COPPE 50
UFRJ

ENGINEERING AND INNOVATION

THE ART OF ANTICIPATING THE FUTURE

COPPE 50 UFRJ

A HERITAGE OF ALL BRAZILIANS

IT WAS A MODEST BEGINNING, BUT THE RESULTS WERE NOT. BACK IN 1963, A GRADUATE COURSE THAT WOULD HAVE GREAT INFLUENCE ON THE BRAZILIAN UNIVERSITIES AND ENGINEERING COURSES WAS CREATED IN TWO SMALL ROOMS IN THE CAMPUS OF THE FORMER UNIVERSIDADE DO BRASIL AT PRAIA VERMELHA.

When professor Alberto Luiz Galvão Coimbra created the first master's degree course in Chemical Engineering in Brazil, he already imagined a center for improving knowledge and developing technology capable of providing solutions to Brazilian problems in different areas and of renewing old predominant academic practices at universities.

To accomplish his objective, Coimbra developed a graduate course model that was completely innovative in Brazil at that time, focusing on scientific research, full-time study and well-paid and fully dedicated professors. Upholding these principles, the small group of the master's degree course in Chemical Engineering expanded to give rise to Latin America's greatest teaching and research center in engineering: Coppe –The Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering– which is an institution of academic excellence that made the most ambitious visions of its founder a reality.

Pioneering Efforts

Since 1963 more than 14,000 students of Coppe have been awarded their master's and doctoral degrees. Many of these students pursued an academic career and created graduate courses based on Coppe's education model throughout the country. It is no exaggeration to say that the graduate system in Brazil, in engineering and in other areas as well, was influenced by Coppe.

Nowadays, Coppe is the Brazilian graduate engineering institute that received the largest number of 7s and 6s - the highest scores attributed by CAPES to courses with an equivalent performance to the most important centers of education and research in the world. The appraisal is performed by Capes, the Brazilian Federal Agency for Support and Evaluation of Graduate

Courses. Coppe students have already received 14 Capes Thesis Awards, which, since 2006, are given to the best doctoral theses presented throughout the country. Two students also received the Capes Greatest Award for Doctoral Thesis, which is given to the best thesis of each one of the following three major research fields: Engineering, Exact & Earth Sciences and Multidisciplinary Science (Materials and Biotechnology).

But the contributions from Coppe are far beyond the academic world. Over the last five decades, the institution has been providing solutions to problems in liaison with companies, governments and social organizations. More than 13,000 agreements have been signed since 1970, which shows the dynamism of Coppe.

Technology developed by Petrobras has helped to put Brazil in the leading position in deepwater oil production and today it is used in the exploration of the pre-salt layer – the most widely known example. Research conducted at Coppe has helped to develop state politics in various fields. For instance, several studies carried out by Coppe researchers have contributed to implement the Brazilian National Biodiesel Program.

Critical Spirit

Coppe researchers have advanced knowledge; therefore, Coppe has acted as a mediator together with governments in the development of studies and projects. Nevertheless, it does not mean that Coppe does not participate anymore, independently and with critical spirit, in the public debate on government actions related to the topics of its expertise.

Coppe pointed out some mistakes on the nuclear agreement between Brazil and Germany in 1975; denounced the conduction of tests to produce a nuclear weapon at the Cachimbo Air Force Base in Pará, in 1986; questioned the privatization of companies and infrastructures in 1998, and warned the government about the imminent energy crisis in 2000, one year before the 2001 blackout.

The following pages show a brief but comprehensive overview of the most important milestones of this story – a story that has difficult moments such as the traumatic departure of the institution's founder and long periods of funding shortage for research. Coppe had to reinvent itself by creating innovative management systems and improving partnerships with companies.

Creating the Future

Proud of its past, Coppe is still alert to future demands. Sustainability is the keyword of dozens of projects developed by its researchers. Coppe is the Brazilian research institution with the largest number of scientists in the Intergovernmental Panel on Climate Change (IPCC) established by UN and has headquartered the Brazilian Forum on Climate Change since 2004. The institution contributes to and offers technical support to the formulation of national and international policies in one of the most challenging areas today.

Coppe also continues to invest in new engineering fields. In 2013, on its 50th anniversary, the institution created its 13th graduate program – the Nanotechnology Engineering Program. That is how Coppe remains faithful to the dreams of its founder. Coppe has turned out to be a heritage of all Brazilians due to its technical knowledge, clear vision of challenges and commitment to the country.

1960

- Brasília, the new federal capital and an icon of modern architecture is inaugurated.
- Rio de Janeiro, the former capital, is now called the State of Guanabara.
- John F. Kennedy is elected President of the United States.

1961

- Jânio Quadros resigns as President. Vice-president João Goulart assumes the position.
- Russian Yuri Gagarin becomes the first man in space and he reveals that "the Earth is blue".
- The Berlin Wall is built in the context of the Cold War, when there was a rivalry between the United States and the Soviet Union.
- The Bay of Pigs Invasion: unsuccessful attempt by troops in favor of the United States to invade Cuba.
- The first Culture Popular Center, of the Brazilian National Student Union (UNE), is created by university students and intellectuals in Rio de Janeiro.
- Professor Alberto Luiz Galvão Coimbra presents the document entitled "An Opportunity for the Implementation of a Graduate Course in Chemical Engineering in Brazil", in the National School of Chemistry of the Universidade do Brasil (now called UFRJ).

1962

- Brazil wins the Soccer World Cup for the second time in Chile.
- The Brazilian film The Payer of Promises wins the Palme d'Or at the Cannes Film Festival.
- Professor Athos da Silveira Ramos creates the Institute of Chemistry at the Universidade do Brasil.
- Peak of the Cold War between USA and USSR: crisis of the Soviet missiles installed in Cuba.
- The Bossa Nova show at Carnegie Hall, in New York, conquers the foreign audience and sparks interest for the Brazilian modern music.

1963

- The Samba School Salgueiro revolutionizes the esthetics of the samba parades with the plot about Chica da Silva.
- In March, Alberto Luiz Coimbra launches the master's degree course in Chemical Engineering, at the Institute of Chemistry of the Universidade do Brasil, the seed from which Coppe has grown.
- Ieda Maria Vargas, from Rio Grande do Sul,is crowned Miss Universe in the United States.
- Approximately 250,000 people attend the Civil Rights March, in Washington, D.C, led by Martin Luther King.
- The President of the United States John F. Kennedy is assassinated.

1964

- The Military Coup on March 31st overthrows President João Goulart. Marshal Humberto Castello Branco assumes the presidency.
- The show Opinião (Opinion), a political and social musical, debuts in Rio de Janeiro.
- Glauber Rocha releases *Black God, White Devil* and attracts more international attention to the Cinema Novo, a Brazilian film movement.
- Nelson Trevisan is the first student to receive a master's degree in Chemical Engineering, which was the course that gave rise to Coppe.
- Coppe and the then BNDE sign the first Funtec agreement, which would be the major funding for graduate research in the following years.

