Open Source in Brazil

Growing Despite Barriers

Andy Oram

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Open Source in Brazil: Growing Despite Barriers

Foi pesado o sono pra quem não sonhou

Brazil, which not so long ago formed one of the bright spots in the world economy (remember the promise of the BRICS quintet?: Brazil, Russia, India, China, and South Africa), has been battered in recent years by its geographic location, history, and political leadership. When you add up the despair of seeing one set of politicians accused of corruption fighting another set of politicians who are, in turn, accused of corruption; the fall of commodity prices; the implosion of the Petrobras oil giant; the pressures of hosting the Olympics (and the frequent protests it caused); the threat of the Zika virus; the failures of public health; and the threat of general crime met by harsh police incursions—one can well wonder how Brazil gets along at all.

Yet, Brazil remains the most important Latin American economy, strong in extractive industries, manufacturing, and services. It is indeed much weaker than many developed countries in many of the factors that support robust computer industries—universities, a business environment friendly to entrepreneurs, a history of technical innovation, fast Internet access, and a population with strong general or technical educations. However, its strengths give it a long-standing IT infrastructure and IT staff that could be the envy of the rest of Latin America. As we will see, a large tech startup culture has also sprung to life over the past decade.

In the 1970s and '80s, Brazil instituted a rigorous form of protectionism, requiring its companies to buy Brazilian-made computers. This produced many of the desired results, creating a home-grown computer manufacturing environment and producing many trained staff. Eventually, of course, the government had to abandon the policy in order to keep up with advances outside the country.

Brazil is also the birthplace of some other historic companies founded on open source software. One, Conectiva, was important in the early history of Linux for creating and selling a popular distribution of GNU/Linux that received worldwide recognition. Another company—mentioned to me by Jon "maddog" Hall, a free-software developer and activist who has devoted an enormous amount of time to Brazil—was Cyclades, whose developers in 1999 became some of the first to build an embedded system around Linux.

According to Luciano Ramalho, an O'Reilly author and leader in the Brazilian Python community, IT is booming in Brazil. None of the problems just mentioned are holding it back, because businesses understand the need to digitally transform themselves. They are going through a reevaluation of computers and IT that is familiar in other parts of the world, as well. Originally, businesses outsourced as much IT as possible, assuming they couldn't do it as efficiently in-house as an outside, specialized firm could. Now, however, they realize that computer automation and data exploitation are intricately connected to their business models, and that these things need to be done in-house. Ramalho's experience is backed up by an article in TechCrunch.

Free and open source software is also thriving in Brazil. Open source is not discussed as prominently as it was during the first decade of the 2000s, but it is ubiquitous. This report distills the many trends in business, education, and government that have brought about the current state of open source in Brazil.

Community

Aqui nesse mundinho fechado ela é incrível
Hackers have created meetups and other spaces for collaboration and training, often with government support. You will find most of the activity centered in Rio de Janeiro and São Paulo, but smaller communities are building their own development spaces.

The energy in Brazil around open source software is best felt at the Fórum Internacional Software Livre (FISL), the biggest open source conference in Latin America. The conference has been running for 17 years straight—although Ramalho says it was almost cancelled this year because of the bickering over leadership in the federal government—and attracted more than 5,200 participants in 2016, 25 percent of them women. I had a chance to attend in 2006 and found a thriving collection of attendees, vendors, and booksellers. Many European and North American leaders in free software, including Jon Hall and Richard Stallman, endured the long flight to come and speak, which shows the importance they assigned to the conference and to the free-software community in Brazil. Thus, one conference track was held in English, with the others in Portuguese.

Hall, who has been a prominent advisor to Brazilian open source developers and an advocate for them worldwide, mentions also the importance of the Latin-American Conference of Free Software (Latinoware) and Software Freedom Day.

Major Brazilian cities have meetups like those in other countries. One meetup in São Paulo even promises the "cultura de Inovação e empreendedorismo digital do Silicon Valley" (digital culture of innovation and entrepreneurship of Silicon Valley)". Brena Monteiro, a coach for Rails Girls, says that technical events are much less common in smaller cities. Monteiro, who studied Linux and Java in college, cofounded the company Uprise IT to bring technology into businesses in her city of Governador Valadares.

