

Brazil

Innovation, Research & Development

Wednesday October 23 2013

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Nation must embrace change to flourish

It is not enough to be a commodity exporter, the nation needs to do more to encourage creative entrepreneurialism, says *Joe Leahy*

The Technological Park of the Federal University of Rio de Janeiro could hardly be better located, given its purpose. Set on an island in Guanabara Bay, the giant natural harbour that forms the setting for Brazil's second-largest city, the centre has a prime vantage point looking out over the ocean and the country's huge oil discoveries that lie beneath. These deepwater fields, called pre-salt because they are buried under a layer of sodium chloride that is up to 2km thick, are helping drive a wave of innovation in the energy sector. The Rio technology park is playing its role by attracting names, ranging

from software group EMC to oil services companies Halliburton and Tenaris, to Rio to help exploit the discoveries.

"The park has been in place for 10 years," says Mauricio Guedes, executive director. "The speed of its development has been almost frightening."

As it is the world's sixth or seventh largest economy, depending on the exchange rate, Brazil is keen to ensure it does not fall behind on innovation, research and development in a world in which it is not enough to be a simple manufacturer or producer of commodities.

Success will depend on whether, by becoming more productive through



In deep: the oil industry, much of its production offshore, is driving a wave of research in energy

Alamy

innovation and the use of technology, the country can offset high costs, changing demographics and the danger of "Dutch disease" – which is caught when a country makes so much revenue from commodity exports that it deindustrialises.

The World Economic Forum classifies Brazil as in the final stage of transition towards a developed economy – the phase of evolving from an efficiency-driven growth model to an innovation-inspired one. "Approximately 74 per cent of the GDP growth over the past decade was due to the increase in the number of people working and only about 26 per cent was attributable to productivity

gains," says Boston Consulting Group. "This is very different from the productivity-driven growth of other rapidly developing economies. As the workforce expansion weakens, it will be critical for Brazil to increase productivity significantly to meet its aspiration of growing GDP by more than 4 per cent per year."

Brazil has made strides in innovation, research and development. The most visible example is Embraer, the third-largest commercial jet producer in the world by units sold. Embraer is innovative as much in terms of its business model as its aircraft designs. Rather than trying to go it alone, the company uses the global supply chain

to source components. To share the risk when developing products, it invites suppliers to participate as partners in projects.

Another institution known for its innovation is Embrapa, the agricultural research agency that brought soybeans from Asia and cattle from India to suit the harsh conditions of the Brazilian *cerrado*, or savannah.

Then there is Petrobras, the world's deepwater oil exploration and production expert. With most of its production offshore, Petrobras is pushing ever deeper into the ocean in search of reserves. In its Lula field, it is

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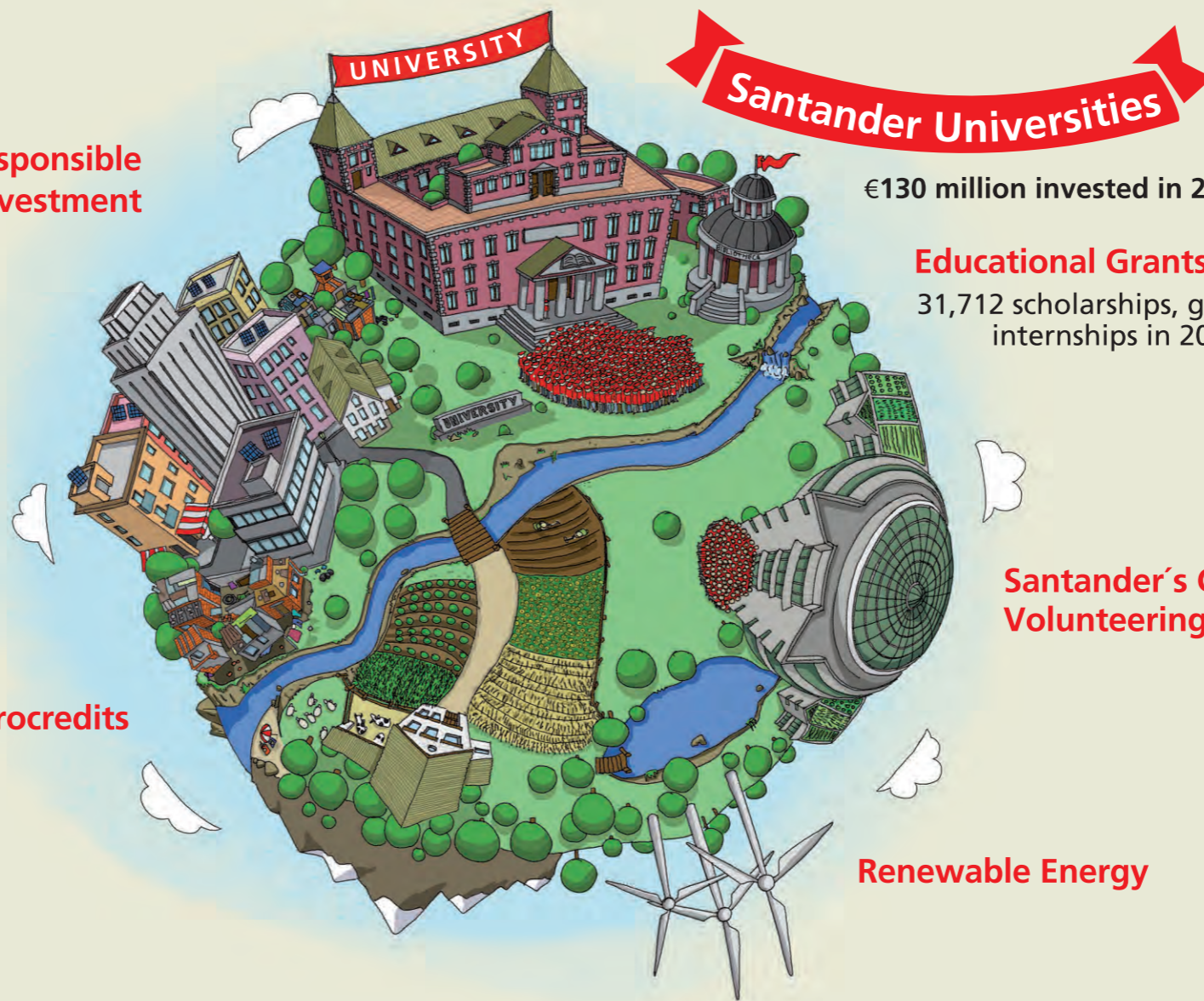
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Brazil Innovation

Pre-salt oilfield creates biggest challenge yet for Petrobras

Energy The sheer size of the reserves and the complexity of operations will put a strain on the state-run company, writes *Samantha Pearson*

When Brazil's first "pre-salt" discoveries were announced in 2007 and 2008, Luiz Inácio Lula da Silva, Brazil's then-president, could not believe his luck.

