-a-day global production process. During nighttime on the American continent, Indian software firms take advantage of the 12-hour difference between India and the U.S. to log on to their U.S. clients' computers. This allows Indian firms to short cut the time and money required to obtain the latest computer hardware, while American software companies expand their global work force to a 24-hour cycle at one fifth the cost, without switching communications to a foreign language. Furthermore, permitting Indian programmers to telecommute on a global scale may help to reduce the Indian brain drain and brain trade (Hanna 1994; Rao 1997).[6]

Bangalore's Information-Age Landscapes

Bangalore morphed from a colonial pensioners' "Garden City" at the dawn of the 20th century to Nehru's "City of the Future" in the mid 20th century and, just in the last decade, to an informational city. Gated, self-contained, techno-exurbs, such as Infosys City and International Technology Park, Ltd. (ITPL), located at the city's outskirts, exemplify Castells' supporting layers of the space of flows. Infosys City is the headquarters of Infosys, a leading Indian software company, and is a 50-acre corporate campus with 1.25 million square feet of built space. It was designed to retain top Indian engineering talent. ITPL, built to international standards by Jurong,[7] a Singaporean consortium, is a high-tech community that comprises 1.85 million square feet of office space, 1.45 million square feet of production space, and 400 residential condominiums (Ashok, 1997; Iype, 2000; Ristelhueber, 1997). In response to and in stark contrast with the rest of the city's dearth of urban infrastructure such as water, electricity, sewers, roads, and parking, ITPL and Infosys City provide their own dedicated utility infrastructure including water, power, sewer, and telephone exchange, as well as such amenities as satellite communications; shuttle service; commercial space; and training, recreation, and entertainment facilities. ITPL was designed to lure multinational electronics and information technology firms and their corresponding information-age elites into a "work-live-play" fortress. The 68-acre park, located 18 km from the city center in exurban Whitefield, offers state-of-the-art international connectivity via an Earth station satellite for high-speed data transfer and video conferencing, dial-up, and ISDN connections. Its facilities are air conditioned, and the residential, office, and production spaces have round-the-clock security guards. The park's current tenants specialize in computer software and information technology, biotechnology, electronics, telecommunications, and financial services (ITPL, 2002).

Sassen (1995) characterized edge cities as a new urban form of digitally-linked centrality "rarely evident in developing countries, where vast urban sprawl with a seemingly endless metropolitization of the region around cities has been the norm" (p. 71). Bangalore's edge-city developments, albeit different from American edge cities, may be the NICs' edge-city counterparts.

What is generally perceived as Third World endless urban sprawl is, at a closer look, a very dynamic process of urban/rural fringe transformation, admittedly not too dissimilar from the forces shaping American cities, although morphologically and socioeconomically different. According to Sassen (1995), industrialized nations are witnessing a reorganization of urban space into decentralized reconcentration of economic activity at the peripheries of cities. This new growth is different from past residential suburbanization or metropolitization in that it is shaped by the locational decisions of national and multinational corporations that make the urban peripheries into the growth centers of the most dynamic industries. Bangalore's "IT corridor," where the majority of software and electronics firms congregate, stretches from exurban Whitefield in the east through the suburban areas of Indiranagar, Karamangala, Hosur Road, and Jayanagar and ends in the southeastern exurb of Electronics City, located 20 miles away from the city (see Figure 2). The corridor, which also contains the high-end housing preferred by IT elite workers[8] and the newest exurban high-tech corporate communities of ITPL at Whitefield and Infosys City at Electronics City, is the correlate of Sassen's digitally connected edge cities. Lured by advanced worldwide digital connectivity, foreign subsidiaries and large Indian software firms such as Wipro and TCS have relocated operations from other Bangalorean venues to ITPL. This decentralizing trend, deplored in MDCs, is nonetheless a welcomed alternative to Bangalore's congested city core. The corridor also represents Castells' characterization of information-age landscapes dependent on (1) the informational infrastructure of advanced telecommunications that link Bangalore to other hub cities in the global network of software flows, and (2) the residential preferences of the information-age elite.