The tech scene is by no means barren in smaller cities, though. Some exciting trends have been noticed by Henrique Bastos, a Python developer responsible for a Django course, some popular Django extensions, python-decouple, and GoogleGroup Exporter. He is very active with developer communities in Brazil, particularly as the financial director of the Brazil Python Association and a fellow at the Python Foundation. Bastos travels the entire country speaking at conferences, and finds important grassroots activities.

In the small towns, people are organizing technical forums with speakers, along with hands-on hackathons. Bastos thinks that, although small towns lack the resources of Rio de Janeiro and São Paulo, they have the key advantage that people know one another well. A conference of 100 to 200 people is a big success, and some of these groups meet once a month or even once a week. Hacking on

open source projects is common at conferences. Bastos measures participation in terms of how often people get in contact, whether face to face or online. He wants them to aim to get in contact at least weekly.

Open source is a great way to connect with people. It is much better than job interviews and other formal channels for finding out what a person is capable of accomplishing and how he or she interacts with others. In addition, it provides a flexible and humane environment in which people can be more genuine. Bastos says that Brazilians enjoy a lot of emotional freedom, and this combines powerfully with open source. Conferences and meetups always end up at a bar, where people can develop strong bonds.

The education of developers that takes place in many developed countries is hampered in Brazil, as in many countries, by a brain drain. Basically, if you become an expert in your technological area, you can get a foreign job that pays more than Brazillian jobs and offers the enticements of living in a major tech center such as London or San Francisco. Thus, the people who could be attending meetups and mentoring the next generation of experts are drawn away.

Ramalho founded the first hackerspace in Brazil, the Garoa Hacker Clube. Its project page covers a range of robotic, media, educational, and other applications. One amusing project illustrates the informality of the organization. The space is administered a bit haphazardly, with members given keys but without set hours. So the "Presence notification" project, based on a similar Dutch system, lets people check online whether the space is open at that moment. Unfortunately, many of their links are broken, so it's difficult to check some of the organization's activities. Ramalho says that its Arduino Night, started in November 2010, has long been the most popular weekly event. In late October 2016, the province of Rio Grande do Sul will hold the first open hardware conference in Brazil.

The free-software movement is committed to evening out disparities in society and providing opportunities for all. Software engineer Valéria Barros points to two particularly strong examples in Brazil. Rio Mozilla Club, which puts the motto "Aprender, Criar, Compartilhar" (Learn, Create, Share) on its home page, runs educational programs for people without Internet access at sites called LAN

houses. These programs teach people how to create and remix video content. Laboratório de Cidades Sensitivas (LabCEUS) was created by the Universidade Federal de Pernambuco. It operates in several cities to engage people in their local communities and give them a voice, including the use of audio and video technology.

Barros also points out several programs in Brazil whose goal is to develop female engineers and that are based on open source software. Two have a worldwide reach—Technovation Challenge and PyLadies—whereas MariaLab is a São Paulo–based organization. Barros describes MariaLab as a feminist hackerspace that aims to create a safe place where women (cisgender or trans) can learn IT and experience its possibilities as well as become teachers themselves.

Unfortunately, Brazil is tarred by the same sexism and expressions of violence against women that one finds elsewhere in the world, as in the misogynistic expressions of GamerGate, the hate speech directed at O'Reilly author Kathy Sierra, and the increasing attacks on celebrities. Monteiro says that negative comments and opposition from men keep many women out of computer science courses and out of the field in general. The free-software movement is no haven. On the one hand, Barros has seen many efforts in the free-software community to create safe spaces for the woman, hold events for women, and recruit them for talks. But Monteiro cites one situation in which a woman within an organization sponsoring a conference wrote a code of conduct for the event, and a number of men posted outrageous comments verging on death threats in response. Although the organization supported the woman and adhered to the code of conduct, incidents like this make many women feel that they won't be safe in the tech community.