"We will have more oil to face up to this financial crisis," he told cheering crowds.

Buried deep in the seabed off the southeast coast, beneath a layer of salt up to 2km thick, the reserves have since been estimated to contain at least as much as the near-60bn barrels of oil found in the North Sea.

However, while the government rejoiced in its good fortune and started planning how to spend the country's new found wealth, researchers at the state-controlled oil company Petrobras had their minds on more pressing concerns: how actually to extract the oil.

While Brazil's pre-salt reserves rank as one of the biggest discoveries in the Americas for decades, they also represent some of the toughest challenges for the industry.

First, the sheer size of the reserves is set to put a huge strain on Petrobras, which has been tasked by the government with being the sole operator of all pre-salt fields. Measuring 800km in length and 200km in width, the pre-salt region extends along the coastline of five states. The reserves are also 340km from shore – the same distance that separates New York from Boston.

Second, the reserves are deeply buried; hidden beneath 2km of water, a layer of rocks and up to 2km of shifting salt.

And aside from the technical challenges, Petrobras is also under intense financial strain as it struggles to see through its \$237bn five-year investment plan, one of the world's

largest corporate spending programmes.

Furthermore, the company has also been used by the government to fund a de facto petrol and diesel subsidy over the past couple of years to help keep a lid on inflation. This policy has cost Petrobras tens of billions of dollars.

During the six years since the initial discoveries, the company's progress has been slow. Petrobras is still importing thousands of barrels of petrol and diesel a day and production has largely been stagnant or in decline since the start of 2012.

Nevertheless, says José de Sá, a Rio de Janeiro-based partner with Bain & Company, the management consultants, Brazil's oil and gas industry has still made important progress developing the technologies it will need to meet the technical challenges of developing the pre-salt.

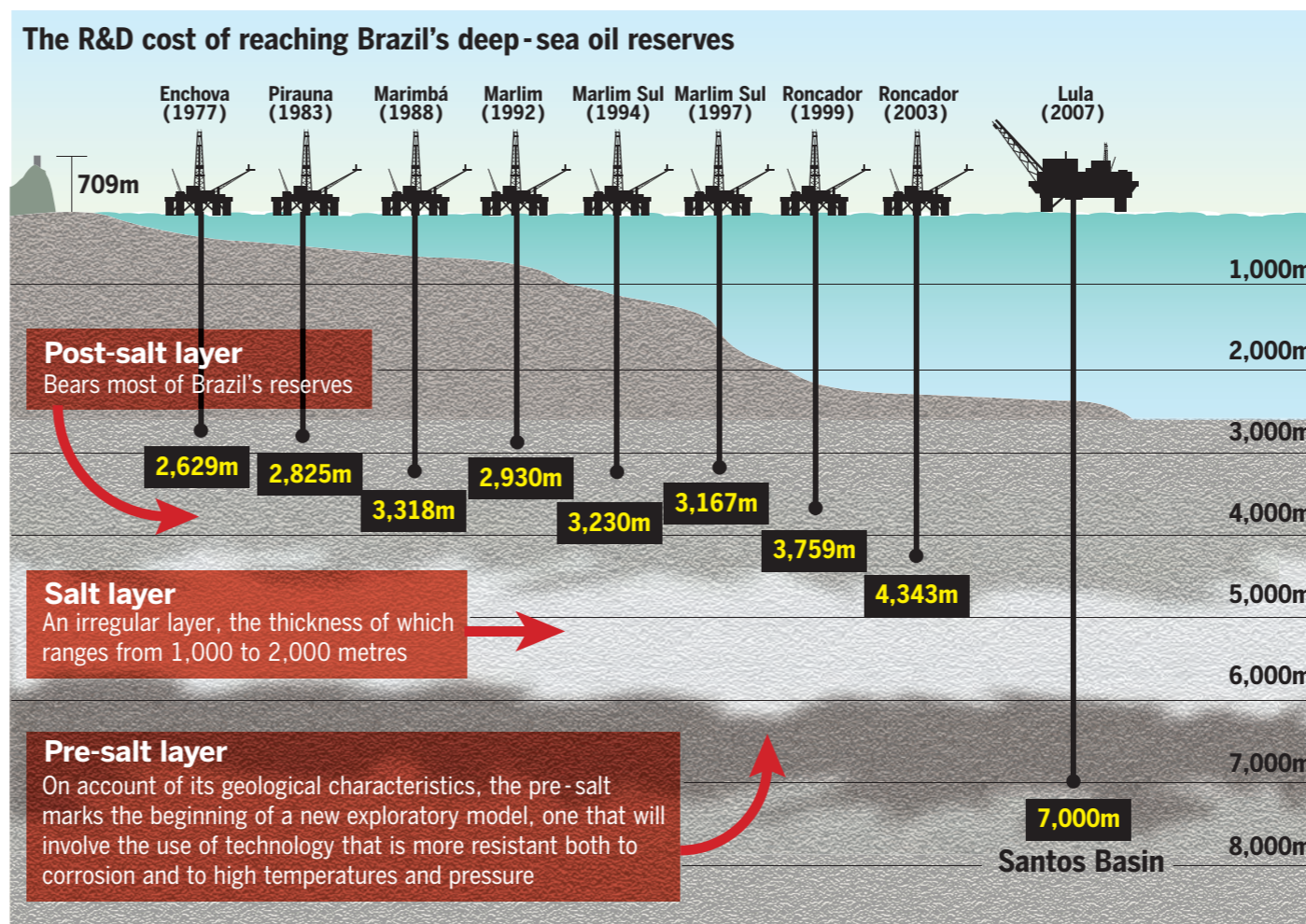
"Brazil has been effectively tackling the pre-salt challenges, most of the time with joint developments between oil companies and key suppliers," says Mr de Sá.