1965

- The Second Institutional Act suspends all existing political parties.
- The master's degree course in Mechanical Engineering is created. The master's degree courses in Chemical Engineering and in Mechanical Engineering become programs and the Coordination for Graduate Programs in Engineering (Coppe) is created.

1966

- Floods and landslides kill 250 people and more than 50,000 people are made homeless in the states of Rio de Janeiro and Guanabara.
- The military government introduces a two-party system. The political parties called Arena and MDB are created.
- Coppe creates the Electrical Engineering Program.

1967

- Marshal Arthur da Costa e Silva assumes the Presidency of Brazil.
- Gilberto Gil and Caetano Veloso create the Tropicalism, a movement for renewing the language of the Brazilian Popular Music (MPB), which influenced other types of art.
- Coppe acquires an IBM 1130 computer and creates its Department of Scientific Calculus, which gave rise to the Electronic Computation Center of UFRJ.
- Coppe's headquarter moves to Cidade Universitária, at Ilha do Fundão.
- Coppe creates the Metallurgical and Materials Engineering, the Civil Engineering, the Production Engineering and the Naval Engineering (which is now called Ocean Engineering) programs.
- In the Civil Engineering Program, Coppe creates the field of Geotechnics, motivated by the constant flooding events that have been occurring since 1966.

1968

- The Law n. 5,540 allows the University Reform. The system of course credits is adopted. The Universidade do Brasil is now called Universidade Federal do Rio de Janeiro – Federal University of Rio de Janeiro (UFRJ).
- The Nuclear Engineering Program is created at Coppe.
- The ARPANet or the Advanced Research Projects Agency Network of the United States Department of Defense, a computer network considered to be a precursor of the Internet, is created.
- Student protests in Paris almost overthrow the French government and have repercussions worldwide.
- The March of the One Hundred Thousand challenges the Brazilian military government.
- The Fifth Institutional Act, which suspends the constitutional guarantees, is issued.

1969

- Professors considered to be left-wingers are fired or compulsorily retired.*
- The North-American astronauts Neil Armstrong and Edwin Aldrin, from Apollo 11, walk on the moon.
- President Marshal Costa e Silva becomes sick and dies. He is replaced by a military junta.
- General Emílio Garrastazu Médici is nominated President of Brazil.

* Aluizio de Souza Carvalho, Anderson Moreira da Rocha, Augusto Araújo Lopes Samith, Bruno Alípio Lobo, Edgar José Guerra, Elisa Frota Pessoa, Eugênio Malanda, Eulália Maria Lahmayer Lobo, Evaristo de Moraes Filho, Friedrich Gustavo Breiger, Guy José Paulo de Holanda, Haroldo de Melo Souza, Hugo Weiss, Jayme Tiommo, João Cristóvão Cardoso, José Américo da Mota Pessanha, José de Lima Siqueira, José Francisco Mendes del Peloso, José Leite Lopes, Lincoln Bicalho Roque, Manoel Maurício de Albuquerque, Maria Laura Mouzinho Leite Lopes, Maria Yedda Leite Linhares, Marina São Paulo de Vasconcelos, Marisa Coutinho Afonso, Maurício Vinhas de Queiroz, Miriam Limoeiro Cardoso, Miriam Santos Souza Machado, Plínio Sussekind da Rocha, Quirino Campofiorito da Rocha, Raimundo José D'Araujo Costa and Sarah de Castro Barbosa.

THE INVENTION OF A DREAM

In the beginning of the 1960's Brazil was eager to fulfill expectations and hopes raised two decades before. It was a time for euphoria.

The two governments of Getúlio Vargas were responsible for establishing a primary industry in the country and for making advances in infrastructure. Juscelino Kubitscheck, who in 1956 assumed the presidency promising "50 years of progress in five", was the leader of a national development project, aimed at replacing imports of industrialized goods.

At the same time, the creativity and Brazilianness of bossa nova, the cinema novo movement and the daring architecture of the country's new capital, Brasília, called the world's attention. The Brazilian soccer team was about to win the World Cup for the second time.

That was the scenario that inspired professor Alberto Luiz Galvão Coimbra when he presented the document entitled "An Opportunity for the Implementation of a Graduate Course in Chemical Engineering in Brazil" to the School of Chemistry of the then Universidade do Brasil (now called UFRJ), in March 1961.

In the document, Coimbra stated that the undergraduate education in Chemistry was insufficient and proposed the creation of a graduate course in which it would be possible to practice the so-called "engineering science". According to Coimbra, the country could only be autonomous when the incipient industry could make use of national technology. To do so, it was necessary to invest on the qualification of engineers capable of producing science and technology instead of just applying foreign solutions and knowledge.

Coimbra's dream was to have a graduate system similar to those in the United States, which combined teaching and research. Coimbra, who in 1949 received a master's degree from Vanderbilt University, decided to visit the main universities in the USA in 1960 and came back amazed with the efficiency of the academic institutions in changing processes and curricula to invest in research. It was a consequence of the dispute with the Soviets, who in 1957 were ahead in the space race after having launched the first artificial satellite under the Sputnik program.

The Cold War: Support from Both Sides

It was the time of the Cold War, a new state of tension that emerged after World War II and divided the world into two power blocks led by The Soviet Union and the United States. The U.S. government wanted to extend its influence over Latin American nations, as there was a threat that they would be influenced by the Soviets, especially after Fidel Castro, the revolutionary leader who conquered the power in Cuba, announced the country's adhesion to communism.

However, to expand Coppe, Coimbra sought support from both sides.The Brazilian professor gained the support from Frank Tiller, an American who had been his master's thesis adviser and who was the coordinator of the Department of Chemistry at the University of Houston at that time. With Tiller's help, Coimbra was able to get funding from American foundations to hire foreign professors and offer grants so that some Brazilian students could take the master's degree course in the United States. After coming back to Brazil, the young students who had just completed the master's degree course abroad would become teachers in the new course.

At the School of Chemistry, most of Coimbra's colleagues considered this a utopian and inconvenient initiative. However, he was lucky to have the support of the director of the Institute of Chemistry at Universidade do Brasil, Athos da Silveira Ramos, who accepted to include the new course in the organizational chart. Athos authorized Coimbra to use two small rooms at the Praia Vermelha campus.

In March 1963, the course was launched and followed the principles that were regarded as laws by its creator: the full dedication of teachers and students, an unknown system in the Brazilian undergraduate education system until then.