In addition to new informational landscapes, the fringe is where four other types of settlements converge. First, at the lowest end of the socioeconomic hierarchy, squatter settlements of poor, landless immigrants from rural villages subsist—either displaced by the expanding urban fringe or from nearby rural regions. They are attracted to the city by construction and low-skill service jobs. A second type is former rural villages transformed into "rururban" settlements by the engulfing urban fringe. Third is middle-class residential subdivisions awaiting legalization and public utility and services extension. Fourth, one finds dwelling sites inhabited by former urban slum dwellers cleared into the fringe by local development authorities (Schenk, 1997). Rather than being areas dominated by city cores and agrarian lethargy, as Third World cities are commonly described when compared with First World cities, the fringes of cities like Bangalore contain dynamic centers of global economic activity directly juxtaposed with areas marginalized from this activity.

Planning for Bangalore's Information-Age Landscapes

These dynamic urban landscapes illustrate the polarizing tendencies of the New Economy, not only in terms of the exclusion of some groups from the digital economy and the spatial segregation of elite enclaves, but also of the beggar-thy-neighbor dynamics involved in the generation and support of these new industrial landscapes and their apparent unending dependence on direct foreign investment.

The expenditure of scarce public revenues to recruit and retain IT multinationals via locational subsidies draws on the rest of the economy and on available public funds, including those necessary to finance the urban infrastructure needs of a booming IT sector. The Karnataka state government, for instance, will spend close to $50 million in developing Bangalore's IT corridor—masterplanned for digital and intermodal connectivity as a string of "information technology colonies" stretching for 23 km between Whitefield and Electronics City (Jurong Consultants, 2002). In the meantime, the rest of the city's infrastructure chokes on the IT industry's newly generated growth. From 1980 to 1995, Bangalore's population grew from 2.9 million to nearly 5 million, and by 2010 it is expected to grow another 2 million. Since much of Bangalore's former public revenue came from state grants, the gap between public finance and urban service provision has drastically widened, due in part to Karnataka's previous rural development planning priorities, but more recently to its public largesse to IT firms. It offers to the IT industry a hefty package of locational subsidies that includes air and water pollution exemptions, tax holidays on capital purchases for 5 years, 10 years of sales tax exemption, and tax breaks on energy and fuel used by the IT industry to generate its own power (Department of Information Technology, Government of Karnatka, 2002). Ironically, Bangalore faces a political and fiscal conundrum as it tries to fund the necessary infrastructure expansions to support the growth of its IT sector. In addition to a citizens' tax revolt, IT firms, like the goose that laid the golden egg, threaten to flee to lower-cost Indian or Asian cities if their taxes are raised or if traffic gridlock and infrastructure deficiencies do not improve. Under a national plan for new satellite towns (Banerjee, 1996), new IT colonies are arguably Bangalore's remedy for alleviating the pressures on its overburdened infrastructure. However, Bangalore has traditionally favored private vehicles over public transit (Bose, 1998) and has woefully failed to