He adds that government policies, especially one that cedes 1 per cent of revenue from large fields, as well as part of the royalties, to CT-Petro, a fund focused on innovation development, favour R&D investments in the sector.

CT-Petro was created in 1999 to help fund research activities across the whole supply chain in Brazil's oil and gas industry.

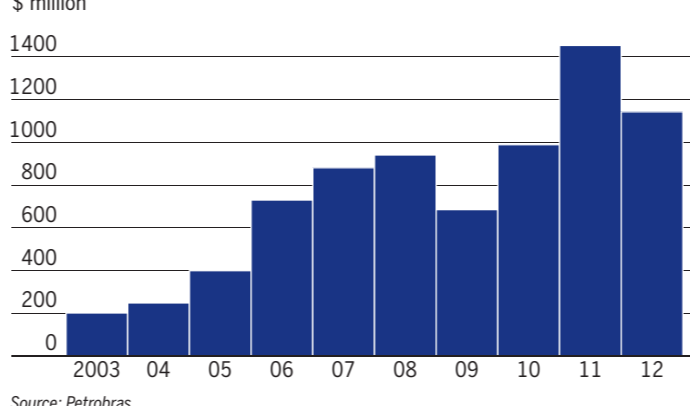
Petrobras, which holds a near-monopoly over the industry in Brazil, has also pursued its own research partnerships, investing \$1.14bn in R&D last year.

While that represents a slight decline from the \$1.45bn it spent in 2011, it still puts Petrobras ahead of



R&D expenditures at Petrobras

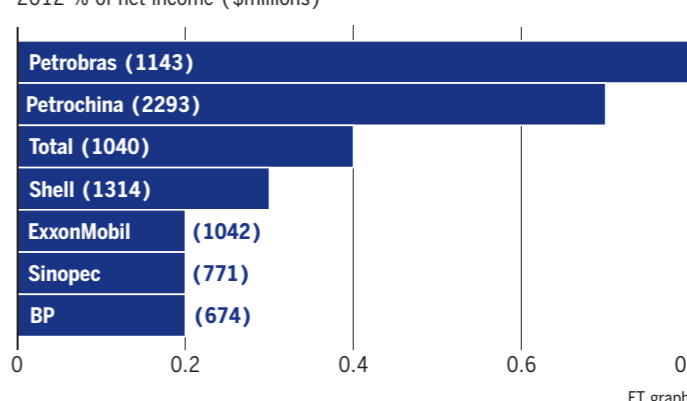
\$ million



Source: Petrobras

R&D expenditures

2012 % of net income (\$millions)



FT graphic

other oil companies such as Sinopec, BP, Total and Exxon in terms of the money spent on R&D as a percentage of net income.

Most of the company's research activities are centred around Cenpes, and its 300,000 sq metre facility at Rio de Janeiro's Federal University, which has 227 laboratories and employs about 1,900 people.

Some of Petrobras's biggest projects last year included the creation of two synthetic fluids in partnership with the US oil services company Baker Hughes.

These will facilitate drilling in pre-salt fields. By minimising salt solubility, the formulas help Petrobras to drill through salt layers without the walls of the wells breaking.

At the beginning of the year, the company also pioneered a way to drill a well at an 85 degree angle. The technique should allow the company to achieve the same level of output from fewer production wells, thereby allowing it to cut costs.

However, the crucial test for Petrobras's technologies and the industry's developing oil services companies will be their ability to compete outside Brazil.

After the pre-salt discoveries were announced, the government introduced tough national content regulations to help build a domestic supply chain. Just as Norway did, it hopes to use the discoveries to become a global oil power.

In spite of the vast opportunities in

the domestic market, some companies such as EEP, a newly formed ship-builder working for Petrobras in Rio de Janeiro, are already looking to expand to foreign markets, mainly in Africa.

However, the global success of such companies also depends on the government's readiness to incentivise exports and improve the business environment at home, where high taxes and bureaucracy can make it hard for companies to be competitive.

"[It] depends on how much Brazil starts to focus on exports as an important part of the supply chain development," says Mr de Sá.

"There is nothing that would naturally hinder these exports other than the famous 'Brazil cost'."

Nation must embrace change

Continued from Page 1

drilling 7km below the surface of the Atlantic. At its Cenpes research centre near Rio's Technological Park, it has 227 laboratories researching everything, from the seismic technology to the materials required to resist the corrosive chemicals and high temperatures of the oil deposits.

Even Brazil's automotive sector is known for some important innovations. Not only has it adapted to use the "Flex" engine – capable of running on ethanol or petrol – but several companies have developed indigenous models. Chevrolet built the Meriva minivan in São Paulo and Volkswagen created the Fox small car especially for Brazil.

"Brazilian innovations in the aircraft, energy and automobile industries have been internationally recognised," wrote Rasmus Lema, Ruy Quadros and Hubert Schmitz in a report for the Institute of Development Studies.

The country's online sector is growing, as smartphone use takes off and Facebook users multiply. The number of venture capital investments is rising. Based on data from Startup Dealbook Brazil, tech start-ups increased from 45 in 2011 to 79 last year.

"Today we have 25 large technology hubs," says Flaviano Faleiro, managing director for strategy and innovation at Accenture in Brazil.

He notes that Brazil's spending on research and

Standing in the way are challenges, including poor education and tangled red tape

Embraer holds its own against global manufacturers

Aerospace

Industry has set a course for the future, says *Thalita Carrico*

When Pope Francis flew to Brazil's holiest Catholic site in July, the Marian shrine of Aparecida in the state of São Paulo, the imagery could hardly have been better for Embraer.

To the right of the pontiff as he disembarked was the emblem of the Brazilian aircraft builder, the world's third-largest manufacturer of commercial aircraft; to his left, the nation's flag.

It was a fitting recognition of Embraer's contribution to Brazilian aviation and its journey towards greater innovation.

Brazil is one of the few nations in the world with

an aircraft manufacturer and Embraer has proved it can hold its own in the most competitive markets, including the US.