According to Leandro Ramalho, Ubatuba, a coastal city of about 85,000 in the state of São Paulo, has leapt into the free-software movement with multiple community projects: hacker and Maker spaces, open-science and open-data initiatives, free-software advocacy, a technology week, weekly open-hardware workshops, and more. Although a tourist destination, Ubatuba is still representative of the numerous smaller cities and towns of Brazil that lack employment opportunities. The mayor there is sponsoring free-software activities, and labs in 14 public schools train students on their own distribution of Linux. The goal is to let people remain in the town while earning good money providing services to Brazil and the

world. Ramalho is now organizing the kind of informal event that Brazilians (and, for that matter, people worldwide) love: a Free Everything get-together that discusses craftsmanship, ceramics, and software over beers (and, hopefully, caipirinhas).

Fabio Kon, who has worked with Linux since 1993 (Torvalds first released it in 1991), offered me an assessment of Brazil's open source communities. Kon used to be a director of the Open Source Initiative (OSI), a leading organization in the promotion of open source worldwide, and now runs the Center of Competence in Free Software (CCSL) at the University of São Paulo, Brazil's leading educational institution. Kon says that from about 2000 to 2012, open source software was fashionable, generating lots of meetups and other events. Although there is plenty of evidence that open source has continued to grow in importance in Brazil, attendance at FISL has decreased (particularly as it has lost federal funding), and the organizers of meetups have turned from technical topics to entrepreneurship.

Even though developers and managers at startups are steeped in open source software and sympathize with its communities, Kon says, these staff are too busy at their day jobs to participate in them much. Their own products are not open source, because they have seen how difficult it is to sustain an open source business.

Kon also laments that Brazilian programmers don't create much new software under open source licenses or contribute to open source projects used outside Brazil. However, Valéria Barros offers counterexamples of people, including contributors to this report, who do substantial coding on open source projects. Henrique Bastos believes that few major open source software projects come out of Brazil but finds that developers are using open source extensively in Unix-like fashion, tying together different tools to make useful products.

Free-Software Movements and Regional Efforts

A minha casa vive aberta
Many Latin American governments, especially the one led by the Partido dos Trabalhadores in Brazil, have declared support for open source software, but results are disappointing. Still, support from

the federal government during the first decade of the 2000s helped educate the public about open source.

Free and open source software has an easy appeal for people outside the United States (or at least in developing countries). First of all, people can count up the millions of dollars that go into the coffers of multinational companies based in the US instead of into local jobs and local businesses, and compare it to other historical examples of companies extracting value while not giving back to the local economy.

Even more important is the inherent flexibility and transparency of open source. The software can be fashioned to suit local needs without asking permission or waiting for a vendor to decide the changes meet its business needs. This is crucial for all kinds of activities ranging from translation and localization to meeting local regulations. People in developing countries also mistrust the data-collection practices of US companies. They felt entirely justified when Edward Snowden's leaks revealed a US data-gathering campaign, implicating US telecom companies as well as the US government, throughout Brazil and the rest of Latin America.

To understand the adoption of open source, therefore, we must look at political and social movements that consciously link the use of free and open source software to numerous social goals, including government transparency, wider public participation in government, freedom from surveillance, and better cooperation between nations. Activists in these movements deliberately prefer the term "free software" (using the Portuguese term *livre* and similar words in other Romance languages) to "open source software" because of freedom's political and ethical resonance.

As in many countries (perhaps all), the appeal of free and open source software is held back by the easy availability of unauthorized proprietary software (a situation proprietary companies like to stigmatize as "pirating"). Thus, Jon Hall cites a Software Business Alliance report estimating that 84 percent of desktop software in Brazil is unauthorized installations of proprietary software. But this doesn't mean that the proprietary companies are eager to crack down—that would drive their users to truly free (as in freedom) software.

The early 2000s saw flamboyant public accolades for free software in Latin America. In September 2004, Venezuelan president Hugo

Chávez reinforced his leftist positions by promising to adopt free software throughout the government. A similar declaration was made by the Peruvian congress in the early 2000s, resisting powerful opposition by Microsoft. Brazil was also early to the scene, as the Partido dos Trabalhadores (Workers' Party, or PT), led by President Luiz Inácio "Lula" da Silva, took up the baton for free software soon after taking power in 2003. To receive the Brazilian government's endorsement, free software programmers worked intimately with party activists as well as with computer businesses that had large operations in Brazil, such as Sun Microsystems, IBM, and Red Hat.

