

Booming Brazil

Designing for growth and two world-stage events

By Bob Drake

With a total land area slightly larger than the continental United States, vast mineral and energy resources under development, and aggressive infrastructure programs in progress, Brazil rapidly is becoming a world economic power. U.S. government statistics indicate that Brazil's major cities compare in population to major U.S. cities, most of its current energy needs are satisfied domestically, and freshwater resources abound (see Table 1). Brazil's 2010 gross domestic product — the market value of all final goods and services produced within a country — ranked ninth in the world, according to the CIA World Factbook, and experienced a real growth rate of 7.5 percent, with significant contributions from the industry and services sectors.

However, Brazil's transportation, sanitation, and energy infrastructures, in particular, are challenged to keep pace with the nation's development. And the urgency to build or upgrade airports,

railways, roadways, and transit systems increased significantly when Brazil was chosen to host both the 2014 World Cup soccer match and the 2016 Olympic Games. According to the Brazilian development bank, BNDES, investments in urban transport projects in the 12 World Cup host cities alone will total US\$6.8 billion (all values in this article are in U.S. dollars), including bus rapid transit, light rail, subways, and other systems.

"The massive effort and demands on adequate infrastructure that will take place for the World Cup and the Olympic Games are going to be of historical magnitude," said Alfredo Castrejón, Ph.D., Bentley Systems Inc. territory vice president for Latin America. "The creation of this infrastructure has two main challenges: 1) to serve its purpose during the actual events, and 2) to serve as infrastructure for the Brazilian

communities around the country in the aftermath. This forward-thinking line into the future is critical to ensure an adequate return on investment for these assets."

Igor Norris Nelsen, general manager for Tigre-ADS Brazil, an alliance with Advanced Drainage Systems Inc., said that the total investment forecast for these two events is about \$85 billion, including \$3.8 billion for 12 soccer stadiums, \$5.7 billion for airports, \$56.6 billion for urban mobility, as well as investments in 300 hotels, and municipal storm drainage and sanitary systems. "This is a very good opportunity for Brazil to improve its infrastructure and quality of life of Brazilian people," Nelsen said.

"The Games in 2014 and 2016 just raised a sense of urgency for Brazil, both in the public and private sectors,"

Figueiredo Ferraz, a traditional civil engineering firm in Brazil, designed the Imigrantes Highway (completed in the early 2000s) using Autodesk software products.

Table 1: Geography, economy, and infrastructure comparison*

	Brazil	United States
Total land area (square miles)	3.3 million	3.7 million (50 states and D.C.)
Total population (July 2011 est.)	203.4 million	313.2 million
Urban population (2010)	87% of total	82% of total
Major cities (population)	Sao Paulo (20.0 million)	New York-Newark (19.3 million)
	Rio de Janeiro (11.8 million)	Los Angeles-Long Beach-Santa Ana (12.7 million)
	Belo Horizonte (5.7 million)	Chicago (9.1 million)
	Porte Alegre (4.0 million)	Miami (5.7 million)
Capital city (2009 population)	Brasilia (3.8 million)	Washington, D.C. (4.4 million)
Gross Domestic Product (2010 est.)	\$2.17 trillion	\$14.66 trillion
GDP real growth rate (2010 est.)	7.5%	2.8%
GDP: Agriculture sector (2010 est.)	6.1%	1.2%
GDP: Industry sector (2010 est.)	26.4%	22.2%
GDP: Services sector (2010 est.)	67.5%	76.7%
Energy production/consumption		
Electricity (kWh)	438.8 billion/404.3 billion (2007 est.)	4.1 trillion/3.9 trillion (2008 est.)
Oil (barrels per day)	2.6 million/2.5 million (2009 est.)	9.1 million/18.7 million (2009 est.)
Natural gas (cubic meters)	10.3 billion/18.7 billion (2009 est.)	593.4 billion/646.6 billion (2009 est.)
Transportation		
Airports (total no. with paved runways)	726	5,194
Railways (kilometers)	28,538	226,427
Total roadways (kilometers)	1,751,868	6,506,204
Paved roadways (kilometers)	96,353 (5.5% of total)	4,374,784 (67% of total)
Unpaved roadways (kilometers)	1,655,515 (94.5% of total)	2,131,420 (33% of total)
Waterways (kilometers)	50,000 (primarily in areas remote from industry and population)	41,009 (47% used for commerce)
Water		
Total renewable water resources (cubic kilometers)	8,233 (2000)	3,069 (2008)
Total domestic water withdrawal (cubic kilometers per year)	11.7 (20% of total)	62.0 (13% of total)
Total industrial water withdrawal (cubic kilometers per year)	10.7 (18% of total)	219.4 (46% of total)
Total agricultural water withdrawal (cubic kilometers per year)	36.6 (62% of total)	195.6 (41% of total)
Per capita water withdrawal (cubic meters per year; 2000)	318	1,600