In January 1964, Nelson Trevisan was the first student to receive a master's degree in Coppe's Chemical Engineering course for the dissertation entitled *Physisorption: Theory and Model*. The student of the first class of the course that gave rise to Coppe was advised by Professor August Zamith, of the School of Chemistry at UFRJ.

COIMBRA AND JOSÉ PELÚCIO
A DECISIVE ENCOUNTER FOR THE FUTURE OF RESEARCH AT UNIVERSITIES

In the beginning, the course survived on the tight budget from the Institute of Chemistry and a few foundations, on Coimbra's determination and on the dedication of a small group of teachers. Things got better when Coimbra was introduced to José Pelúcio Ferreira. In charge of the Department of Economics of BNDE (now called BNDES), Pelúcio was looking at options to use the budget allocated by BNDE to qualify employees at companies. Most people did not use the budget appropriately or did not use it at all. The newly created master's degree course in Chemical Engineering could benefit from this budget.

The encounter between Coimbra and Pelúcio was decisive for the future of the Brazilian universities and scientific research in the country. Besides being in tune with each other, they soon became friends an discussed the criteria and guidelines of what would be the Technical and Scientific Development Funding (Funtec).

The turbulence following the military coup in March 1964 did not prevent the creation of Funtec. In the following years, the budget of Funtec was used to create graduate programs in Brazil, paving the way for a national technological and scientific development policy. The first agreement was signed on December 21st 1964, with the master's degree course in Chemistry, created by Coimbra, which was the seed from which Coppe grew.

Since 1963, encouraged by Frank Tiller, Coimbra started to consider the creation of graduate courses for other engineering fields. With the support of the director of the School of Engineering, Afonso Henriques de Brito, the master's degree course in Mechanical Engineering was created in 1965. Just afterwards, the School of Engineering and the Institute of Chemistry gave up the opportunity to house these two graduate courses. Therefore, the Coordination for Graduate Programs and Research in Engineering (Coppe) was formally created to comprise these two graduate courses and the other new ones that would be created in quick succession: in Electrical Engineering, in 1966; in Metallurgy and Materials, Civil, Naval (after renamed as Ocean Engineering) and Production Engineering in 1967; and in Nuclear Engineering in 1968.

> IN SEARCH FOR THE BEST STUDENTS, COIMBRA WOULD SEND TEACHERS TO TRAVEL ALL OVER BRAZIL TO INTERVIEW UNDERGRADUATE STUDENTS AND EXPLAIN THEM WHAT WAS A GRADUATE COURSE.

The summer rains in 1966 were devastating in Rio de Janeiro and its surroundings. Floods and landslides killed 250 people and left 250,000 people homeless. Coppe turned its attention to the dramas of the Brazilian population, and the Civil Engineering Program started its activities by creating an area of Geotechnics. In its first year, it was coordinated by Professor Willy Lacerda, and by the engineer Willem van Lejden, a Dutch invited to teach at Coppe. In the following year, Willy went to take his doctoral degree course abroad, and professor Jacques de Medina assumed the position of coordinator.

In search of the best students to take the newly created courses, Coimbra would send two teachers to travel all over Brazil to interview undergraduate students and explain them what was a graduate course.

In 1967, Coppe was already receiving the first doctoral candidates and several companies were searching for solutions to technological problems. Petrobras was one of the first companies. In 1968, the Chemical Engineering Program signed an agreement with the company to develop a project to study permeation techniques through membranes, which was a topic of interest to oil refineries and to other types of the industrial processes requiring mixture separation. The results of the initial project were the conclusion of many master's dissertations and doctoral theses and, more recently, even the creation of a company that manufactures products with this membrane technology.

The faculty was expanding with the arrival of important figures in the national engineering scenario and of more foreign professors, and some of them came from countries behind the so-called Iron Curtain. Without being intimidated by the suspicions of the military government regarding everything that came from the communist orbit, Coimbra brought the renowned Russian naval engineer Dimitri Vastvoscev, and Vitor Lenski, who was a Russian authority on strength of materials. It was the beginning of 1968 – the fateful year that would end up with the issue of the Fifth Institutional Act on December 13th. Since then, constitutional rights were suspended; police brutality against suspects of left-wing activities increased and the dictatorship was consolidated in Brazil.

In this new scenario, the boldness of Coimbra and Coppe would face major barriers that would cost the professor and the institution dearly.

ALBERTO LUIZ GALVÃO COIMBRA

Idealism Put into Action

It is an undeniable fact that Alberto Luiz Galvão Coimbra saw far ahead when he founded Coppe in 1963. At a time that teaching at universities in Brazil was just an extra activity, he got into trouble when he strongly defended a teaching model based on the full dedication of teachers and students. Whereas the engineering schools were basically worried about qualifying engineers for the job market, Coimbra wanted to invest on research. Today, at the age of 90, suffering from subsequent retinal detachments, it is difficult for him to watch soccer matches or to read a book. However, he still has a critical vision of the country.

"Brazil's investment in Coppe and in other graduate centers is not totally used by the governments to develop national technology. We cannot just sell iron ores and soybeans. We have to establish an important industrial park," says Coimbra, with the same nationalist energy that motivated him to start the task that many people thought to be impossible: to create an engineering graduation course. Today he says he is "happy to see several Coppes in the country." "We wanted to have influence on the country's development and sovereignty and on the establishment of a national technology. This was our dream. To some degree, the dream came true."

The First Years

As there were no doctors or professors among Coimbra's close relatives, nothing in his history would lead us to suppose that he would play a major role in the evolution of the Brazilian university. Coimbra's father, Deodato Galvão Coimbra, was the adventurous son of a great ironware merchant from Itu, a city in the countryside of the state of São Paulo. When he was 14 years old, he went to study and work in England and lived with some of his family's friends. He only came back from Europe in his thirties to establish himself in Rio and import American clothes to sell to the greatest shops in the country. That is how he met Zahra, the daughter of Alberto Pereira Braga, who owned a factory of wallpapers and Carnival goods that were sold in his own shop, Casa David, located at Rua do Ouvidor, in downtown Rio.

The couple's first son was born with the aid of a midwife, in 1923, in the mansion of the family Pereira Braga in Botafogo. Alberto Luiz Galvão Coimbra was baptized with the name of his paternal grandfather, but his last name was inherited only from his father, who was a distant relative of Friar Galvão, the only Brazilian-born Saint. However, his mother, who had had a high-quality education at an elite boarding school, would influence his nationalist spirit and objector nature. "Today my mother would be considered a left-wing woman. She used to admire the ideals of the French Revolution and of Socialism. My father was more conservative. I inherited this nationalist vein from my mother," says Coimbra.

The couple encouraged their children to practice the English language and everybody used to speak English at home in the then bucolic Copacabana. This fact was very helpful when Alberto lived in New York at the age of 17. His father went to work abroad and took all the family with him. Coimbra had already finished school and spent one year out of school dedicated to reading. He used to be immersed in books by his favorite authors – Belgian George Simenon and American Mickey Spillane – and classics of the *Modern Library* collection. In addition, he learned how

to typewrite and developed his fluency in English.