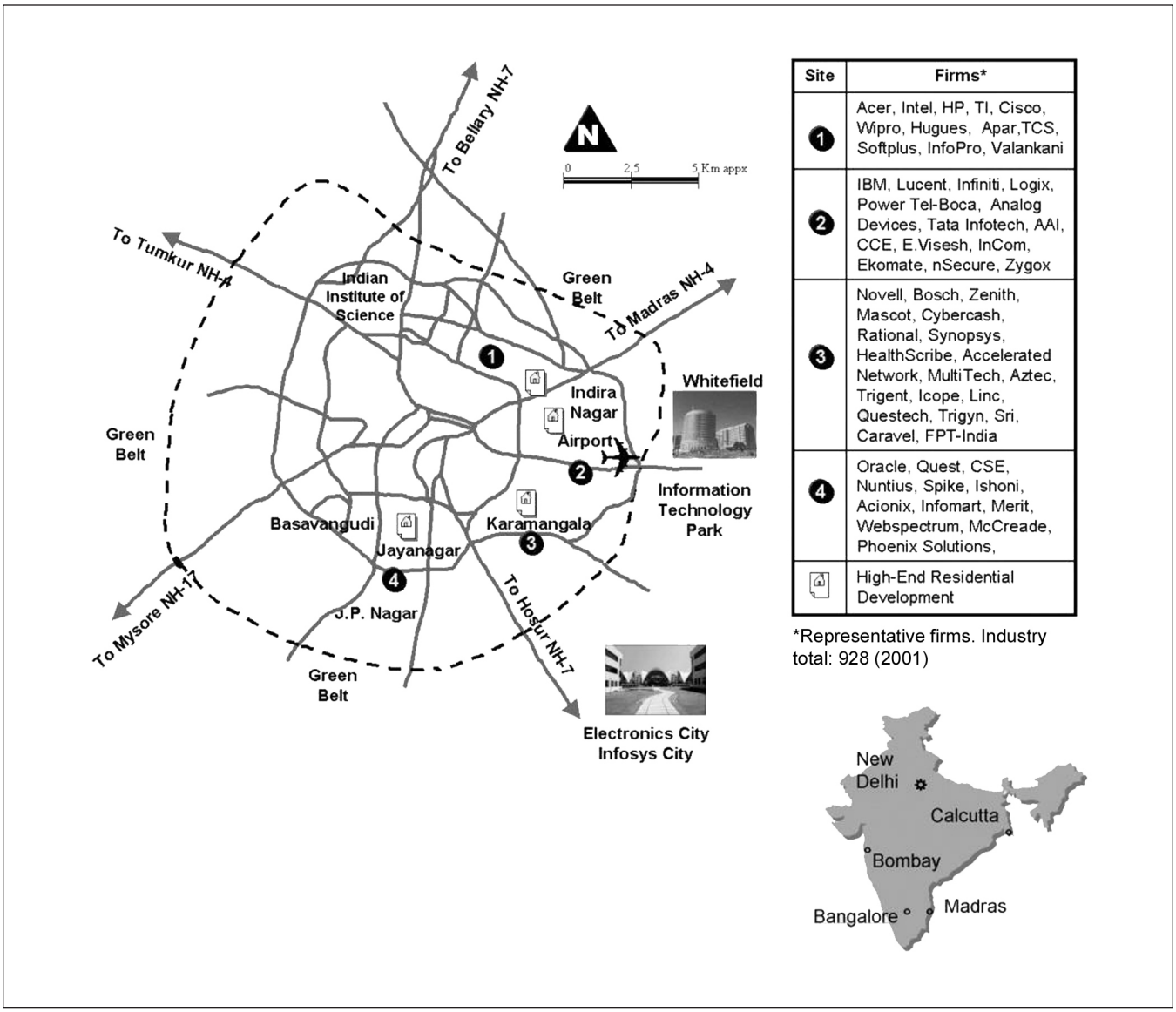

FIGURE 2. Bangalore's IT corridor and its firms.

keep pace with the surge in road and air transportation needs of its information-age economy. In order to break out of the public finance conundrum that jeopardizes its touted "South Asia's Silicon Valley" status, the city must bid for fresh sources of foreign direct investment with requisite pledges for new rounds of locational subsidies to foreign partners (Government of India, 2002)—a vicious cycle that even strategic-trade theorists caution against (see Moran, 1998).

Guadalajara, Mexico

History

Walton (1978) described Guadalajara as a divided city. From its founding in 1542 by the Spanish conquistadors until the advent of the industrial revolution in the mid 19th century, Guadalajara's elite groups were largely made of the conquistadors' progeny, merchants, and the Catholic Church. Their wealth derived from agriculture, cattle ranching, and trade, and in the case of the Catholic Church, from donations, tributes, and repossessed property mortgaged to different religious

orders (López Moreno, 1996). Their legacy is still visible in the old colonial grid at the center of the city and the many churches and large colonial structures situated on the grid. By the second half of the 19th century, a new industrial, commercial, and real estate elite emerged in Guadalajara resulting from two interconnected factors: (1) the liberal reforms of President Juarez, who transferred church corporate assets to the hands of the old agricultural oligarchy and a few real estate entrepreneurs; and (2) an outgrowth of foreign direct investment (namely, French, British, and American) in railroads and factories during Mexico's first wave of industrialization from 1877 to 1911 under President Porfirio Diaz. During the 1890s, as the city reached a population of 100,000, the new elite built the first French- and American-style horse-and-street-car suburbs on the west side of town and industrial factories in the southwestern part of the city in proximity to the Guadalajara–Mexico City railroad (López Moreno, 1992). The ensuing east/west division between rich and poor residential neighborhoods and between capital-intensive industry in the southwest and an abundance of labor-intensive craft industries in the rest of the city characterizes—to this day—Guadalajara's dual socioeconomic and industrial layout (Alba & Kruijt, 1988; De la Peña, 1986; López Moreno, 1996).