Luiz Carlos Aguiar, president of Embraer Defence and Security, says: "Without innovation, there's no way a company will grow and remain competitive in the global market, so this is in our DNA."

After the second world war, Brazil's aircraft industry, never globally significant, shrivelled to almost nothing. It was revived by the military dictatorship, which ruled from 1964 to 1985. In 1969, the generals created state-owned Embraer. The company ran into difficulties in the economic turmoil of the 1980s and was privatised in 1994.

Embraer developed a business model whereby its engineers design the aircraft body, wings and tail

but use the global supply chain for components. This allows them to exploit the best technologies at competitive prices. Hence, a typical Embraer aircraft might have engines from Pratt & Whitney, navigation aids from Northrop Grumman – both US companies – or an aerial refuelling system from Cobham, of the UK.

Embraer took on the seemingly impenetrable business jet market in 2000. Eleven years later, the company was celebrating the delivery of its 300th Phenom 100, an executive jet.

Embraer Defence and Security opened its doors in 2010. This year, it completed a landmark deal for 20 of its Super Tucano light fighter aircraft with the US Air Force. The deal, which

faced fierce resistance from US producers, was the first time Embraer had sold attack aircraft to the country with the world's largest military capability.

While the Super Tucano, a trainer modified for attack duties against guerrilla forces or drug traffickers, was a breakthrough, Embraer's latest project will be a bigger test of its innovation skills.

The company is building the KC-390, the heaviest aircraft yet made by the Brazilian group, has electronic flight controls, in-flight refuelling capability and a sophisticated maintenance alert system. It will be able to carry 20 tonnes of cargo at 870 kilometres an hour.

As part of its defence

expansion, Embraer has also been buying small companies, including Orbisat, which makes "synthetic architecture radar", which surveys the land at treetop and ground level.

This function looks through trees and vegetation and creates an image of the ground beneath, a useful tool in a country that is home to 60 per cent of the Amazon jungle.

Away from Embraer, Brazil's air force is developing software for the prototype of an unmanned aerial vehicle (UAV) that is named after the Acauá, a type of eagle, that will take off and land without human assistance.

It is also working on computer algorithms that will allow the Acauá to fly in the same airspace as other UAVs without a collision.

"What we have been developing is very difficult

to find in the international market," says Fabio Almeida, who is chief researcher at Brazil's Institute of Aeronautics and Space.

"We already have 67 flights well executed. "We're thinking 20 years ahead, but this is what innovation is about," Mr Almeida adds.

Away from defence, the country is switching to a performance-based navigation system that relies on satellites rather than ground-based radar.

The benefits of revamped air traffic control are likely to include shorter trips, lower fuel use, less noise around airports and a reduction of harmful gas emissions.

Pedro Scorga, director of operations at Gol, Brazil's second-largest airline, says that, for a country with infrastructure limitations, "this is a big step".

Genetic modification means beans can stay on the menu

Agriculture

Science has helped to boost production, writes *Amy Stillman*

If there is one food Brazilians cannot live without it is the humble bean, which is perhaps why Embrapa, the national agriculture research agency, has spent R\$3.5bn (\$1.6bn) over a decade to develop a bean genetically engineered to resist the golden mosaic virus, one of the most damaging diseases to the crop in South America.

Spread by whitefly, the virus damages the plants' tissue, prevents them from flowering and distorts their colour. In Brazil, it is responsible for the loss of up to 280,000 tonnes of beans a year, equivalent to 8 per cent of average annual production.

"The golden mosaic virus is a terrible pest," says Mauricio Lopes, president of Embrapa. So the organisation developed a bean that is resistant to the virus using a biotechnology called RNA interference. The modified bean produces fragments of ribonucleic acid molecules that prevent the synthesis of a protein the virus needs to replicate. Mr Lopes says the new bean will be on the market – and people's plates – by 2015.

While GM foods may be unpalatable in some markets, such as Europe where they are more strictly regulated, they are gaining ground in Brazil.

Since regulatory approval in 2003, GM soya has grown to represent about 85 per cent of Brazil's crop. The nation is the second biggest soya exporter after the US.

The country is of rising importance as a biotechnology destination, and Mon-

santo's latest pest-resistant soyabean – the first specifically for South American growers – goes on sale in Brazil this year.

"If the technology performs well, Brazilian farmers will buy it, because we've had many problems with pests," says Daniel Glat, a farmer in the northern state of Tocantins and former director at US hybrid seed company DuPont Pioneer.

A further five GM organism traits – the desirable elements in crops that cannot be created by selective breeding – have been approved in Brazil this year, says Aprosoja, the soyabean co-operative.

Mr Lopes says: "Brazil is a big agricultural nation and we cannot just say no to technology and innovation. In a tropical country like ours, there are more pests, more diseases and, on top of that, we have climate change and must increase

our agricultural output. There is no way to have agriculture in Brazil without science."

Such thinking has guided Embrapa since it was founded in 1973, when food and energy shortages led the government to invest in agricultural research to improve food security.

The agency first brought soyabeans from the temperate regions of Asia, Zebu cattle from India and grasses from around the world, crossbreeding genes to suit the tropics.

More recently, Embrapa has been working to develop traits through conventional breeding and genetic modification so species, including vulnerable crops such as coffee, can resist higher temperatures.

"We think some crops in Brazil may be displaced in the near future, depending on changes in temperature, so we have 400 researchers working on how to adapt

agriculture to climate change," says Mr Lopes.

As a result, Embrapa's budget has more than doubled in a decade, to R\$2.28bn, and congress is debating legislation to allow it to open a private arm.

Fernando Martins, of consultancy Bain & Company, says technology developed for extreme weather conditions in Brazil's northern agricultural frontier could be used elsewhere, including Africa.

He says: "As we solve the challenges of finding varieties that can grow in more difficult areas of Brazil, we'll also solve the issue of a hotter and dryer climate."

Brazilian farmers also use global positioning systems that monitor crops and measure fertiliser and pesticide use. "Brazilian agriculture is probably the most technical in the world because of the challenges here," says Mr Glat.

"There is no need to cut down forests to reach a new level of productivity"

The next hurdle, however, could be the biggest. With the threat of climate change and the dangers of deforestation in the Amazon, Brazilian farmers are under increasing pressure to plant sustainably.