"This was really helpful at the beginning of Coppe, when I was responsible for writing to the foreign bodies. There was only one secretary and she worked part-time, so everybody had to help, including me," recalls Coimbra.

Interest for Mathematics

Coimbra studied in renowned schools such as Colégio Universitário and Colégio Andrews. Although he was not the best student in class, he was one of the 13 students who passed the university entrance test to study Industrial Chemistry at the National School of Chemistry, at Universidade do Brasil, which is now called UFRJ. He recalls that he was "proud of taking a course whose university entrance test was very hard to pass. "At university he became interested in math, which would later on lead him to graduate in Chemical Engineering. He used to devote spare time to sports, especially rowing and soccer, and to the student union.

In 1947, continuing to study after having graduated from university was extremely rare. However, Coimbra was recommended by professor Athos da Silveira Ramos to receive a scholarship, so he went to the United States to take his master's degree course at the Vanderbilt University. "The adventure started when I took a Douglas DC3 that took off in Brazil, flew to Dominican Republic and then to Florida hours before a hurricane came," he recalls. The young professor was able to see an extremely organized university structure in which students and professors devoted all day to academic affairs. In contrast, he recalls that "teaching at universities in Brazil felt more like moonlighting; it was like an honor, but it did not mean efficiency."

He was still finishing his master's degree course when the Jesuit Priest Roberto Saboia de Medeiros visited the campus. At the recommendation of Coimbra's adviser, Frank Tiller, Saboia invited him to teach at the Faculty of Industrial Engineering in São Paulo. Back to Brazil in 1949, Coimbra got married to an old girlfriend, the stylist Betty Quadros, and went to live in the city of São Paulo.

The Glutton

In 1953, Coimbra returned to Rio as a professor of the Institute of Chemistry at Universidade do Brasil. With two children, he had several jobs. In addition to teaching at UFRJ, he "taught at the Pontifical Catholic University of Rio (PUC-Rio) and at the oil refinery course

THE FIRST CHEMICAL ENGINEERING GRADUATE CLASS THAT GAVE RISE TO COPPE.
PROFESSOR ALBERTO LUIZ COIMBRA, THE FOUNDER OF COPPE, IS THE ONE IN THE MIDDLE WEARING A TIE.

at Petrobras, and owned a company that developed projects for the industry."

Because Coimbra was so devoted to work, he would receive the nickname "glutton" from his students, which meant that he devoured the student's works and demanded more from them. Even with this insane routine, Coimbra decided to pursue a project that would change the graduate courses in Brazil. He took the decision to implement a master's degree course in Chemical Engineering.

In 1960, professor Frank Tiller, from Vanderbilt University, recommended that Coimbra go on a trip to several American universities. Tiller, a respected chemist, intended to influence the Brazilian university by modifying its administrative organization. He expected that his former student would undertake the task. However, Coimbra came back from the trip with another proposal. The dispute between the United States and The Soviet Union over the primacy of technological advances had changed the engineering courses in the United States. New emphasis was given to scientific research, and physics and mathematics fundamentals were appraised. According to Coimbra, who was eager to see technology developing in the land of coffee, Brazil needed that. "Business administration is not my thing. Let's create a graduate course," said Coimbra to Tiller.

Determination and Boldness

The graduate course in Chemical Engineering, which would give rise to Coppe, would show the determination – and lack of inclination to bureaucratic formalities – of its founder. As there was no room available to teach classes, Coimbra occupied two rooms, which were used by professors that were almost always absent, at the Praia Vermelha campus. He quit all other jobs to fully and exclusively dedicate himself to the university, and he used to ask the other professors to do the same. He used to be strict, did not go on vacation, and requested that the professors attended the university, were on time and wore ties. With a small budget, he would search for partnerships to bring foreign professors to the university. He was supported by the Americans, but as he was independent, he would also bring Russian scientists at the time of the military government. And he refused to fire them, even though he was advised by the university's advisory board to do so.

Although this was not the only episode in which he defied the military government (in at least two cases he insisted on hiring persecuted professors), Coimbra says that he had never had time for politics. "I am only a militant when I talk about soccer: I support Botafogo," he declared once. He was never affiliated with any political party, although he considers himself a socialist. Still, his independent attitudes have definitely influenced the filing of an administrative lawsuit against him, after the accusation by three professors, who today are remembered as the "Horsemen of Apocalypse".

As he was impatient with bureaucracy, Coimbra's way of managing Coppe was poorly orthodox and he used to be in charge of receiving and managing the budget. The administrative lawsuit resulted in the withdrawal of the founder of Coppe after he had spent ten years in charge of the institution, as well as in long and painful legal proceedings in which he was declared innocent. Today he just wants to forget this episode, but he admits: "I think they wanted to control Coppe and I was on their way," says Coimbra.

Exile

Coimbra is reluctant to talk about what he had suffered. He had to testify at least three times at the Brazilian Federal Police, where he had a record and was humiliated. He also testified at the headquarters of the Ministry of Educa-

tion in Rio de Janeiro. The general in charge of his inquiry asked why Coppe hired foreign professors, especially Russians. "I explained that Brazil had an incipient technology, therefore it was necessary to bring foreign teachers from various countries so that the students could gain an up-to-date qualification," he recalls.

The worst moment was when he was walking the streets of Ipanema and a car with no identification stopped next to him. Plainclothes agents told him to get in the car. They covered his face with a hood and took him to a quarter, possibly the Quarter of the 1st Army Police Battalion, in Tijuca, where the DOI-Codi – the intelligence and repression agency during the military government – was headquartered. "A very tall sergeant asked all the questions. Everything in the building was made of concrete. The wall was made of concrete. The floor was made of concrete... During the interrogation, many questions about Coppe's hiring Soviets were made."

In 1973, the University Council decided that Coimbra would be forbidden to hold leading positions. Coppe's founder left the university and was received by his friend José Pelúcio Ferreira, who at that time was one of the directors of Finep (Financier of Studies and Projects), a state-owned company which funded science and technology. He spent ten years in exile there, an unproductive period that he describes to be the "worst in his life". His work was recognized in 1981, still during the military government, when he was awarded the Prêmio Anísio Teixeira by the Ministry of Education. "When they realized that the Ministry of Education, which was controlled by the military government, was going to award me, they had to overturn the decision that prohibited me from occupying a position in Coppe's board of directors, "says the professor. Back to Coppe in 1983, Coimbra became the coordinator of the Chemical Engineering Program, the first graduate course of Coppe, and continued as a researcher until his retirement in 1993, with already his deserved honors. "I cannot complain that I was not recognized. People were not unthankful, on the contrary," evaluates the professor.