* Source: CIA World Factbook

said Márcio Reis Pinto, marketing manager, Autodesk do Brasil LTDA, a subsidiary of Autodesk Inc. established in 1994. “However, before those events were announced, we already had key fundamental growth drivers.” According to Pinto, those drivers include:

- transportation, water resources, and electrical power generation and distribution;
- urban planning and design;
- PAC, a government program to drive growth, with a strong foundation in infrastructure development;
- Minha Casa, Minha Vida (My House, My Life), a low-cost housing program based on credit availability to the middle and lower class;
- Pre-salt, a project by Petrobras based on the discovery of large oil fields in the deep ocean waters off the Brazilian coast;
- growing demand for commodities, especially from China; and
- general macroeconomic stability, with increasing credit offerings to support domestic demand for consumer goods.

During the next three years — 2011 through 2014 — total infrastructure investment in Brazil is expected to increase almost 54 percent to \$217 billion, compared with the 2006-2009



Arup

When finished in 2014, the 12.8-kilometer-long, \$2 billion Metro Line 4 railway in São Paulo is expected to carry 1 million people a day on fully automatic, driverless trains. The first section opened in June 2010.

period, according to BNDES. In particular, expenditures on ports, railroads, roads, and sanitation will experience the greatest growth rates (see Table 2). BNDES highlighted the following infrastructure projects and forecast investment amounts for the 2011-2014 period:

- Madeira River hydroelectric plant — \$13.4 billion
- Angra III hydroelectric plant — \$6 billion
- Belo Monte hydroelectric plant — \$14.9 billion
- Tapajos hydroelectric plant — \$14.3 billion
- Wind energy projects — \$4.6 billion
- TAV high-speed rail — \$19.02 billion

Infrastructure opportunities

The core infrastructure growth drivers are resulting in good opportunities for engineering firms and suppliers in several infrastructure segments, Autodesk's Pinto said, including logistics (airports, railroads, roads and highways, ports and shipyards); utilities and urban infrastructure, especially in World Cup/Olympics areas; and energy plants (wind, hydroelectric, oil and gas).

“For example, there will be nearly 2,000 new hydroelectric dams/plants created to support the growing energy demand in Brazil,” Pinto said. “One of the most prominent projects underway is Belo Monte — a large-scale

Table 2: Forecast infrastructure investment in Brazil*

Sector	Expenditures (Billion U.S. \$)		Growth	
	2006-2009	2011-2014	Period	Per year
Electric power	\$59	\$79	34.0%	6.0%
Telecoms	\$35	\$41	15.0%	2.8%
Sanitation	\$15	\$23	56.9%	9.4%
Railroads	\$11	\$34	202.1%	24.7%
Roads	\$17	\$29	71.4%	11.4%
Ports	\$3	\$10	225.1%	26.6%
Total infrastructure	\$141	\$217	53.8%	9.0%

* Source: BNDES

dam project expected to be the third largest hydropower plant in the world, just behind Three Gorges in China and Itaipu in Brazil.”

