



# Network building

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Thesis discusses the reasons for the lack of growth in Brazilian research in international networks

**W**hereas several nations have managed to expand their scientific production in international networks, the articles of Brazilian researchers written jointly with foreigners have stabilized at the level of about 30% and have been growing, in absolute terms, more slowly than domestic collaborations, i.e., the joint work of scientists of the same nationality. This is one of the highlights of a PhD thesis on Brazil's scientific collaboration networks, defended last year by Samile Vanz, a researcher and professor at the Federal University of Rio Grande do Sul (UFRGS) and produced under the guidance of Ida Stumpf. Samile analyzed 49,046 Brazilian articles published in journals indexed on the Thomson Reuters' Web of Science base from 2004 to 2006, and found that 95% of these were based on some type of collaboration. Partnering arrangements within the country itself has accounted for about two thirds of the articles and has remained stable in broad terms, having posted only a slight growth, from 69.2% of the total in 2004 to 70.1% in 2006. As for the level of international collaborations, it dropped slightly.

The proportion of Brazilian articles with at least one foreign author, which stood at 30.8% of the total in 2004, slipped to 30.1% in 2005 and to 30% in 2006. Stability at this level drew this researcher's attention, given that, during this period, Brazilian scientific output rose by as much as 8% annually, currently accounting for 2% of global production and for 45% of Latin American production, and considering also that policies were put in place to expand international participation: in the early 2000s, Capes (the Coordinating Office for the Improvement of People with Higher Education) started to rank more highly grades (6 and 7) only those graduate programs that maintained international collaboration. "Collaborative work is rising in Brazil and accounts for

almost all the indexed scientific production; the international partnering agreements, however, fluctuate but don't really advance," concludes Samile Vanz.

The number of co-authored articles is used as an indication of scientific collaboration among countries, institutions and researchers or among sectors (academia, government and private-sector enterprises). Although there are ways of increasing the international contribution to research without this necessarily leading to the publication of articles, such as graduate student exchange programs and participation in congresses and workshops, the importance of the co-authorship indicator for Brazilian research has been observed in several studies. One of these, published in 2006 by Abel Packer and Rogério Meneghini, from Bireme (the Latin-American and Caribbean Center of Health Sciences Information), analyzed the Brazilian articles with more than 100 citations on the Web of Science base from 1994 to 2003. It found that 84.3% of them resulted from partnering with other countries. Another study by Rogério Meneghini, published in 1996, showed that articles resulting from international collaboration have, on average, four times more citations than those that only involve domestic collaborations, which, in turn, have a 60% greater impact than those published by a single author. "Brazil needs to fight for its research to achieve greater international participation, because this will lend more visibility to the country's output and will mean gaining access to resources and equipment that are not available when one conducts research in isolation," states researcher Samile, whose work had the collaboration of a group from China that specializes in bibliometry – she did a one-year PhD internship in the lab at the Technological University of Dalian, where she learned data treatment and analysis techniques that she used in her thesis.

According to the literature, several factors explain the trend toward collaborative work. These range from the ne-

ed to share equipment costs and maintain contact with researchers from other fields of knowledge for interdisciplinary studies to expanding access to financing and the desire to expand one's academic credentials, learning new methodologies and developing skills through contact with more experienced people. The advent of the Internet and of wireless networks have made it easier for researchers who are far apart to maintain contact. The drivers of collaboration, says Samile, are not the same in all fields of knowledge. In Mathematics, as it is a theoretical discipline, partnerships tend to result from the need to exchange ideas and debate problems. In physics, on the other hand, the need to share expensive equipment, such as particle accelerators, heavily underscores collaboration.

**T**he roughly 30% of collaborations achieved by Brazil are far from being a trivial figure. "These figures' stability shows that we have a consolidated scientific community, with strong groups that are able to advance on their own in several areas," says Jacqueline Leta, a professor from the Federal University of Rio de Janeiro, who was on the examining board of Samile's thesis. "One possible explanation is that the formal scientific community, which is the one that establishes partnering, is fairly stable. What has been rising is not the number of researchers, but of graduate students, for whom collaborative production is harder," she states. According to Jacqueline, small countries tend to have very high collaboration ratios, indicating the dependence of their scientific community. Brazil's 30% exceeds the 25% of the United States, a country that accounts for one third of worldwide scientific production. However, these figures are lower than those of other Latin American countries such as Chile, Argentina and Mexico. Europe too has been raising its collaboration ratios, which now stand at 50% of its production, twice the figure of two decades ago, thanks to European Union policies designed to bring together the scientists of its member countries. The European level is twice as high as that of countries such as the United States and Japan, whose level, nevertheless, has also been rising, indicating the growing internationalization of research.