Certainly, the Brazilian free-software community benefitted from government attention for a few years. The PT endorsement called attention to its achievements and brought more business to it. FISL, which was originally launched with the help of the state government of Rio Grande do Sul, began to receive federal government backing. Many government administrators attended and spoke there, and President Lula himself delivered a keynote at FISL in 2009.

Ultimately, none of these well-intentioned initiatives proceeded very far. Although I have to rely on vague impressions I hear from open source advocates, it appears that most countries lacked the technical expertise to carry out a conversion to open source software. Government staff was not, for the most part, trained in how to evaluate open source software, install and maintain it, and work with the open source community to handle bug fixes and feature requests; these are hard-won skills that take time and practice. There was also a paucity of local companies that could help bridge the gap between the untrained government staff and the open source communities.

In Brazil, lack of education is probably not the cause of the delays in transitioning to open source. The Brazilian free software community is large and well-organized politically. But it takes effort and political will to recruit open source experts and give them the leeway to change the entire system of procurement and deployment. Many managers outside of IT departments must be on board. Therefore, open source didn't get much further than the political goodwill won by the PT when it announced the adoption of free software. According to Marques and Gobbi, proprietary companies launched a campaign against open source in 2010, unmatched by any lobbying effort by open source advocates. And according to Cesar Brod, an executive at the Linux Professional Institute (LPI), government sup-

port for the free-software movement never went beyond the PT to become a government-wide policy.

Several of my correspondents tell me that the current chaos over corruption has ended the government's interest in open source. According to Luciano Ramalho, the forced resignation of a leading PT government official, José Dirceu de Oliveira e Silva, in 2005 along with the complete dismissal of his staff, dealt a particularly bad blow because he was in charge of the supposed conversion to free software. By that time, according to Marques and Gobbi, thanks to its public relations and funding, the public tended to associate open source with the PT, so open source became a victim of the corruption scandals. It has suffered this collateral damage in several ways: the general paralysis now pervading government, the loss of PT staff who had been trained in the benefits and ways of dealing with open source, and the general zeal of opposing parties who want to indiscriminately tear down any initiative associated with the PT.

Regardless of the setbacks, Ramalho has seen progress: "I believe there has been an organic growth of free and open source software use on servers across the government and private sectors. For instance, the Receita Federal, our equivalent of the IRS in the United States, was 100 percent committed to the Microsoft tech stack before Lula was elected, but today it is much more diversified and mostly use Java on GNU/Linux. It even supports GNU/Linux on the desktop with its tax reporting applications."

The suggestion of an association between free software and corruption is particularly unfortunate, because open source software is strongly resistant to corruption thanks to the open and public process behind its development. Additionally, corruption in Brazil hardly started with the PT—it equally taints the opposition politicians who are jockeying to take over from the PT. Corruption rewards personal connections and established actors instead of creative, new projects, particularly ones designed by communities, so corruption puts a brake on entrepreneurship as well as open source.

The worldwide "open data" drive to make government data more available has prompted a recent effort among Latin American governments to become more computer-savvy. Adopting open source tools and open formats is central to the provision of open data. Red Gealc (Network of Electronic Government of Latin America and the Caribbean), which includes 32 participating countries, represents a

wide-ranging effort to make government more transparent, release data sets, and give members of the public the tools to make use of the data. Luis Felipe Costa, who introduced me to Red Gealc, drew up guidelines for it that cover licenses, technology, and governance in open source software. Red Gealc also offers online courses on government transparency and created an eight-level model of maturity in open source development communities.

Business and Workforce

É um pedaço de pão

You can find open source software everywhere in business, with a good deal of growth attributable to the importance of open source in cloud computing and to startups. Consequently, Brazil suffers from a shortage of workers knowledgeable in open source.