Che Guevara on the Wall

From that moment on, Coimbra says that he had a "life of a retired man" and that he spent his time in a delightful house in Teresópolis, a city in the hills of the state of Rio de Janeiro, with a Botafogo flag hanging out in the front. He has been married to Marlene, from Bahia, for 36 years, and two years ago he went back to Rio. The couple now lives in a comfortable apartment in Barra da Tijuca, whose pool was designed by Coimbra's friend and engineer Luiz Bevilacqua, who is Coppe's professor emeritus. Beside the swimming pool, Coimbra likes to spend time with his friends and family – three sons and three granddaughters (the youngest is 4 years old).

As Coimbra is disciplined, he walks on a treadmill every day. He likes to watch soccer matches, even though he is not able to pay attention to all the moves: "The old balls used to be whiter. I have more difficulty in seeing the newer soccer balls." He enjoys American jazz (especially Fats Waller and Paul Robinson), Ray Charles and Frank Sinatra. Among the Brazilian artists, he mentions Maysa and Dick Farney. But he has a favorite song: "Mrs. Robinson", by Simon and Garfunkel. "I think it's number one. The lyrics are so simple... It's fantastic. I listen to it whenever I can."

The conversation is held in his house's office. Some award certificates, such as the Prêmio Anísio Teixeira and the Prêmio Estácio de Sá, given by the state of Rio de Janeiro, as well as some old photographs of him playing soccer and among the rowers, are hanging on the walls. On one spot there is a picture of Che Guevara. "I admire him. He was an idealist," says Coimbra, who recently liked the fact that Brazil supported the construction of a port in Cuba. He defines himself as a socialist. "In a world of limited raw material, if we do not socialize, everything is going to last less than it should. And life will be more difficult."

Coimbra is in tune with the Brazilian issues by watching the news on Jornal Nacional and listening to the radio. He reads newspapers and classic books (Tchekhov is one of his favorite authors) with the help of a magnifying glass or on iPad, as it is possible to increase the font size. Which politicians does he admire? Getúlio Vargas (because of his nationalism), Jânio Quadros, Leonel Brizola, Lula da Silva. He likes President Dilma Rousseff. "They are not perfect, but that's the best we have," says a realist Coimbra. He is still worried about the Brazilian industrial politics or the lack of it. "The national pharmaceutical industry is over. We used to have many parts factories for the oil industry. The foreigners bought everything," he says.

One of Brazil's backwardness that Coimbra most complains and feels sorry about is that the full-time education system implemented at Coppe, and in the undergraduate courses, was not adopted at primary, secondary and high schools. "If teachers are well-paid and students go to school from 9 am to 3 pm, Brazil will make a leap forward," he guarantees. Idealism does not ask to retire.

PERLINGEIRO:

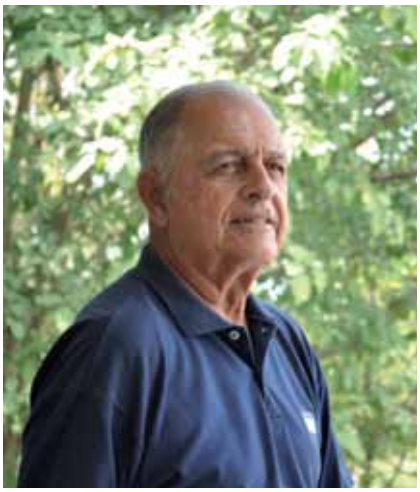
Difficult Choices in Favor of Coppe

In 1961, Carlos Augusto Perlingeiro, a young student, was about to graduate in Chemical Engineering and accepted the invitation from professor Alberto Luiz Coimbra, with whom he worked, to be part of the first class of the master's degree course that he would still create. Perlingeiro had been invited by Petrobras to participate in a course that qualified the company's engineers. He gave up a safe job to embark on an adventure proposed by Coimbra. What he did not know was that ten years later he would have to make a new and difficult choice – and once more he would choose Coppe.

The masters' degree course would only start in 1963, but Perlingeiro did not waste time. He would spend the days preparing himself for the course with the aid of a student scholarship. Coimbra asked him once: "Do you want to study about electronic brain in the United States?" At that time, for most Brazilian students, computer was like science fiction. Perlingeiro spent two months in Texas learning how to program in a Borus of the size of a fridge.

When he came back, he started to teach as a professor assistant in the Chemistry undergraduate course and suggested to include Computation as an obligatory course. He was in charge of this course and wrote what is probably the first Brazilian didactic text on the subject, entitled *Introdução à comunicação com computadores digitais* ("Introduction to the Communication with Digital Computers"). "I could not write 'programming' because no one would understand it," he explains.

His master's degree dissertation was the first one of Coppe to use computers. In 1968, he was the first one from the initial group of students to finish



his doctorate in the USA. In 1969, he became the coordinator of the master's degree course in Chemical Engineering and held the position until 1973. In this year, after Coimbra had left, he became the vice-director of Coppe.

Professor Sidney Santos, who was nominated to replace Coimbra, did not know much about the routine of Coppe, although he taught in the School of Engineering. Perlingeiro was responsible for the daily routine, the payrolls and the negotiations with Finep, who used to fund the institution. Finep wanted to exclude two of Coppe's programs from the funding list. "I was in a tight spot. I ended up convincing them to maintain the funding of all Coppe courses."

But Perligeiro's colleagues believe that he did much more than just that. He earned Sidney Santos' trust and was able to show to the new director the principles underlying the creation of the institution, thus convincing him of the importance of the ideas introduced by Coimbra. Therefore, Perlingeiro contributed to Coppe's survival and to the maintenance of its ideals in a turbulent time of its history.

At that time, Perlingeiro remembers that for the second time he gave up working for a private company. "Promon was willing to create a Technology and Research Center and invited me to work there. But I could not abandon Coppe at that moment."

MASSARANI:

Lessons of a Master that Used to Say that He Was an Apprentice

A sorcerer's apprentice – with good humor, that is how Giulio Massarani (1937-2004) used to define himself in honor of Coppe's founder, Alberto Luiz Coimbra, who he considered to be his master. When Giulio was still an undergraduate student, he was chosen by his professor to participate in the adventure of creating Coppe in Brazil. They made it with hard work and without using any magic.

Massarani was born in Rome to a Jewish family at the time of the fascist dictatorship and was brought to Brazil when he was one year and a half. He was naturalized in the 1960's. Giulio held the first position in the university entrance test for Chemical Engineering in Universidade do Brasil (now called UFRJ) and was one of Coimbra's best students. In 1960, professor Coimbra recommended that he receive a master's degree scholarship from the University of Houston. Coimbra was already working on the creation of a graduate course in Chemical Engineering and decided to

send his best students to study abroad in the expectation that they would become professors in Brazil. "At first, we were not much aware that we would contribute to create a graduate course. I'm not sure if Coimbra didn't make it clear or if we didn't get it," said Massarani in 1995.