A law that came into effect this year forces Amazonian farmers to preserve up to 80 per cent of their land; in the Cerrado, the savannah in the centre west region, that is 35 per cent.

Embrapa is investigating how to get more from existing farmland by integrating crop rotation with planting trees and raising livestock, so increasing productivity by allowing soils to recuperate and reducing the acreage needed to farm.

"There is a big revolution in the making in Brazil, which we call sustainable intensification," says Mr Lopes. "There is no need to cut down forests for us to reach a new level of productivity."

Brazil Innovation

Entrepreneurs seize chances in social media marketplace

Internet With slightly more than half the population online, opportunities abound, now and in the future, writes *Samantha Pearson*

At first, most people assumed it was a joke. "Good morning you marvellous beauty, I've always followed you. But don't give me 'good morning' – give me good results," read a tweet from the official Twitter account of Brazil's president, Dilma Rousseff.

It was directed at Dilma Bolada, a satirical fake Twitter account of the president set up by the comedian Jeferson Monteiro that has more than 150,000 followers.

But, as incredulous fans began to speculate over whether the official presidential account had been hacked, the conversation continued.

"Many people think that I'm not me. Does that bother you?" the fake president tweeted at the end of September – to which Ms Rousseff immediately tweeted back: "It doesn't bother me – it makes me laugh a lot. Life without humour is very gloomy."

The exchange, it turned out, was

genuine – and was a way for Ms Rousseff to announce the relaunch of the Twitter account she had used during the 2010 elections. She also tweeted that she had opened an Instagram account and promised to open a Facebook profile soon.

For the social media world, it was a recognition – albeit a belated one – of the huge importance of tools such as Twitter and Facebook in the country. Over the past few years, everyone from grandmothers to drug dealers has looked to make their mark online, giving the Latin American nation the world's second-biggest Facebook community after the US.

Data from Facebook last year showed that four out of five internet users in Brazil were signed up to the social networking site, and spent eight hours a month using it.

As a result, Brazil has become a hotbed for some of the world's most innovative social media businesses, which are seeking to interact with –

and make money from – the country's growing online community.

For Alexandre Hohagen, Latin America vice-president at Facebook, Brazil's obsession with connectivity is explained by the national psyche. "It's a very social culture, so people really like to share, to be exposed, and to make friends," he says.

When Facebook first became popular in Brazil, many internet users were already familiar with Orkut, Google's social networking site.

The fast-growing market for smartphones in the country has also helped make social networking sites available to a larger section of the population, says Mr Hohagen. For the more than 12m people who live in the country's *favelas*, or slums, smartphones are the only affordable way to access the internet.

A population of about 200m boasts almost 270m active mobile phones, a number that is likely to rise to 350m by 2018, says a report released in June

by Ericsson. Smartphones accounted for about half total mobile sales in the first quarter of 2013, compared with about 40 per cent during the whole of 2012, according to the report. As a result, data traffic is expected to rise 12-fold over the next five years.

Recent mass protests across the country against problems such as corruption, which attracted more than 1m people in one day at their peak in June, also served as testament to the country's ultra-connectedness. The demonstrations were almost exclusively organised over Facebook and Twitter, and the social networks also became an invaluable tool for information about the protests as they

'It's a very social culture, so people like to share, to be exposed, to make friends'

were happening. But the country's online community has not only helped bring about social change, it has also created a fertile ground for innovative businesses.

A São Paulo-based advertising network for social media, boo-box, was recently ranked the second-most innovative company in Brazil and placed in 45th position worldwide by Fast Company, a business media specialist.

Marco Gomes founded boo-box in 2007 at the age of 20. In the same year the company received \$300m from the Brazilian venture capital fund Monashees Capital and in 2010 Intel Capital also invested in the company.

After linking with the Argentine software firm Popego in 2011, boo-box is now one of the biggest advertising platforms in Latin America, connecting content publishers on websites, blogs and social networks to advertisers looking for targeted marketing. Its network reaches about 60m Brazilians a month via 1bn advertisements.

LikeStore, created in 2011 to allow Facebook users to create online stores on the social network, offers more than 300,000 products or services now.

Foreign entrepreneurs have been drawn to this booming market. Niklas Zennström, co-founder of Skype, invested in Wrapp, a gift-giving company, shortly after it was founded in Sweden and brought it to the Latin American country last year. The company is based around a smartphone app that lets users send free and paid gift cards from participating retailers to their Facebook friends.

For social media companies, the most exciting aspect of the Brazilian market, however, is the millions of people not yet on the internet. According to Brazil's Ibope polling institute, about 105m people now have access to the worldwide web, leaving 95m yet to make the leap.

"This is just the beginning; the opportunity is still massive," says Facebook's Mr Hohagen.



High-tech rally: smartphones have brought social media to the masses, with protests against corruption earlier this year organised over Facebook and Twitter Reuters

Science park Historic city puts incentives in place for business

Cutting out into the Atlantic Ocean, Recife, on Brazil's northeastern tip, has had something of a rollercoaster ride through history.

In the 17th century, the city flourished as the capital of a Dutch colony and the centre of the region's lucrative sugar trade.

Known as the Brazilian Venice because of its islands and peninsulas, the capital of the state of Pernambuco quickly became one of the world's richest and most powerful cities.

When global sugar prices dropped following the Caribbean sugar boom, the city fell into decline along with other parts of the northeast coast.

Development indicators in some parts of the region are still comparable to those of African countries. However, in 2000 Recife's luck changed. In an effort to rejuvenate the area, the government worked with the private sector and the Federal University of Pernambuco (UFPE) to create an information and communications technology park in the city's historic centre.

The park, called Porto Digital, or "Digital Port", has attracted a cluster of more than 200 companies, including multinationals such as IBM and Microsoft, with collective annual revenue of more than R\$1bn (\$460m). As a result, Brazil's Venice has increasingly become known as its Silicon Valley.

As a way to lure technology companies away from the more developed cities in the south, the government offers a series of fiscal incentives to participating companies, a big attraction in a country with one of the world's most onerous tax systems.

One of the biggest incentives is a discount of up



to 60 per cent on the so-called ISS services tax paid to the municipal government.