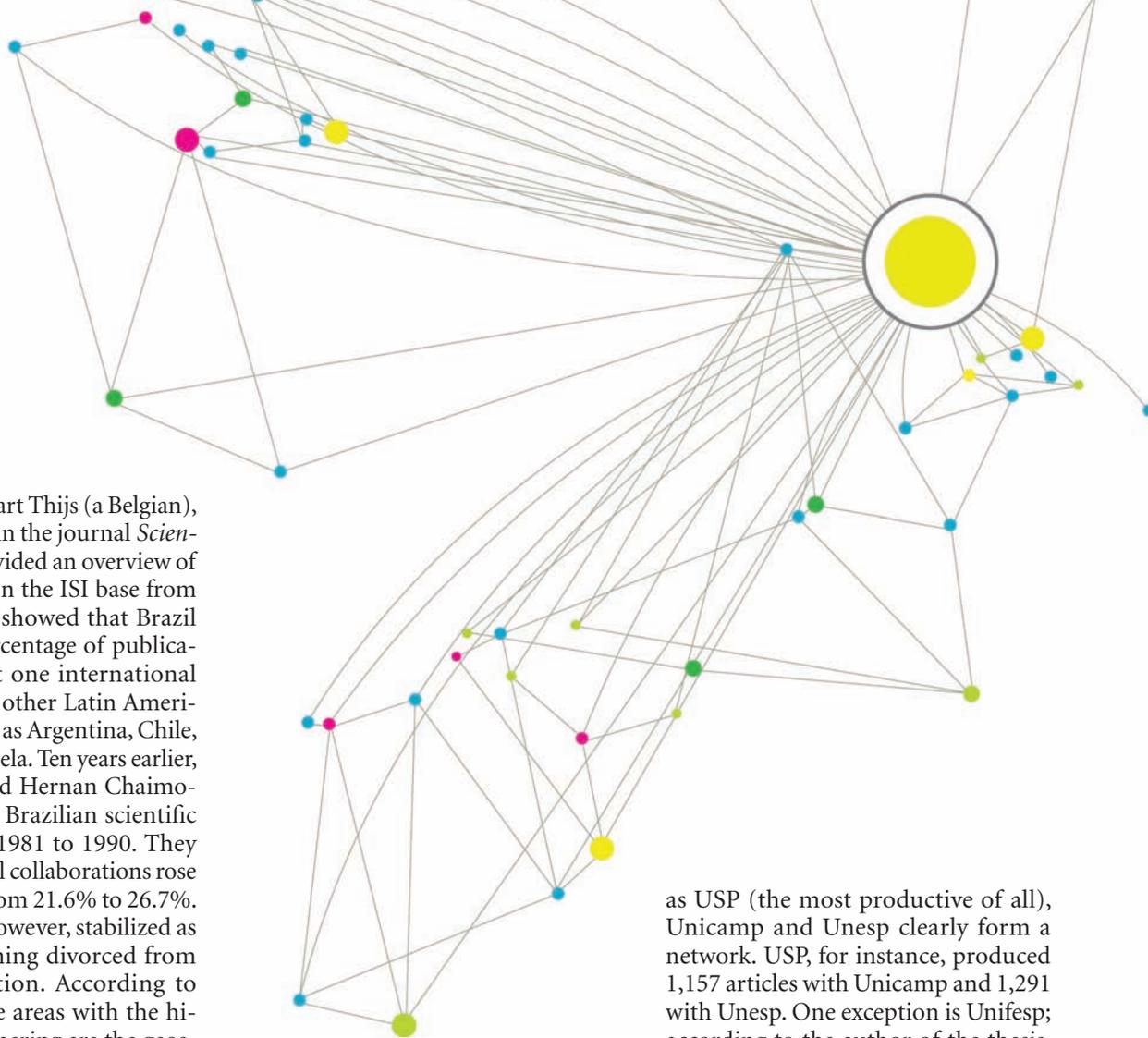
Lea Velho, a professor at Unicamp's Department of Scientific and Technological policy, says it is hard to assess the meaning of the 30% figure. "There isn't any clear theory yet, to interpret data of this type," she says. However, she states that the level can be useful to reflect on the reason why Brazil is unable to increase these indicators. "There is a lack of encouragement for our scientific community to be more involved with the foreign community," she says. "On one hand, we stopped sending PhD students abroad, which used to be a potential source of future collaborations, as we turned toward 'sandwich' doctorates [in which the doctoral candidate only spends a segment of his/her time abroad] or post-doctoral studies abroad, which do not establish such strong bonds. On the other hand, we have a financing system that has increasingly been providing good opportunities for grants and project funding in Brazil itself. This is rather different from what occurs in other countries, where taking part in international networks and the struggle for funding are crucial for the researcher to be able to continue to pursue his or her work," she states. According to Lea, it is fundamental in Europe for a researcher to get funding from the European Union network based framework programs. "European univer-

**International  
collaboration is  
justifiable, amongst  
other reasons, for  
the opportunity  
to share costs  
on large projects  
and to learn from  
those with more  
experience**

sities go so far as to hire people to format the presentations of projects, such is their importance. Here in Brazil there is no such encouragement for partnerships."