After having obtained his master's degree, Massarani became the assistant of professor Donald Katz, one of the powerful men in Chemical Engineering in the USA at that time and also the assistant of Louis Brand, an American mathematician. These were two of the foreigners invited by Coimbra to teach classes in the new course.

At a time that almost nobody knew what was a master's degree course, Massarani was part of the group of young professors that used to travel around Brazil to find new good students to study at Coppe. On board Douglas DC-3 airplanes that shook a lot, Massarani traveled throughout Brazil. When the professors arrived at the chosen cities, they announced on a newspaper the place where they would select candidates to take the master's degree course in Chemical Engineering in Rio de Janeiro. "We used to stay at the hotel lobby waiting for some crazy students to show up. We were the trading salesmen of the graduate courses," he said laughing.

Massarani became a professor who was admired by everyone. He was Coimbra's disciple in that he rigorously prepared his classes, which were written and organized on notebooks piled in his office. "He was a fantastic and dedicated professional... He was a fully and exclusively dedicated professor," recalls Coimbra.

In addition to teaching, Massarani developed research about particulate systems, involving fluids and particles and problems such as filtering, separation of different liquids and fluid flow. The Laboratory of Particulate Systems gave rise to several research groups in different institutions.

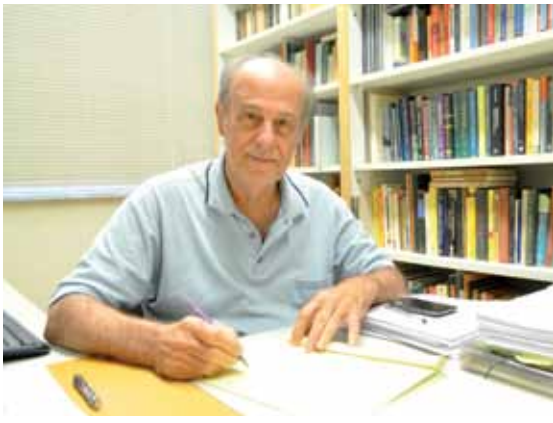
Together with Professor Afonso Telles, Massarani organized in 1973 the first Enemp – Encontro Nacional sobre Escoamento em Meios Porosos (the Brazilian National Meeting about Fluid Flow in Porous Media). In 2013, the now so-called Congresso Nacional de Sistemas Particulados (the Brazilian National Congress of Particulate Systems) was in its 36th edition. Another initiative of Massarani was to create, in 1978, UFRJ's Jornada de Iniciação Científica, an undergraduate research event aimed at arousing interest for research among undergraduate students. It was Massarani who designed the event's logo, a sorcerer's apprentice. Today, the event is named after its creator, who was an apprentice that became a master of "sorcerers" spread throughout Brazil and worldwide.

BEVILACQUA:

From a Private Company to the Academy

At Luiz Bevilacqua's office, within the Civil Engineering Program of Coppe, papers and publications fill up the closet and are piled up on a chair and an extra table. They are the belongings of the long career of the professor emeritus. His academic journey started in 1966, when he left a private company to become a teacher. Sidney Santos, his former professor and colleague at PUC-Rio, suggested that he talk to Alberto Luiz Coimbra. The founder of Coppe was planning to create a graduate course in Civil Engineering. "If you want to, you can start our program," Coimbra told him.

In 1967, Bevilacqua started the course, which still took place at a building in the Praia Vermelha campus. Soon afterwards, he would move to the campus at Ilha do Fundão, which was still under construction. He used to have lunch at a bar called Mosca Real, and regular public transportation was still not available at the campus. "A bus used to pick up the students early in the morning and would take them home between 4:30 pm and 5 pm. A Volkswagen van would pick up the ones who stayed at the campus after 5 pm. "Creating the Laboratory of Civil Engineering was literally a conquest. "In fact, it was an occupation. There was nobody on the place chosen and we were occupying the place."



Carioca from a neighborhood called Gamboa (close to downtown Rio), son of modest Italian descendant merchants, Bevilacqua obtained his doctoral degree at Stanford University, in the United States, in Theoretical and Applied Mechanics. He was also able to continue his studies on computation there, a topic he was able to begin to explore at Coppe. "The first computer at Coppe was an IBM 1130 Computing System. One of its ap-

plications was in structure engineering – lattices. Today its performance would be ridiculous, but it was faster than the slide rules," he recalls.

Bevilacqua was responsible for attracting one of the greatest names in the Brazilian civil engineering, Fernando Lobo Carneiro, to Coppe. In 1968, Bevilacqua wanted to take his doctorate. To convince Coimbra to let him do so, he invited Carneiro, a respected researcher at the Instituto Nacional de Tecnologia (the Brazilian National Technology Institute), to be the new head of the Civil Engineering Program. "It was not easy to convince him, but after he met Coimbra and visited Coppe, he became extremely happy."

When Coppe director Alberto Coimbra left Coppe in 1973, Bevilacqua was part of the group that kept the institution alive. Many professors left Coppe in fear of its decadence. In 1975, the Deliberative Council suggested that Bevilacqua be Coppe director. But he was not nominated. The dean told him that he would like to "observe his behavior first." Bevilacqua did not accept that and applied for leave to work for Promon. Afterwards, he resigned from UFRJ.

He returned to Coppe in 1986 at the invitation of the then director Luiz Pinguelli Rosa. He worked on the development of a submarine robot for Petrobras, a project involving teams from Electrical, Mechanical and Naval Engineering. After having retired in 1998, he was the executive secretary of the Brazilian Ministry of Science, Technology and Innovation and commanded the Brazilian Space Agency. In 2008, he received the title of professor emeritus from UFRJ.

Bevilacqua was the founder of the National Laboratory for Scientific Computation (LNCC) and was also the dean of the Federal University of ABC. "I had the opportunity to create a new university there, as Coimbra did at Coppe. I learned from him that we cannot stick to rules, otherwise nothing is done."

JACQUES DE MEDINA:

The Engineer that Found out that He Was a Professor

Jacques de Medina had never taught before when he was invited to be one of the first professors of the Civil Engineering Program, in 1968. Today he is almost ninety years old. Although he has been retired since 1994, he is still a consultant and can tell about his career as a teacher and a researcher. He created subjects at the courses, built reference laboratories, introduced new numerical methods, formed new research groups of national prestige and, overall, helped to change the scenario of road pavements in Brazil.