The local government has also created public employment agencies to make it easier for companies to hire the highly trained staff they need without the hassle of dealing with the country's bureaucratic employment laws.

Bruno Caraciolo, at the Angelini, Caraciolo, De Faro & Gregorio law firm in São Paulo, says: "The incentives for these [companies] are not just tax reductions; the sector benefits from a lot of labour incentives, significantly reducing the bureaucracy and costs of 'high-level' employment, which drive away foreign investors from Brazil."

The park's link to UFPE, which boasts one of the country's top research facilities, has provided a ready supply of trained workers for Porto Digital. For UFPE, the presence of Porto

Showcase: Recife's technology park stands on one of the city's many islands

Porto Digital has lured more than 200 companies, including IBM and Microsoft

Digital means that many of their students do not have to move cities to get a good job after they graduate.

As a testament to the growth of the park's cluster of companies, Recife this month hosted the latest International Association of Science Park's world conference. For the city, it was a chance to showcase Porto Digital in an effort to attract much needed foreign investment – necessary for Recife to become a key exporter again, but this time of technology not sugar.

Despite the enthusiasm for Porto Digital, Mr Caraciolo says the park still needs the wider support of business: "The cluster still has a deep lack of private investors, who could bring the scale needed for some projects, as well as commercial contacts and knowhow for international distribution of products and services," says Mr Caraciolo.

Samantha Pearson



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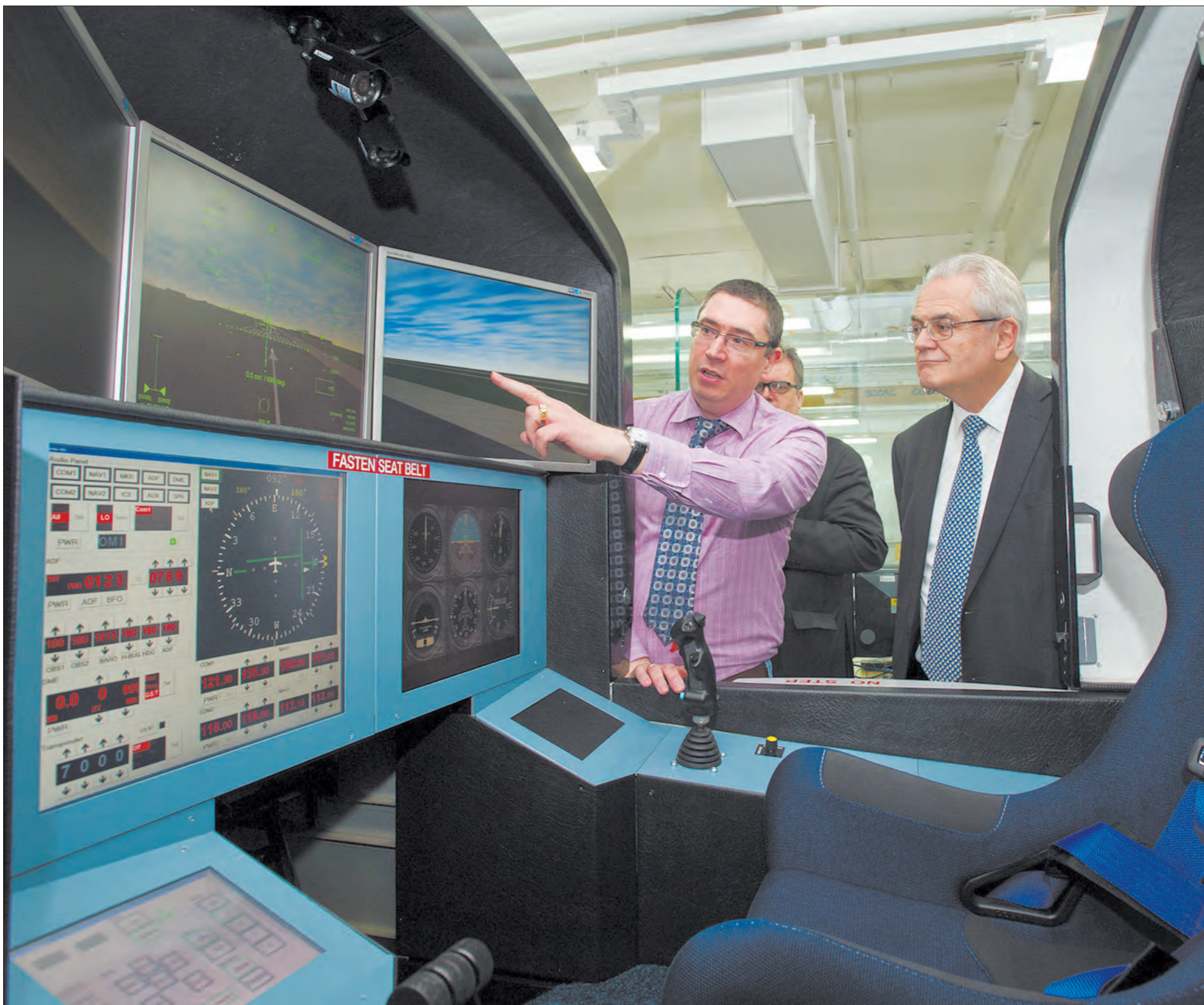
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Brazil Innovation



Fly-tech: Roberto Jaguaribe, Brazil's ambassador to the UK, right, is shown a flight simulator during a visit to Sheffield Hallam University in 2012, before students arrive

Market-facing R&D required to spur creativity

Opinion

MARCOS TROYJO

Brazilians take pride in what their creativity has accomplished in the arts, architecture and football – think of bossa nova, Oscar Niemeyer and Neymar.

But that same creativity has also been successfully applied to products such as Havaianas flip-flops; Osklen “eco” clothing; Embraer, the world’s third-biggest producer of commercial jets; and Natura’s environment-friendly cosmetics.

Brazilians are also proud of their business drive – the 2010 Global Entrepreneurship Monitor report lauded Brazil as the most entrepreneurial of the G20 countries. So, if creativity and entrepreneurship are abundant, why does the country fare so poorly when it comes to setting up tech-intensive, innovative companies? Why do we not see more start-ups, vying to become Googles, Teslas or Twitters?