According to Fabio Kon, the same factors that made it easy to start up a software firm anywhere in the world—cloud services and a swelling number of open source tools and libraries—led to a new entrepreneurial environment in Brazil around 2012. A government incubator program called Startup Brazil (comparable to the Small Business Innovation Research [SBIR] program in the US) would give the equivalent of US$50,000 to selected early-stage startups and help the successful ones find further investment. In addition, a São Paulo program called PIPE (Innovative Research in Small Enterprises) funds 200 companies each year, of which 100 are startups. Even after an economic downturn in 2015, startup activity remained high, with just a small decrease. The most common sorts of new software companies handle ecommerce, and the next most popular domain is agriculture, in which companies offer Internet of Things (IoT) approaches to improving yields.

Kon hopes that over the next year or two, the political situation will calm down and the economy will improve. That will lead to changes benefitting the tech sector: more money for education, lower taxes, and more investment in startups.

As mentioned earlier, Brazil suffers from a brain drain and a shortage of computer staff. Kon estimates that a graduate from one of the country's top 10 universities will receive an entry-level salary between 3,000 and 5,000 reais (US$950 to US$1,500) a month. This

figure can double within five years of employment but still will not approach the earnings that person could get in the US and Europe.

Luciano Ramalho says there is full employment in the Brazilian IT sector, with a shortage of knowledgeable people in all areas of computing. Cesar Brod cites fruitless searches for trained Linux and open source experts in Brazil by major firms such as Global Automation, Intel, and Hewlett-Packard. He also says that cloud computing has become popular in Brazil, as in other places, and that most cloud companies run Linux as the host machines. Therefore, a large number of professionals familiar with Linux are being hired by cloud companies, leaving fewer for customers.

Brod reports that many people don't believe open source companies have learned how to make money and survive in Brazil. However, he has started two such companies and hopes that their models will be copied by others.

The first company, Solis, was founded by open source programmers who came out of the university setting, a typical open source story because research institutions are quicker than commercial businesses to adopt open source. The company took over from the university two key pieces of software that are still its core products: an academic administration called SAGU (now marketed as Solis GE), and Gnuteca, a library circulation system. Founded in 2003, the company now employs 60 people, and Brod estimates that other products and services spun off from it provide work for some 300 to 350 other people. Brod estimates that 80 percent of Solis's business comes from outside its own province. In 2004, he wrote an article about the company's strategy for *Linux Journal*.

The second company, Sysvale, Brod still considers a startup. The opportunity to found it came in 2013 when a new Brazilian law required more open data from municipalities. Most of them, of course, had little IT of any sort in place and were not prepared to provide their data on the Internet. Brod worked with a university in Bahia, an area so historically underdeveloped that it is the setting for numerous books about backwardness (most notably *La guerra del fin del mundo* by Mario Vargas Llosa). At the Universidade Federal do Vale do São Francisco in Bahia, Brod recruited graduates to work in local city offices using open source software to solve the data-transparency problem. After staying a couple years in these positions, the students were initiated into the methods of real-life

software development and could find jobs elsewhere, all the while having made a meaningful contribution to the town. Sysvale was founded by some of these graduates and now provides services to many public-sector offices in both affluent and poor areas of the country. It won a "best business idea" award in 2014.

To turn a college graduate into an effective on-the-job coder, Brod seeks out students who show a strong love of learning. Sysvale starts them out with one week of SCRUM training, followed by some sub-sets of extreme programming. Then, the graduates are thrown into the open source community. Brod finds that the free software phi-losophy is not difficult to teach to students who are "not yet conta-minated by the proprietary industry." They begin participating in forums and learn English to be more effective.

Brod also notes that many environments mix Windows, Linux, and maybe even mainframes. There is a great demand for people with this mix of skills, and few who have it.

After starting five companies in Brazil, Douglas Conrad investigated free software and decided to make it the basis of his next company. To make the company sustainable, he adopted a business model that I call closed core, embodying a mix of proprietary and open code. In 2004, he created open source call-routing software called SNEP. Built on Linux and released under the GPL version 2, SNEP func-tions as a layer on top of Asterisk but adds useful features such as routing and a web-based administrative interface. Conrad says that 8,000 companies use the software, including the major bank Caixa Economica Federal (CEF), and that 40 partners are working on the SNEP software. In an illustration of the real-world experience open source can bring to students, three schools are using SNEP to teach students communications software and entrepreneurship.