Recognizing the significant opportunities for U.S. firms and suppliers, in March 2011 the Export-Import Bank of the United States authorized \$1 billion in export credit for infrastructure projects for the state of Rio de Janeiro. Through the bank, the state will have access to \$1 billion in financing for buying goods and services from U.S. exporters.

Engineering firm Arup has been involved in highway and metrorail work in Brazil for several years, mainly as technical advisor to sponsors of public-private partnership projects, said David Palmer, principal with Arup. “Some of these projects are ongoing, e.g., Line 4 metro line in São Paulo where we serve as independent engineer,” he said. “Others, often confidential, have been completed after having advised potential investors on the risks and benefits of their respective investment opportunities. These have primarily involved metros, ports, and highways.

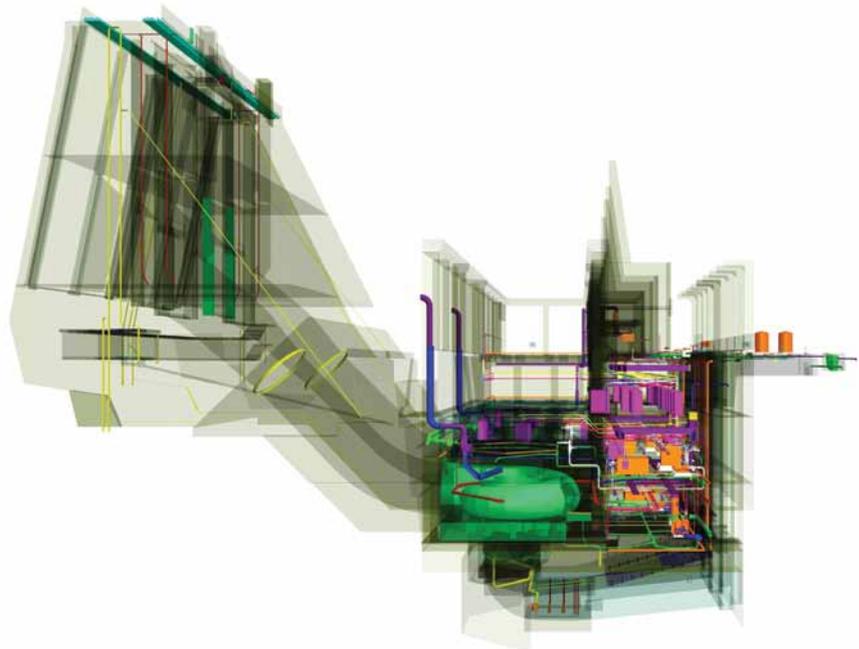
“Since Arup has been involved in most of the recent Olympics — for example transportation planning, infrastructure, and the aquatic center in Sydney; the iconic Bird’s Nest stadium, Water Cube, and other buildings for Beijing; and site development and facilities in London — as well as having a global reputation for stadium design generally, we are dealing with a wide range of opportunities,” Palmer said. “With respect to overall infrastructure development in Brazil, Arup is a full-service firm covering all fields of planning and design for construction, including ports and airports, highways and rail (incorporating bridges and tunnels), urban planning, water and wastewater, sustainability and environmental engineering — as well as, of course, buildings.”

Oracle Primavera has been a project management software provider for transformational Brazilian infrastructure work for many years, according to Garrett Harley, industry manager, Engineering & Construction, Oracle Primavera. “We see Brazil as enormous opportunity for both owners and contractors alike,” he said. “It’s hard not to get excited about being involved in either of these world-stage events. Oracle Primavera has been at the execution front at many of the preceding games and stages including the London games, as well as the Salt Lake City Winter Olympics. These are massive undertakings and project management discipline and systems are critical to pulling these events off.”

and construction of hydroelectric power stations, including the Estreito hydroelectric power plant. Engevix used similar software in design and construction of the \$180 million, 90-megawatt Coqueiros hydroelectric power plant in Goiás. Prosul used Bentley’s software to design the São Francisco do Sul BR 101 highway project, and Petrobras used it in development of a new fleet management system for the Campos Basin to optimize ship routes, monitor fleet activity, increase environmental awareness, and reduce costs.