Well, “creativity is not enough”. As Theodore Levitt, Harvard’s legendary marketing guru, wrote: “creativity is thinking up new things; innovation is doing new things”.

Most of Brazil’s innovations have not renewed business sectors, reignited business cycles or made early adopters rich. They have mostly focused on creative adaptation, not creative destruction.

This approach has been central to the industrial policy of the past 10 years, replacing imports with domestic production.

Innovation usually springs from the interplay of capital, knowledge, entrepreneurial spirit and a congenial environment. Is it possible to create such a climate when Brazil only invests 1 per cent of GDP in research and development, against an OECD average of 2.3 per cent? Also, three-quarters of its spending is given to state-run institutions and research centres, or concentrated on R&D in state-controlled commodities groups, such as Petrobras and Vale.

Some, such as Embrapa, the agricultural R&D institute, do play a key role in driving up competitiveness. Yet the bulk of the country’s R&D is devoted to pure science. Regular interaction with businesses is not part of the ethos. The same can be said of most public-sector universities. Some highly praised academic institutions, including the University of São Paulo, face opposition to closer ties with companies from many faculty members and students.

President Dilma Rousseff’s government has hoped to boost innovation by means of Science without Borders, which offers 101,000 scholarships to Brazilian graduates and undergraduates to study abroad. Welcome as this is, the programme barely touches on market-orientated R&D, which requires a friendlier

approach to business.

As a result, the country turns out research in scientific journals, but not innovative product-focused work. For example, when it comes to applying for patents at the World Intellectual Property Organisation, the numbers are embarrassing. In 2012, the US filed for nearly 50,000 new patents; China, 17,000; South Korea, 11,000; Brazil filed just over 600.

This, coupled with China’s appetite for agricultural and mineral commodities, helps explain the deindustrialisation of Brazil’s export market. In 2012, its agricultural and mineral exports exceeded industrial goods. This had not happened since 1978.

Along with Brazil’s drive to produce local content, BNDES, its cash-rich state development bank, pursued a policy of fostering national champions in areas such as petrochemicals, food-processing and telecommunications – as well as sometimes strengthening large conglomerates in non-tradable sectors, such as construction and retail.

Last April, BNDES announced this policy had “run its course” and the bank would focus on “innovation-based” sectors such as health and pharmaceuticals.

The role of the private sector is crucial if Brazil is

The bulk of the country’s research is devoted to pure science

to change course. So why do domestic businesses invest so little in innovation?

Standing in the way of business-led innovation are the same obstacles that block the road to prosperity: the gulf between universities and businesses; industrial policies that shun foreign competition; uncompetitive labour legislation that collects 58 per cent of R&D wages in payroll taxes; a tax burden, at 36 per cent of GDP, that is wearing out innovative companies; and marketplace complexities that force businesses to hire excess legal and accounting expertise, instead of engineers and scientists.

It seems the country’s poor innovation capabilities have less to do with its deficiencies in science or entrepreneurial capacity and more to do with the microeconomic and institutional straitjackets that help to rank Brazil 56th in the latest Global Competitiveness Report.

Without long overdue economic reforms, it will be hard for the country to generate the productivity and prosperity it needs from its R&D sector.

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President puts faith in foreign studies

Training Nation invests billions to give workers the knowledge to compete, writes *John Paul Rathbone*

Football star Ronaldo moved to London this year. The famed Brazilian striker was not looking to develop his sporting skills; the “phenomenon” retired from the pitch in 2011 to launch a sports marketing business.

Instead, the 37-year-old native of Rio de Janeiro came to Britain to start a job placement with WPP, the global advertising agency, under the stewardship of advertising supremo Sir Martin Sorrell, the company’s chief executive.

“I won’t leave him alone,” said Ronaldo of his mentor. “I will be asking him questions all day... just like a striker.”

Despite his singular fame and fortune, Ronaldo is one of tens of thousands of Brazilians moving abroad to expand their horizons and learn new skills.

This diaspora is being driven by its home country’s rising demand for highly skilled workers and a school system that fails to produce an adequate supply.

Despite having some top-notch universities, Brazil regularly has scores near the bottom of the OECD’s Programme for International Student Assessment rankings of educational attainment, with about 30 per cent of 15-year-old students generally considered below proficiency.

Language is another barrier to greater knowledge transfer. “Brazil is quite a closed country, both in terms of trade and language,” says Celso Lafer, head of Fapsep, the São Paulo Research Foundation.

“Portuguese, for example, may be

a universal language, but it is not an international one,” he says, paraphrasing Fernando Pessoa, the celebrated Portuguese poet.

Fapsep has been sending graduate students to study abroad since the late 1990s and Mr Lafer, a former foreign minister, also invites foreign academics to teach in Brazil as part of Fapsep’s internationalisation drive.

Yet Fapsep is not the largest force in Brazil’s attempts to expand the frontiers of its educational system, despite its R\$1bn (\$454m) annual research budget, equivalent to 1 per cent of the state of São Paulo’s economy.

The biggest spender is Science Without Borders, a pet project of Dilma Rousseff, Brazil’s president. SWB, set up in 2011, is a strategic attempt to boost the country’s economic growth rates.

With a R\$3bn budget, SWB aims to send 101,000 Brazilians abroad by 2015 to study at some of the world’s best universities, especially in the US and the UK, where there is the bonus that classes are taught in English.

Chosen students – some PhDs but mostly undergraduates – will study in areas deemed essential to Brazil’s future, especially biotechnology, petroleum engineering, and ocean science. The idea is that developing these areas will help the country, already the world’s third-largest food producer, to build on its natural resource wealth.

“Take Israeli oranges and Brazilian soya. Both grow in places where nature did not intend them. Both are the result of bold research and

development decisions,” said Orit Gadish, chairman of Bain & Co, a management consultancy, during a World Economic Forum talk in Rio de Janeiro in 2010.

“But,” she said, “Israel has moved on. Oranges no longer contribute much to economic output – although the irrigation systems and high-tech businesses that grew out of them do. Brazil’s challenge is to further exploit its own agro-industrial intellectual property in a similar way.”

To do that would require abundant skilled labour. Hence SWB, just one of the ways in which Brazil is seeking to augment its well known shortage of “knowledge workers”.