He is the only son of a Portuguese merchant, Gregório de Medina Jr., and of Hélène, a French woman who came to Brazil in 1918. Medina was born in 1925 and graduated in Civil Engineering (1947) and in Electrical Engineering (1948) from the then Universidade do Brasil, which is presently called UFRJ. At a time in which just a few used to leave the country to search for new knowledge, he took his master's degree in Civil Engineering at the Purdue University, Indiana (USA), in 1951.

At that time he already worked as an engineer in road agencies and became expert in paving. His professional career began in 1948 at the then called Departamento Nacional de Estradas de Rodagem – the Brazilian National Department of Highways (DNER). In this agency, he built a reference laboratory and introduced in the country the repeated loading tests on soil and asphalt mixtures, and equivalent tests on sand.

In the following years, Medina was in charge of organizing and consolidating the Geotechnics area of the Civil Engineering Program of Coppe. This research area was started at Coppe in 1967, the second year in a row of heavy rains that caused many deaths in Rio de Janeiro. The first coordinator was the young engineer Willy Lacerda, who assumed the position for one year until he went to take his doctorate in the University of California, Berkeley, in the United States. Medina held the position and brought with him the experience that he had gained at DNER. In the following years, Coppe helped to introduce in the country techniques that take into account the condition of national soil formation, which enabled great reduction of dimensionality and greater durability of the roads. The study on the soil physical and chemical properties had greatly contributed to that. This subject introduced by Medina has put Coppe in the leading position in the studies on environmental geotechnics.

In 1996, in recognition of Medina's academic journey, the Laboratory of Geotechnics at Coppe was named after him. His book *Mecânica dos pavimentos* ("The Mechanics of the Pavements"), a reference in the field, is going to be published in its third edition and he is coordinating its update.

Since 2008, Jacques de Medina has been a professor emeritus of UFRJ and has always showed interest in innovation and renovation. At the end of the 1970's, a time in which environmental issues were rarely discussed in Brazil, professor Medina presented to Finep a project to map residuals that could potentially be used at engineering works. The project was not approved, but his initiative showed that he was an observant person.

It was his taste for innovation and research that led the founder of Coppe, Alberto Luiz Coimbra, to invite Medina, despite his lack of teaching experience, to teach at Coppe. In fact, his relationship with Coimbra began before the creation of the institution. Since 1935, when they were teenagers, they were colleagues at the school Colégio Anglo-Americano in Rio. "I think I didn't disappoint my childhood friend. I also know that I was part of Coimbra's conspiracy to fill Coppe with Botafogo supporters," he jokes.

FRANK TILLER:

The Support at the Right Time

A respected American researcher in Chemical Engineering, Frank Monterey Tiller (1917-2006) was responsible for developing a plan, together with the founder of Coppe, to send students who had just graduated in the National School of Chemistry of the former Universidade do Brasil, presently called UFRJ, to take their master's and doctoral degree courses in the United States. After coming back to Brazil, these young students would become professors at the graduate course in Chemical Engineering that was being implemented by Coimbra and that would give rise to Coppe.

Frank Tiller was born in Louisville, Kentucky, in February 1917 and was one of the first researchers to apply mathematical models in chemical engineering. In addition, he is considered to be the father of modern filtration theory. Frank met Coimbra when the Brazilian student was taking his master's degree course at Vanderbilt University, in Tennessee, between 1947 and 1949. Tiller, who received his doctorate in 1946, was theadviser of the Brazilian student.

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The two always kept in touch, even when Tiller was transferred to Texas, in 1955, to be the head of the Department of Chemical Engineering at the University of Houston.

Tiller knew Brazil very well and used to visit the country since the 1940's and he even spoke Portuguese. In the beginning of the 1960's, he made a deal with Coimbra. The Brazilian professor would send his best students to take the master's degree course in Houston, and Tiller would be in charge of obtaining scholarships together with the Organization of American States (OAS). Besides, the young American doctors would be sent to teach at Coimbra's course. Tiller would also come to Brazil every so often, as well as the most experienced professors that he would convince to spend some time in the country.

According to Coimbra, Tiller was more or less explicitly aimed at influencing the Brazilian university to mold it according to the American standards – an attitude that reflected the years of Cold War and of disputes between the United States and the Soviet Union over areas of influence.

In the second half of the 1960's, Frank Tiller was partly devoting his time to the University of Texas and partly to the classes at Coppe, when he met Rudolph P. Atcon, an American consultant hired by the Brazilian Ministry of Education. At that time, Atcon encouraged the creation of the Conselho de Reitores das Universidades Brasileiras – the Council of Deans of Brazilian Universities (Crub), aimed at introducing "modern administration methods and practices" into the Brazilian universities.

Coimbra decided that Coppe needed to diversify its partnerships. He started to negotiate agreements with other countries. In 1968, professors from the Soviet Union, Europe and Japan arrived in Brazil.

Frank Tiller died in January 2006, when he was about to turn 89 years old. He is recognized as a scientist in the field of chemical engineering and as someone who has helped to establish engineering courses in various Latin-American universities.

JOSÉ PELÚCIO:

The Man who Created Science and Technology Policies

The Brazilian Science owes a great deal of its development to an economist. José Pelúcio Ferreira (1928–2002), who was born in Lambari, in the state of Minas Gerais, was a fundamental character in the formulation of a national policy of scientific and technological development. In the beginning of the 1960's, Pelúcio was the head of the Department of Economics of the then BNDE, now called BNDES. At that time, the bank used to offer a 3% quota of the value of its funding for companies

to invest in education and qualification. The funding was not much used because the company owners did not know what to do with it. The Brazilian companies were not worried about qualifying their human resources, let alone about developing technology.

According to Amílcar Ferrari, who worked with him, Pelúcio was asked by the board of directors of BNDE, in 1964, to provide a solution for the use of the funding. Ferrari tells that the board had realized that the low technological capacity of national companies was related to the lack of researchers in Brazil. In a long memorandum, Pelúcio suggested that the bank directly help to qualify new researchers.

At the same time, Coimbra was struggling with the lack of money to continue his plans to expand the engineering graduate course that he had created in the previous year. That was when a friend of his introduced him to Pelúcio. During the meeting, Coimbra proposed that the professional education funding should be allocated to graduate courses.

Their talk gave rise to Funtec, a fund administered by BNDE to invest in research and graduate education. Coimbra signed the first contract in 1965 and he is proud of that. "It was a great amount of money. Everybody started to earn more money – the heroes who decided to tighten their belts in the two years since the creation of the Chemical Engineering course, he recalls. "The role of Funtec was fundamental for the creation and expansion of graduate courses and research at universities throughout Brazil.