Autodesk’s Pinto noted that its products also are being used across the entire infrastructure market. For example, Figueiredo Ferraz, a traditional civil

Located on the Claro River, Coqueiros is a 90-megawatt hydroelectric power plant that will generate energy for 650,000 people in the state of Goiás, Brazil. To design the \$180 million plant on an accelerated schedule, Engevix Engenharia deployed professionals in geographically distant units, some more than 700 miles away, and kept them connected using Bentley collaboration software.



Design and collaboration software also is proving critical to Brazilian firms. For example, according to Bentley’s Castrejón, Camargo Corrêa Company has used a project team collaboration and work-sharing platform in the design

engineering firm in Brazil, is responsible for the Imigrantes Highway (completed in the early 2000s) and the more recent urban infrastructure development. The firm currently is moving to a building information modeling process

to help increase its productivity and be able to deliver more projects with a smaller team, Pinto said. Additionally, Transpetro, a subsidiary of Petrobras, uses Autodesk software to manage its growing oil and gas transportation pipe network.

Tecnologia de Materiais Brasil LTDA, which distributes geosynthetic products and services for Tensar International, has been involved in the Brazilian market for more than four years. Although focused on the mining, transportation, energy, agriculture, and landfill markets, the company also is working with consultants for several projects involving the World Cup and Olympics, said Miguel Rivera, operations manager for Tecnologia de Materiais Brasil. “The most active markets [are]

roads, stadiums, airports, and general infrastructure,” he said.

Soccer stadium construction is helping fuel demand for pipe products for both field drainage and storm drainage system applications, said Tigre-ADS Brazil’s Nelson. Additionally, municipalities are undertaking both stormwater and sanitary sewer projects. The company recently received its largest order — 2 million pounds — for storm drain pipes in Maceio City in the state of Alagoas.

However, infrastructure design and construction aren’t the only opportunities for civil engineering firms and suppliers. Management of existing and new systems and facilities also is critical. “The World Cup and Olympic Games will have a tremendous impact on the

local infrastructure,” said Castrejón. “Most of the cities that will host World Cup games currently lack an updated and centralized cadastre. This makes the management of this infrastructure and all of its interactions extremely challenging.”

For example, although Brazil has some of the largest freshwater sources in the world, more than half of its municipalities — representing 70 percent of the water consumption in the country — are expected to face shortages by 2015, Castrejón said. “Recently, the Brazilian utility Companhia de Saneamento Básico do Estado de São Paulo decreased water losses in its 272-kilometer-long distribution system by 57 percent through use of Bentley’s water and wastewater solution.”

Operations and maintenance of the Metro Line 4 railway in São Paulo are being provided through a 30-year public-private partnership. According to Arup’s Palmer, the firm’s work on the line “is significant in that it enhances our already substantial Americas and global rail business, as well as being an essential expansion in a city in need of transportation improvements.” When finished in 2014, the 12.8-kilometer-long, \$2 billion transit line is expected to carry 1 million people a day. Commercial operations began in June 2010 on the first of three sub-phases. Trains are completely driverless and fully automatic, monitored from an operations control center.

Such projects reinforce Brazil’s appearance as a nation of extremes. Vast areas of the country remain undeveloped: The Associated Press reported that the Brazilian government confirmed in June the existence of an “uncontacted” tribe in a southwestern area of the Amazon rain forest. At the same time, urban centers are modernizing rapidly and infrastructure markets are booming as Brazil establishes a greater role on the world stage.

Large-diameter HDPE pipes manufactured in Brazil are being used for storm drainage and sanitary sewer lines.

Tigre-ADS Brazil