University graduates can earn four times more than high-school graduates, a ratio higher than in any OECD country and, although Brazil produces 30,000 engineering graduates a year, Mexico has three times as many, despite having a population half the size.

The number of Brazilians studying at US campuses is also only a few per cent of the combined Chinese and Indian numbers.

For universities in the US and Europe, SWB represents a huge potential windfall, and many have leapt at the opportunity to recruit Brazilian students paying top-end fees.

Yet, sadly, the scholarship scheme has been riddled with problems from the start.

The plan to send 101,000 students abroad is so ambitious that lower-quality students are being chosen to pad out the numbers, critics say. According to official statistics, 37,000

fellowships had been processed by August 2013, with 64,000 still to go.

“There is a gap between the intention and the action,” commented one university admissions officer. “The bottom quintiles are sometimes not good enough.”

Then there is the usual Brazilian bureaucracy. In one case, a group of SWB students at the University of East London had to borrow money from the institution after Brazil failed to send them their grants.

Furthermore, when they complained about the delay to SWB administrators, they were asked if they wanted to return home. That response was pilloried in the Brazilian press as “Arrogance without Borders”.

Problems are perhaps to be expected with such a big scheme. Doubly so in the case of Brazil, where state bureaucracies tend to respond slowly. Yet it is also true that no other Latin American country has a scheme that comes close to rivaling it.

“Dilma Rousseff deserves credit for the priority she has given it,” says Mr Lafer. “Even if the screening is less rigorous than it should be, the end result will be positive: more Brazilians will have studied abroad.”

To sceptics, it may sound as though taxpayers are simply funding a number of expensive “gap years”, but Brazil has been here before. Forty years ago, the government funded students to acquire PhDs abroad in agricultural science, aircraft design and energy exploration. Today, the country is at the forefront of all three fields.

Brazil often has scores near the bottom of the OECD’s rankings

Vaccine producers flourish in field dominated by multinationals

Immunology

Researchers make big breakthroughs despite budget limits, says *Thalita Carrico*

Life-saving injections were once such an alien concept in Brazil that a campaign against smallpox in Rio de Janeiro in 1904 provoked riots that left scores dead.

The common people felt vaccinations, which in many cases were forcibly given, were invasive, and they added to popular anger over other social ills, leading to the unrest today known as the vaccine revolt.

But the vaccinations eradicated smallpox in Rio and the visionary doctor behind

the campaign gave his name to one of the country’s leading institutions, the Oswaldo Cruz Foundation. The joint work of the foundation and the Butantan Institute represents 90 per cent of Brazil’s vaccine production.

“Brazil is considered one of the biggest producers of vaccines,” says Luis Carlos de Souza, a researcher at the University of São Paulo.

In a market dominated by multinationals, Brazilian vaccine makers appear to be flourishing. This is in spite of the country’s low funding for research and the control of prices by the Ministry of Health, which buys and distributes most of the vaccines.

A team of scientists at the Heart Institute of the University of São Paulo, which has developed and

patented a vaccine that might be able to prevent Aids, is one example of the country’s ability to innovate in this area.

The project has so far taken 12 years of studies and had a budget of only R\$1m (\$460,000). This month testing of the vaccine on monkeys is due to start.

“It is a vaccine fully developed in Brazil,” says Edecio Cunha-Neto, who worked with Jorge Kalil and Simone Fonseca on the project to develop it.

The scientists approached the subject from a different angle from those already tried. They analysed a group of HIV-positive people who were exceptionally resistant to the virus. It was found these people had high levels of a certain type of a white blood cell, CD4, capable of recognising specific

parts of HIV proteins. To test if the CD4 cell was responsible for this resistance, the team identified protein regions common to almost every strain of HIV.

Using computer programmes, they selected the peptides, or parts of the proteins, that had the greatest chance of being recognised by the CD4 cells.

These recognised at least one of the peptides in more than 90 per cent of the study group, and in 40 per cent of the patients the CD4 cells recognised more than five peptides.

The surprising part was that this cell type had been overlooked by previous researchers. “They were the ugly duckling; no one had given them any attention in the HIV vaccine research field,” explains Dr Cunha-Neto.

Currently the vaccine, HIVBr18, will not eliminate the virus from the human body. But it could keep the viral load down to the point where the infected person would not develop immunodeficiency or transmit the virus.

Another project has led to a potential vaccine against dengue fever by the Butantan Institute. The mosquito-borne disease infects high numbers of people every year. The Butantan vaccine may offer hope and is the

Only 40 per cent of the population were vaccinated in 1978. Today, the average is 95 per cent

first to try to cover all four types of the virus.

“This will be only the second [dengue vaccine] to reach clinical testing,” says Paulo Lee Ho, director of technology development at the institute.

Volunteers have been recruited to start human trials this month.

In addition to trying to prevent other diseases spread by mosquitoes, Brazilian researchers are also using biotechnology in an effort to reduce the number of disease-transmitting insects.

The University of São Paulo, with UK company Oxitec, is using a farm in Bahia state to produce genetically modified mosquitoes. They have released more than 17m transgenic male mosquitoes into the wild to mate with females.

These transmit a gene that causes the offspring to die in the larval stage. The scientists claim there is no risk of side-effects to the environment, animals or humans.

The country has also been innovative in its approach to distribution. The government has signed 88 technology transfer agreements with foreign and domestic private companies for vaccines and medicines that have allowed them to be made more cheaply in Brazil.

Alexandre Padilha, the health minister, says: “We keep investing in research; in addition to that, we gain time and knowledge with the transfer agreements.” Eradicating disease in a country of this size is a big challenge, and the efficiency of Brazil’s National

Immunisation Programme is internationally recognised. In 1978, five years after the programme began, only 40 per cent of the population were vaccinated. Today, the average is 95 per cent.

The state offers more than 25 types of vaccine, distributed with military precision.

“On a national vaccination day, we use more than 40,000 cars, boats and aeroplanes. We go to the remotest areas,” says the health ministry.

In 1990, for example, the number of measles cases reached 45,000; two years later, when the vaccination campaign started, the cases dropped to 3,000. In 1995, there were no reported outbreaks. And, despite the scale of these operations, there have been no revolts.