The proprietary side of Conrad's company is OPENS, a Software as a Service (SaaS) company located in the state of Santa Catarina in southern Brazil. The service parses telephone information and pro-vides intelligence based on it. For instance, a customer service rep who answers your call can greet you with, "Hello, Andrew. I know you called us last week about an outage. How is the system working now?"

As an individual running his own software consultancy, Henrique Bastos finds open source a tremendous boon to small businesses. He can use friends' libraries to fulfill his own contracts, and offer his

libraries to his friends. They can also collaborate easily on a contract through open source. Furthermore, opening code makes maintenance easier, because many people can collaborate as they have time. So Bastos releases as much of his code as open source as possible, isolating ancillary code from the core product delivered to the customer.

Internet access is an important part of open source adoption, both for downloading software and for participating in forums where it is developed and discussed. The International Telecommunications Union estimates that more than 65 percent of Brazilians have Internet access (although another summary is less optimistic). Internet speeds in major urban centers are several orders of magnitude less than speeds in most developed countries, and the country as a whole is much worse. Kon says that even in an advanced market such as São Paulo, Internet access fails several times a day. The cost of 10-megabit-per-second Internet access (download speed) is US$26 per month, according to one site. When you consider that the average monthly income is 2,000 reais or US$627 (or, for a computer programmer, 3,000 reais or US$941), the cost is a significant but affordable burden.

Education

Toda a cidade vai cantar

Although open source is being adopted widely in Brazilian businesses, education in open source for the employees of these businesses is harder to obtain. The reasons go back to underdevelopment in the economy and education, Brazilian university regulations, and the dominance of English-language texts. Because of difficulties in gaining access to education, Brazilian students and programmers must find nontraditional ways to pick up open source skills. Forward-thinking local governments support some creative educational projects.

Most of the world takes proprietary software and services for granted. Only Silicon Valley and a few other places evince the startup mentality that assumes that new employees will possess a day-to-day intimacy with Linux, Git, an open source database such as MongoDB or MariaDB, and other free software tools. The question for this section of the report is where can people acquire such skills?

Although useful, a computer science education isn't required for frontend programming or system administration jobs in Brazil. Luciano Ramalho, for instance, the Python expert, held computing jobs for 20 years without a college degree, finally getting one in library information sciences at age 45. Henrique Bastos has also founded a successful business and become an important figure in the Python community without finishing college. Seeing his wife's experience working within the school system, he considers it broken and suspects that the next generation of children will learn in a totally different way that obviates the need for a formal education system.

The most pressing shortage is in data science and machine learning. Unlike frontend programming or system administration, you can't become a data scientist by taking a few courses and picking up techniques informally. You need a strong math and statistics background for data science.

Brazil's federal and state universities are excellent, and are free to all who pass the necessary entrance exams. These exams, however, create a bias toward affluent students. As in the United States, affluent people have access to better schools—often private ones—so wealthy students come out much better prepared for university than poor students. Lula's PT government made a difference here, offering scholarships and low-interest loans to help poorer people get a college education, but the disparities are still large.

The recent movie *Que Horas Ela Volta?*, distributed in the US as *The Second Mother*, provides an interesting view of a lower-class woman who overcomes enormous barriers in her quest for entry to the University of São Paulo. Physicist Richard Feynman's experiences lecturing in Brazil, reported in his famous book *Surely You're Joking, Mr. Feynman!*, might also still be relevant, even though he published it in 1985.

The University of São Paulo also has the Center of Competence in Free Software (CCSL) run by Fabio Kon, which offers courses, lectures, workshops, and community gatherings to strengthen the local open source ecosystem. The CCSL also carries out R&D projects and offers consulting to private companies and government in subjects related to open source policies.