An incipient information-age elite gradually emerged in the mid 1960s, when the city's population reached 1 million, and the state of Jalisco, in partnership with the local American Chamber of Commerce, internationally promoted Guadalajara as a place of tourism and industry. In order to attract foreign investment, Jalisco built an international airport, electric power plants, gas and oil pipelines, and new industrial parks on the periphery of the city (Alba & Kruijt, 1988). In the electronics industry, subsidiaries of Motorola and Burroughs were the first to open plants there in 1966. In 1975, IBM built its only Mexican manufacturing plant in El Salto Industrial Park, located on the outskirts of the city. By the end of the 1980s—after Mexico joined the General Agreement on Tariffs and Trade (GATT), drastically liberalizing tariffs—the number of multinational corporation subsidiaries increased to nine, including computer manufacturers such as Hewlett Packard, Wang, Tandem, and others, plus a number of local spinoffs and domestic subcontractors. By 1993, the total had grown to 35 firms, prompting the local and international press to suggest that Guadalajara could become a little "Silicon Valley" (Audirac, 1993; Palacios, 1992). Since the signing of NAFTA, Guadalajara's electronics industry has experienced a boom. It grew to a total of 55 firms in 1998,[9] employed 35,665 persons, and increased exports from $2.1 billion in 1995 to $5.2 billion in 1997 (Cadena Productiva de la Electronica, 1998). By 1999 the number of firms had reached 320 (Vega, 1999). This new boom is different from that of previous decades in that IBM adopted just-in-time production in its Guadalajara plant, which forced it to develop a network of Mexican and foreign subcontractors.[10] Other multinational original equipment manufacturers followed suit, and rather than a little "Silicon Valley," the industry is evolving into a hub-and-spoke district (Markusen et al., 1999) or supplier network (Ernst, 1997) made of clusters of contract manufacturers and specialized suppliers.[11] These clusters, anchored by IBM, Hewlett Packard, NEC, and more recently Lucent Technologies, combine both Mexican and multinational subcontractors. Their manufacturing processes—including product development and clean-room production—take advantage of a low-cost female work force, as well as of a pool of engineering and skilled labor trained at six universities, two technical institutes, and a semiconductor research and development center created via a partnership between IBM, the University of Guadalajara, and Stanford University (Brunner, 1991; Cadena Productiva de la Electrónica, 1998; Palacios, 1992).

There has been considerable controversy about whether Guadalajara's insertion in the world electronics industry has generated an information-age elite and whether its electronics firms differ in technical sophistication and skilled manpower from the maquiladoras or in-bond assembly plants located along the U.S.-Mexican border, which are organized as traditional export-processing zones. Despite Wilson's (1992) work documenting structural differences from border maquiladoras, sweeping generalizations found in the literature have tended to dismiss the diversity of informational landscapes found in Mexico.[12] For instance, Kenny and Florida (1994), based on a study of Mexican border maquiladoras, questioned the potential of NAFTA to attract Japanese capital-intensive investment to Mexico, arguing that the country lacked the infrastructure and skilled engineering personnel to attract clean-room assembly operations. Although Guadalajara is indeed a low-cost manufacturing location in the world electronics industry, the above authors did not recognize domestic variations resulting from differences in urban and educational infrastructures and that Motorola's semiconductor plant (which includes clean-room assembly) has been in operation since the late 1960s. Fewer risk factors made global electronics firms—including Japanese ones—prefer Guadalajara to border cities. Lower female labor turnover, more availability of engineers and technicians, lower wage rates, a better climate, and more cultural and urban amenities were important comparative advantages identified by managers of Guadalajara's electronics firms.[13] In sum, rather than a typical export-processing

zone, Guadalajara has evolved into a significant node of preferred electronic subcontractors of original equipment manufacturers in the global space of places and manufacturing flows.