The internationalization of Brazilian research is an important element in the strategy of FAPESP, which maintains cooperation agreements with agencies, enterprises and institutions in Germany, Canada, the United States, France, Mexico, Portugal, the United Kingdom and Switzerland. One example is the cooperation agreement signed in 2004 with France's CNRS (National Center for Scientific Research), focused on encouraging the exchange of scientists and the submission of joint projects involving researchers from São Paulo institutions and their French colleagues. These have already given rise to four calls for proposals and have funded 27 projects. Similarly, FAPESP also has an agreement with DFG (Deutsche Forschungsgemeinschaft), Germany's main research promotion agency. Last year, the Foundation established a link with British research, when it signed cooperation agreements with RCUK (the Research Councils of the United Kingdom) and with King's College London, which became the first British institution of higher education to enter into partnership with FAPESP. Additionally, FAPESP's internationalization strategy includes bringing scientists from abroad to Brazil. Therefore, opportunities for post-doctoral grants are offered in monthly advertisements in the journal *Nature* as well as on the foundation's website in Portuguese and in English. Some of the Foundation's major initiatives, such as the Biota program (which studies São Paulo state biodiversity), Bioen (which concerns bioenergy research), and its global climate change research program have been holding workshops and seminars with the participation of foreign researchers, to encourage the participation of São Paulo researchers in international networks and to keep them in contact with cutting-edge science in their fields of knowledge.

One of the aims of Samile's work was to update the study on co-authoring, which had already been the subject matter of prior research. One such example is an article by Wolfgang Glänzel (a Hungarian), Jacqueline Leta



(a Brazilian) and Bart Thijs (a Belgian), published in 2006 in the journal *Scientometrics*. This provided an overview of Brazilian science on the ISI base from 1999 to 2003 and showed that Brazil had the lowest percentage of publications with at least one international partner relative to other Latin American countries such as Argentina, Chile, Mexico and Venezuela. Ten years earlier, Jacqueline Leta and Hernan Chaimovich had analyzed Brazilian scientific production from 1981 to 1990. They found international collaborations rose during this time from 21.6% to 26.7%. This percentage, however, stabilized as from 1993, becoming divorced from scientific production. According to Samile's thesis, the areas with the highest ratio of partnering are the geosciences, with more than 50% of articles involving international collaboration, followed by mathematics and physics, with some 40% each. Brazil's most frequent partner is the United States, with 22% of the coauthoring. This is followed by France (with 8.2%), Germany and Great Britain (with 7.3%), Italy (with 4.3%), Canada (with 4%), Spain and Argentina (with 3.8%). As for the relative analysis of these data, which compares co-authored articles with total country production, it showed, according to Samile, that Brazil's chief partners are the United States and Argentina. Collaborations with the United States are concentrated in fields such as clinical and experimental medicine, biology and biosciences. In the case of France, the priority areas are physics and chemistry. Collaborations with Chile stand out in geosciences and space sciences (15.7% of the total), probably because of Brazilian participation in consortiums responsible for the building of major telescopes in Chile.

Despite this stability on the international level, there is plenty of evidence that research as part of a network has been growing in Brazil. The thesis' data show that the mean number of authors of Brazilian articles reached 6.3, far above the global average of the year 2000, which was 4.16. Moreover, this indicator has been trending up: the mean was 5.9 authors in 2004, 6.4 in 2005 and 6.5 in 2006. According to Samile, this can be explained by the Brazilian scientific community embracing cooperative work. Alternatively, it might be researchers' response to the requirement that they publish more – increased co-authoring might help them fulfill this requirement.

An analysis of the web of domestic collaboration among the 16 Brazilian institutions with the highest scientific productivity showed several regional networks. São Paulo institutions, such

as USP (the most productive of all), Unicamp and Unesp clearly form a network. USP, for instance, produced 1,157 articles with Unicamp and 1,291 with Unesp. One exception is Unifesp; according to the author of the thesis, it is the most isolated, even though it produced 730 articles with USP. Samile ascribes the performance of São Paulo institutions to the state's investment in science. In the South Region, the Federal University of Rio Grande do Sul (UFRGS) also seems to stand alone, whereas the Federal Universities of Santa Catarina (UFSC) and of Paraná (UFPR) form a group that tends to collaborate with the Federal University of São Carlos (UFSCar) in inner-State São Paulo. Another group comprises the Federal Universities of Rio de Janeiro (UFRJ) and Minas Gerais (UFMG), plus the Oswaldo Cruz Foundation (Fiocruz). In the Northeast, the federal universities of Ceará (UFCE) and of Pernambuco (UFPE) are frequent collaborators. However, Samile Vanz warns that it is necessary to advance into longer series to draw more in-depth conclusions. She is committed to this task and plans to continue analyzing data from more recent years about collaboration in Brazilian research. ■