The research universities in the state of São Paulo graduate, every year, more than 500 professionals in IT-related subjects with very

good skills in open source development. However, this is still a very small number compared to the size of the São Paulo economy and its needs.

According to Kon, Brazil's public universities produce computer science graduates who are familiar with open source tools and active in those communities. To illustrate the penetration of open source, he estimates that 600 of the 800 computer science students at the university have GNU/Linux on their laptops. Hardly anyone outside the hacker community runs Linux on the desktop, just as in the US and Europe.

In contrast to the public universities, there are large numbers of for-profit schools (as in the US) of questionable quality that promise paying students the skills that will get them a job. These for-profit schools tend to focus on proprietary tools. In fact, according to Kon, a few software companies give the schools proprietary software at no cost, stipulating that courses be designed around it.

As mentioned earlier, data centers and SaaS services in Brazil are largely based on open source. Kon says this was not true 10 years ago. These companies have entered firmly into the open source camp, without advertising the fact, because open source makes them more cost effective and robust. One interesting question is how their IT staff have become trained on the new open source tools. Kon says that company training has become rare. Instead, employees train themselves, often using online courses such as Coursera and edX.

Douglas Conrad, whose open source business I described earlier, met Jon Hall in 2004 and found that they held similar views about how to promote free software: not to focus on the ideological benefits ("free as in freedom") but instead to show how it can spur entrepreneurship and provide other benefits to society. They founded Project Cauã, which teaches young people how to start a business using free software. As SaaS takes over, Conrad believes we have to change our concept of free software. We should stress sharing and collaboration, not just as nice things that make the world better, but also as a way to bolster one's own success. (The turn toward practical justifications is historically the impetus for adopting the term "open source".) He tries to instill in students the ethos of making enough money to live comfortably while doing something that is meaningful for them and helps others.

In starting a business, Conrad urges students to think of the entire customer experience, not just the code. Three principles drive success:

Focus
> Although you should believe that you can do anything you put your mind to, you need to focus on something and devote enough time to learn it thoroughly.

Partnerships
> If you're a great developer, focus on the code, but bring in a marketing person to listen to customers.

Inclusiveness
> Sharing code is valuable, but you should do more. Otherwise, different people will build redundant businesses using your code and that do essentially the same thing. On the positive side, by including others in your business, two services based on different code bases can cooperate to serve clients more effectively.

Bastos's company also offers training, and estimates that more than 3,000 people have passed through his courses since 2010. Although he focuses on Django, like Conrad he uses the class project to teach real-life professional skills: how to connect with real customers, deal with crises, and so on. Thus, Bastos's work represents another path to open source success, standing outside of the university system, and melding technical skills with entrepreneurial skills.

Jon Hall points to another important barrier to learning computer science: the high prices of textbooks in Brazil, a problem I can attest to from my visits there in the 2000s. Free-software developer Brena Monteiro also warns that the quality of Portuguese technical translations is terrible—a failure that I hope was not true of the O'Reilly Media books translated into Portuguese.

I talked to Marcelo Marques and Rodolfo Gobbi, who founded and run 4Linux, the largest company in Brazil that trains students in Linux and open source technologies. (They also wrote a book for O'Reilly several years ago.) They have noticed that, for reasons they can't explain, fewer students have been taking computer courses in Brazilian universities over the past several years. As mentioned earlier, you can get a job as a web programmer without a university course. 4Linux draws many of its students in that area.

The Linux Professional Institute (LPI), which was founded in 1999, began offering its exams in Brazil in 2002 with support from 4Linux and Conectiva. The exam has several levels that cover wide areas of system administration, both on the GNU/Linux system itself and on popular utilities and services such as mail and security.

Certification provides a universal worldwide standard for competence and gives people a goal to work toward. Because experience counts more than training for a certification such as LPI, people without access to good colleges, or other resources for expensive training like other certifications require, have enhanced opportunities for getting jobs. However, Brod says that the top activity by LPI is not giving the exam itself (although that is where their funds come from) but promoting organizations that can teach people the skills needed to succeed with Linux and related tools.