Guadalajara's Information-Age Landscapes

There are three discernible spatial nuclei of electronics firms in Guadalajara that correspond to the timing and locational decisions of multinational corporations subsidiaries (see Figure 3). The first zone, in the western part of the city, marked by Motorola and Kodak's presence, emerged in the late 1960s and is now completely surrounded by residential and commercial development. A second zone in the northwestern Los Belenes industrial park and a third in the southern edge of town, which forms part of Guadalajara's industrial corridor of El Salto, include two major industrial parks that house IBM, NEC, and subcontractors. A fourth zone currently in outward expansion is located along the southern urban peripheral highway loop (anillo periférico)—at driving distance from high-income subdivisions and in proximity to the city's southwestern light rail terminal. Lucent Technologies, Siemens, and new contract manufacturers have recently initiated operations in this zone. The post-NAFTA arrival of multinational corporations points to a new trend in Guadalajara's insertion in the 24-hour-a-day global informational economy via geographically dispersed yet highly integrated manufacturing and innovation flows. These new contract manufacturers, such as Solectron, Jabil, Flextronix, and SCI, offer original equipment manufacturers, quick concept-to-volume manufacturing services, and advanced logistics for market distribution. For instance, with networks of innovation centers in more developed countries and volume fabrication in newly industrializing and less developed countries located on four continents, Solectron's engineering teams work on a 24-hour-a-day basis on the same project, exchanging detailed technical information with counterparts halfway around the world. At the end of a team's working day in one geographic location, a second team, located in another part of the world, continues working on the project (Solectron, 1999). Within a short turnaround period, the contract manufacturer, using common processes and equipment at each international site, seamlessly transfers the manufacturing process from its California high-velocity system to its Guadalajara high-volume, low-cost manufacturing plant. This process illustrates the latest form of systemic globalization of international production networks through the dispersal of multinational corporations' prototyping and volume manufacturing processes (Ernst, 1997). The contract manufacturer strategically chose Guadalajara for high-volume, low-cost fabrication and speedy end-market distribution to the NAFTA region, while its other design and advanced logistics centers and low-cost manufacturing plants located on three other continents are respectively oriented to the markets of the Asian/Pacific region and the European Union.

Laissez-Faire Planning of Guadalajara's Information-Age Landscapes

Mexico's new federalism includes the typical devolution of responsibilities to state and local governments. As in the case of India, the latter must provide public services and infrastructure with reduced federal assistance, and many have embraced a municipal entrepreneurial approach to planning and public administration. Given the economic importance of the electronics industry, the state of Jalisco recently diverted $25 million from a poverty alleviation program to a revolving fund for industrial incentives, which included the construction of new industrial parks with the required infrastructure and assistance to foreign firms for plant installation and land purchases. However, Guadalajara's electronics multinationals, lamenting Intel's decision to forego Guadalajara for a Costa Rican locale, deemed these incentives insufficient and pressured the state to match Malaysia's 5 to 10 year tax holidays (El Informador, 1999).

Armed with advanced cadastre and property registry systems, only the most technically qualified municipal administrations—Guadalajara being one of them—have been mildly able to confront their new fiscal responsibilities. However, Mexican urban scholars (Arroyo Alejandre, 1993; Garza, 1999; Wario, 1993) deem the process of urban development planning, from the federal to the local level, "toothless" and ineffective in providing adequate municipal infrastructure and services to the city's metropolitan population, which since the 1960s has doubled every 15 years. Furthermore, since the Mexican economy has become ever more dependent on foreign capital (e.g., 56% of the Mexican banking industry is foreign owned; Garza, 1999; Moran, 1998), the pro-NAFTA and entrepreneurial regime of Mexican public administrations has, since the 1990s, increasingly minimized planning intervention, letting the needs of developers and the real estate market determine land use and public project priorities (Garza, 1999; Wario, 1993). A telling case is that of a flamboyant local magnate and industrial park developer who has given free rein to a team of world renowned architects (Ito, Nouvel, Johnson, Hadid, Libeskind, and Mayne, among others) to design his controversial JVC Center, a $400 million, 750-acre cultural, corporate, and residential complex on the outskirts of Guadalajara near an ecological reserve. Perceived as a publicity stunt and savvy economic scheme by some, the center is supposed to put Guadalajara on