Brod says that, as LPI developed into a global organization, in 2006 it hired a single manager to cover all of Latin America. This ended up short-changing the countries in that region (particularly Portuguese-speaking ones), so in March of 2016, the organization hired Brod to focus on promoting the exam and related training in Brazil. Certifications seem to be regarded as more important by Brazilian businesses than by American companies. Cesar Brod says that many software RFPs from the Brazilian government require bidders to provide LPI- or Red Hat–certified staff to handle the contract.

Another barrier to entering the computer field is the need to learn English. Because most technical books, papers, and websites are in English, with an eye toward reaching a global community that has coalesced around that language, everyone must become pretty proficient in English before they can advance far in the computer field. Even when Brazilians write code and documentation for local projects, they tend to do so in English because the project might someday appeal to developers outside the country. So, Cesar Brod advises students and staff that their salaries will be doubled if they know English. Spanish is also useful in order to communicate with other Latin American countries.

Looking Toward the Future

Gosto muito de te ver, leãozinho, caminhando sob o sol

Brazilian open source advocates are, out of necessity, weaning themselves off their tight collaboration with the federal government and finding grassroots ways to promote the software and methods.

Marcelo Marques and Rodolfo Gobbi say that budget cuts and the fall of the Brazilian Real against the US dollar are forcing government agencies to take another look at open source, this time for practical reasons rather than ideological ones. Marques and Gobbi are among the first to see this new interest, because they are receiving more requests about their training programs from government offices.

Open source actually tends not to save money at first (due to conversion costs), and other arguments for its adoption are stronger than cost-related ones, but budget cuts can still be a useful incentive to pique curiosity about open source. The cost and effort of converting to open source software often goes to waste, according to Jon Hall, because commercial and government sites get new managers who arbitrarily relicense proprietary software, discarding the knowledge and cultural understanding derived from the open source period.

Open source is not just a business or a project, but a growing community. Therefore, despite the setbacks in government, both in Brazil and elsewhere, the movement continues to advance. Luciano Ramalho sees a positive sign in Red Hat's recent expansion in Brazil. As part of their products and services, many other companies—including IBM, Oracle, and Intel—use open source software.

What can the free and open source communities in Brazil do to keep the process moving along? Some problems lie within their grasp to solve, whereas others exist on a larger level that requires decisive action by government and society. Several intersecting issues need to be addressed:

- The shortage of trained staff, which is particularly distressing given the poverty and a high unemployment in Brazil.

- The continuing weaknesses in Brazil's primary, secondary, and university-level education.
- Geographic disparities—employment and educational opportunities drop rapidly as one moves out of major cities.
- Inertia and corruption that leave companies and government agencies feeding huge amounts of money into proprietary software that was designed for the North American market.
- Factors that hold back computerization in general. Hall cites high import taxes (especially on small systems like the popular Raspberry Pi), unnecessarily expensive hardware, risk aversion among manufacturers of computers and parts, poor shipping infrastructure, and low investment by venture capitalists.

Brazil seems ripe for a major educational push in technology. It needs a hundred more organizations like 4Linux, Solis, Sysvale, and OPENS. Given low budgets and deliberate neglect by the government, creative educational solutions need to be put in place by NGOs and businesses. Rural areas might benefit from hackerspaces and Maker spaces that can reach young people with nonacademic, hands-on learning. Volunteers might be able to fill in where trained staff are lacking or there is not enough money to hire them. Brena Monteiro believes that more women need to be recruited as programmers, a process that includes fighting gender bias. She considers training female developers a prerequisite for recruiting more women into the free-software movement.

The inevitable world trend in software is toward standardization and commoditization, which means open source. Brazil will no doubt continue along this path, as well. Artificial government stimuli provided some benefit, but less than the community had hoped for. It also led to an undeserved backlash when the PT lost its momentum. Free software advocates have no doubt learned from this history and will rebuild their movement on the basis of open source's benefits.

About the Author

Andy Oram is an editor at O'Reilly Media. An employee of the company since 1992, Andy currently specializes in programming topics. His work for O'Reilly includes the first books ever published commercially in the United States on Linux and the 2001 title *Peer-to-Peer*.