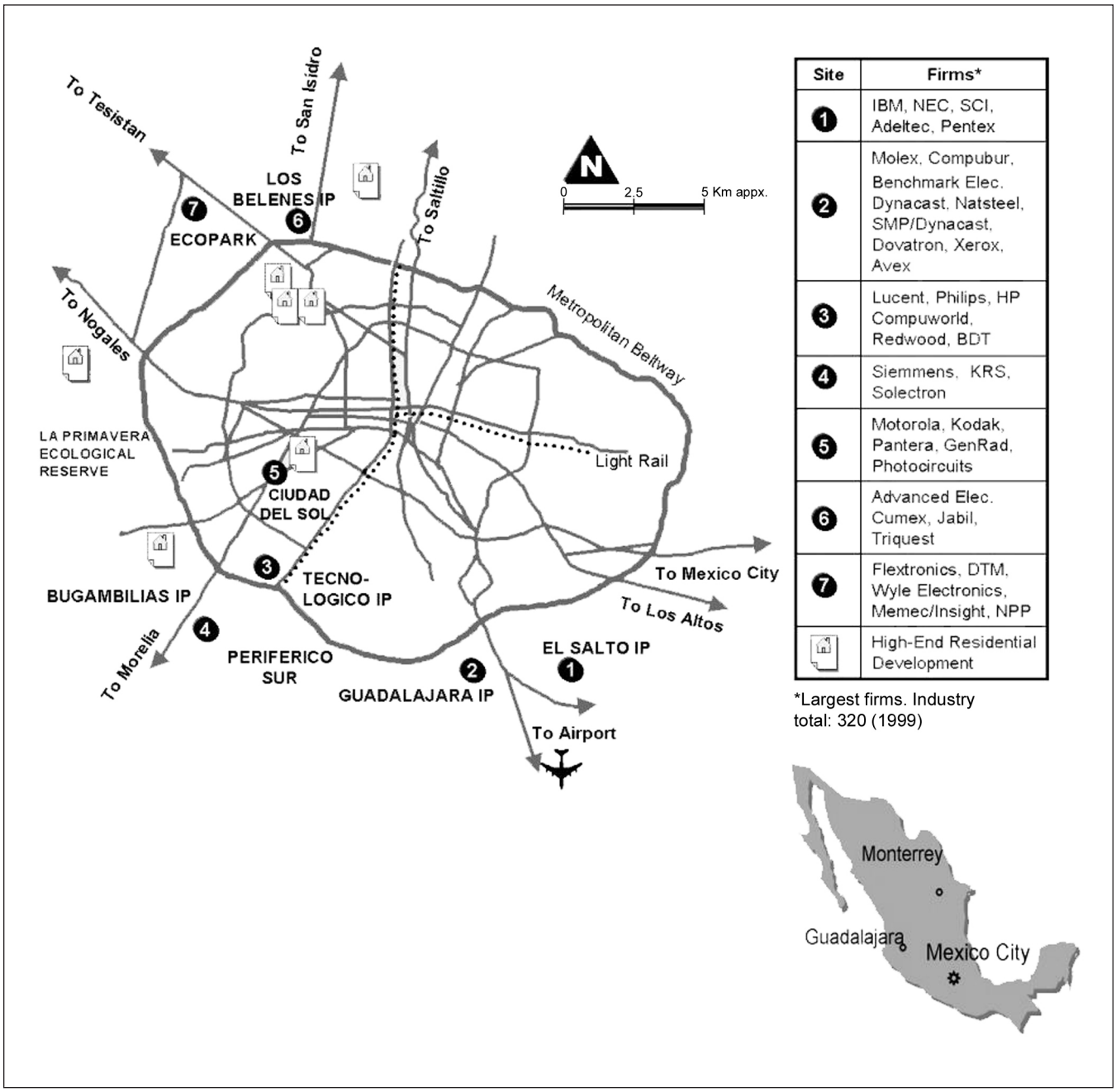

FIGURE 3. Guadalajara's IT industry clusters and their firms.

the list of must-see places, not unlike Bilbao's Guggenheim museum, and to provide luxury housing attractive to the New Economy's elite (Ouroussoff, 2001; Pearson, 2001). Whereas these projects were typically economic development undertakings spearheaded by heads of government utilizing national architectural talent and espousing some public mission, today the Mexican and local governments simply pledge the indispensable subsidies, namely tax concessions and infrastructure facilities (roads and utilities), to the private-place-making schemes of Guadalajara's corporate elite.[14]

Perpetuating the historic sociospatial division between rich and poor, Guadalajara's information-age elite resides in secluded, gated golf and country club com-

munities and security-controlled apartment buildings in the west of town, while low-income neighborhoods are densely packed together in the central, northern, and eastern parts of the city. In 1990, squatter settlements comprised one fifth of the total 300 km^2 metropolitan area and included more than 800,000 squatter residents living in the interstices of the urban/rural fringe. It is estimated that more than 60% of future metropolitan growth will consist of squatter settlements (García & Rodríguez, 1994).

In sum, Guadalajara is a highly socioeconomically segregated city and its western sector offers to the information-age elite the guise of a buoyant middle-class city with American-style suburban amenities and avant-garde exurban places vying for global prestige. The city's western residential, commercial, and office expansion has been strongly influenced by American-style suburbanization. In addition to high-end residential development, foreign investment in commercial real estate has built a flurry of foreign franchises and regional shopping centers, such as Guadalajara's Wal-Mart and Price Club superstores sited across from each other and imposing on the city their oversized parking lots. Christopherson (1994) identified these suburban developments in the U.S. as post-Fordist, while Latin American authors have branded them "neoliberal" (Ciccolella, 1998; Red de Investigación y Acción en Desarrollo Local, 1998; Red Nacional de Investigación Urbana, 1996). They are oriented to the needs of the business community and high-end residential consumers, who seek exclusive enclaves.

Conclusion

The cities of Bangalore and Guadalajara, which have tapped into the world electronics industry for export-led development, are clear examples of nodes in the informational/global economy. Joint ventures between multinational software and electronics corporations and Indian and Mexican national and state governments—capitalizing on the international division of labor—have linked both cities to global networks of manufacturing flows working on a 24-hours-a-day global scale. From this vantage point, North/South polarities and First and Third World distinctions are losing their old meaning (Castells, 1996). This condition challenges North/South conceptions that do not recognize the internal diversification as well as economic integration of both regions and the emergence of edge-city-like urban forms in newly industrializing countries. As the Bangalore and Guadalajara case studies illustrate, new urban-edge forms—digitally connected to high-tech centers in the industrialized world—are also newly emerging informational landscapes that defy the conventional wisdom about urban form and change occurring outside developed nations. Moreover, as this work suggests, a process of intense urban-edge development is also taking place in regions of newly industrializing countries as similar global forces such as multinational corporations' strategies, entrepreneurial governments, and the preferences of new information-age elites shape the informationalizing metropolitan peripheries in both developed and developing nations. Evidently, the physical layout and the socioeconomic composition of these urban-edge forms in countries such as India and Mexico drastically differ from those in richer nations. Also, greater proportions of their urban society and economic activity are digitally disenfranchised and further peripheralized into new geographies of marginality. The informational economy is highly exclusionary and dualistic. It privileges technical capacity and reinforces historical patterns of income polarization and increased regional disparities. Bangalore's and Guadalajara's informational landscapes illustrate this in four major ways through:

- reinforcement of historical sociospatial divisions;
- exclusive business accessibility to advanced IT infrastructure;
- the fortress-like spaces that house the information-age elites and insulate them from the highest socioeconomic disparities converging on the urban fringe; and
- fierce regional and inter-city competition for shares of global capital.

As players in the global economy, nation states have reoriented their regulatory functions to the needs of the market and allowed multinational corporations to engage in regulatory arbitrage, deepening worldwide competition among cities and regions for foreign direct investment. While this may be globally advantageous for some countries and urban regions, at the city level, it can become a zero-sum game that, as Bangalore and Guadalajara illustrate, promotes local regulatory undercutting, preempts local planning intervention, and exacerbates local spatial and infrastructure inequalities. Furthermore, as this study suggests, U.S. cities seeking to attract high-tech jobs may already be competing with cities such as Bangalore, which, in addition to possessing a critical mass of low-cost, high-skilled software workers and more relaxed environmental regulations, enjoy a 12-hour time zone advantage in the new global mode of production. Thus, beyond the advantages that the international division of labor confers to multinational corporations, location in a different world time zone may be a strong reason for these firms to bypass cities in the U.S. for cities halfway around the world.

Debates about regions' and cities' new roles in the age of globalization fill books and journals, with various authors questioning the "city-corporation" model (Schteingart, 1996) and unrealistic attempts to replicate the East Asian miracle (Clark, 1994). Others (Borja, 1996; Markusen et al., 1999; Savitch, 1996) foresee in the present market-driven era opportunities for local policy innovation to enhance local capabilities (e.g., research and development, technological, and social capital resources) for global competitiveness. Although the imperative is there for countries such as India and Mexico and cities such as Bangalore and Guadalajara to harness multinational corporations' latest shift from "partial" to "systemic" globalization, the jury is still out regarding the ability and political willingness of national and state governments to balance their entrepreneurial imperative with their responsibilities for social and environmental justice.

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NOTES

1. *Informational* is the term coined by Manuel Castells to refer to an information-age (network) society and mode of development. Rather than industrial and national, *informational* connotes a new social order that is simultaneously local (space of places) and global (space of flows) and webbed through new information technology-enhanced social and institutional practices. The technosocial infrastructure that facilitates the securities broker transactions around the world or my electronic typing, storage, and transmission of this manuscript, together with the international wage disparities that facilitate the employment of women in semiconductor manufacturing in Guadalajara or the software developer in Bangalore are part and parcel of a New Economy that is global and informational, i.e., organized for the production of telecommunications and information technologies (hardware and software) and for information creation, processing, and delivery.
2. This is the author's rather arbitrary classification. The groupings are by no means exhaustive or mutually exclusive, nor do they include most of the scholarship on globalization, economic restructuring, and urban development, which is voluminous, diverse, and covers more disciplines than those represented by the aforementioned authors.
3. World city literature is extensive and focuses primarily on developed countries. For diverse world city scholarship, see Knox (1995); for scholarship on Pacific Asia, see Lo and Yeung (1996). This article selectively covers only authors relevant to its focus on developing countries.
4. Markusen et al. (1999) found second-tier cities to be home to specialized industrial complexes in the developed and developing world, but eschewed world city and global economy explanations, preferring to give causal weight to local choices by political and entrepreneurial actors.
5. Official population figures tend to be lower. The 1995 estimated population for metropolitan Bangalore was 4.67 million (Bose, 1998), while the estimated 2000 population for the Guadalajara metropolitan area was 3.8 million (Comision Nacional de Poblacion, 2000).
6. As India opened data communications to foreign investment, from 1991 to 1994 alone direct U.S. investment in India grew from $104 million to $1.1 billion, and by 1997 Indian software exports reached $1 billion, growing at 50% per year (Rao, 1997; Stremlau, 1997).
7. The design and site planning was undertaken by Technology Parks, a subsidiary of the Singaporean group Juron Town Corporation, which owns Singapore Science Park. Other partners were the Indian Tata Group of companies in joint venture with the Karnataka state government, Sembawang, one of the largest Singaporean engineering contractors in Asia Pacific, and RSP Architects Planners and Engineers, also with a strong presence in Singapore and the region. The Karnataka Industrial Areas Development Board provided the land and road connecting to the city's downtown.
8. Bangalore's most expensive residential areas are scattered along Airport Road, M.G. Road, Cunningham Road, Infantry Road, and in suburbs farther from the city center (e.g., Karamangala, J. P. Nagar, and Jayanagar). However, they may not be considered posh by Western standards.
9. This figure does not include the software and producer service firms, which raise the number to more than 120.
10. In Guadalajara, IBM spearheaded the move to decentralized, networked production after the federal government allowed it to operate as a foreign wholly owned enterprise. For just-in-time production, it developed a network of preferred Mexican (e.g., Compuworld, manufacturer of hard drives) and American subcontractors with the proviso that only one third of the total of any subcontractor's business could be transacted with IBM. To reward subcontractors' loyalty, IBM brought them in contact with its inner network of worldwide suppliers (personal communications, IBM and Compuworld managers, July 1993).
11. Hub-and-spoke districts are networks of firms dominated by one or several large firms surrounded by their suppliers (Markusen,1996). A supplier network is a type of interfirm production network that includes subcontracting and a variety of other arrangements, such as original equipment manufacturers, contract manufacturing, and consignment and turnkey production (Ernst, 1997).

12. Wilson's (1992) study of Mexican maquiladoras posited that Guadalajara represented a new industrial configuration. Arroyo Alejandre (1993) also reported that maquiladoras found in the interior of the country had more local technical value added than plants found at the border. This difference is now well established (Dedrick et al., 1999).
13. Guadalajara's young working women are more likely to live with parents until married and to be less exposed to housing shortages than their counterparts at the border. This is due to Guadalajara's culture, which is more conservative and religious than that of border towns. This view was repeatedly expressed by managers of various Guadalajara electronics firms (HP, IBM, Motorola, Compubur, Cherokee, and Pantera) interviewed by the author in June and July 1993.
14. It is estimated that after the project design is completed, the value of the land will increase 10 fold (Ourousoff, 2001). However, Frank Gehry, Rem Koolhas, and Steve Holl abandoned the project, alleging it was a risky proposition.

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