When Funtec was created, Pelúcio had the ambition to see Brazil's autonomous development. This ambition was influenced by that fact that he was constantly in touch with the economist Celso Furtado and his collaborators Cleantho

Leite and Américo Barbosa in BNDE, in the 1950's. José Pelúcio, who had recently graduated, was selected to work at the Bank when it was founded in the beginning of that decade. At the institution, he flirted with the developmental ideas that Furtado, who was the Bank's manager, helped to produce when he was a member of the Economic Commission for Latin America and the Caribbean (ECLAC). UN created the Commission with the purpose of studying the reasons for the region's underdevelopment and providing solutions.

In 1969, a period of military government, Pelúcio joined the team of the former Planning Minister, João Paulo dos Reis Velloso, and helped him to create the Brazilian National Fund for Scientific and Technological Development – Fundo Nacional de Desenvolvimento Científico e Tecnológico (FNDCT). In 1971, Pelúcio became the director of Finep, a state-owned company created to finance studies and projects, and he transformed the company into the greatest supporter of science and technology in the country. When Alberto Luiz Coimbra was withdrawn from UFRJ in 1973, due to an episode in which the founder of Coppe was persecuted by people related to the military government, Pelúcio took him to work at Finep. Pelúcio did the same for other people persecuted by the military regime, such as Américo Barbosa and the jurist João Lara. "I was really powerful at that time. I was respected by a lot of people. Why would I let extremely talented people without having anything to do?," he once argued in an interview in 1996.

In the 1980's, Pelúcio was the Secretary of Science and Technology in Moreira Franco's government in the state of Rio de Janeiro. That was when he reactivated the Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (Faperj) – the foundation aimed at fostering research and scientific development in the state of Rio de Janeiro.

ATHOS DA SILVEIRA RAMOS:

A Strong Support

Athos da Silveira Ramos (1906–2002) was an influential professor at the School of Chemistry who was the first to support Alberto Luiz Coimbra's efforts to create a master's degree course that gave rise to Coppe. In 1962, he helped Coimbra to organize two or three short-term training courses taught by the American professors. It was a kind of preliminary to the formal graduate course planned by Coimbra.

In 1962, Athos became the president of the recently created Institute of Chemistry, which was aimed at gathering and organizing into subjects and laboratories the 39 disciplines spread throughout nine schools of the Universidade do Brasil (now called UFRJ). His mission was also to encourage research and start regular graduate courses. Athos proposed to Coimbra that the future master's degree course could be offered by the Institute of Chemistry

and he had at disposal two rooms in the Praia Vermelha campus.

Since 1939, Athos da Silveira Ramos, who was born in the state of Rio Grande do Sul, had been a professor at the School of Chemistry and had been a major influence in Chemistry education in the country. Besides being a full-professor at the Universidade do Brasil, he also taught at the Escola Superior de Guerra (the Superior School of War), was the president of CNPq (the Brazilian National Council for Scientific and Technological Development) between 1962 and 1964 and, at the end of his life, he was the president of the Brazilian Education Academy (1992-1994).

Athos played an important role in the academic life of Coimbra. He had been Coimbra's Industrial Chemistry professor in the undergraduate course and had encouraged his student to travel to the United States to take his master's degree course in Chemical Engineering – an area that was starting in Brazil, but which was gradually replacing the old Industrial Chemistry in the more developed countries. When Coimbra came back to Brazil, he was invited by Athos to teach at the School of Chemistry.

FOREIGNERS THAT HELPED TO CREATE COPPE

With the initial help by Frank Tiller, Alberto Luiz Coimbra brought renowned foreign professors to organize the graduate course in Chemical Engineering. When the course was offered, **Donald Katz** (1907-1989), an experienced American professor from the Michigan University, was already part of the team. He taught two subjects, and had Giulio Massarani as his assistant in one of them and Affonso da Silva Telles in the one.

Katz was born in Jackson County, in Michigan, and was recognized as an expert in petroleum engineering in the United States. In 1983, he received the National Medal of Science for solving many practical engineering problems. In 1984, he was designated distinguished member of the Society of Petroleum Engineers.

Another American of great academic prestige who collaborated with the new graduate course was **Louis Brand** (1885–1971), who had been Tiller's professor. He was an influential mathematician and author of a book series about vector analysis and mechanics. He came from a family of erudite musicians from Cincinnati and considered mathematics an esthetic and simple exercise. He was in charge of the Department of Mathematics of the University of Cincinnati and then of the University of Houston.

Afterwards, more foreign professors came to Coppe from France, Germany, Japan, Canada and England. They would stay here for pre-established periods. The multinationality was not casual. Coimbra neither wanted to depend on anybody nor on a single teaching philosophy. Therefore, he cut the umbilical cord tied to Frank Tiller and began to bring people with different tendencies and from various schools. He used to invite the best and most influential Brazilian and foreign professors from the Schools of Chemistry and Engineering to teach at Coppe. From this select group, he did not require full-time and exclusive dedication.

The Soviets

It was because of the arrival of the Soviet professors that Coimbra felt for the first time the strength of the military government that began in 1964 in Brazil. When Victor Lenski, a distinguished international researcher in strength of materials and professor of the University of Moscow arrived in Brazil in 1968, his hotel room in Ipanema was turned over by the police. In that same year, Erlan Lenski, Victor's son and a civil engineer from the University of Moscow; Dimitri Rostovtsev, a naval engineer from the Leningrad Naval Institute, and Yuri Skliarevski, an electrical engineer from the Energy Institute of Moscow, also arrived in Brazil.

In 1971, the contract for technical assistance from the Soviet Union had ended. Coppe wanted to renew it to keep the four Soviet professors who taught at the Naval, Electrical and Civil Engineering Programs for a longer period. Coimbra went to Brasília to question the decision from the Ministries of Education and Foreign Affairs. However, it did not work. The professors had to go back to the Soviet Union and the partnership with the country was never reestablished.


Engenheiro russo chega para dar na UFRJ aulas de Matemática Aplicada

O Catedrático de Matemática Aplicada e Resistência de Materiais da Universidade de Moscou, engenheiro Victor Stepanovitch Lensky, chegou ontem ao Rio, onde dará aulas em curso de pós-graduação da Universidade Federal do Rio de Janeiro, dentro do acôrdo firmado recentemente entre as duas Universidades.

O Professor Lensky foi recebido no Galeão, de manhã, pelo Diretor do Curso de Pós-Graduação da UFRJ, Professor Alberto Luiz Coimbra, e seu assistente, Professor Luiz Bevilàqua. Até junho o engenheiro soviético fará diversas pesquisas na Universidade, para então iniciar suas aulas de Matemática Aplicada, dadas em inglês.

ESPECIALISTA

Especialista em testes de resistência de materiais, o Professor Lensky aperfeiçoa a máquina que submete metais e materiais a prolongamento, assim como a teoria e a prática de carregamento múltiplos.

Nos 1960 e 1961 estêve nos Estados Unidos, a convite da Universidade Brown. Depois

SEGUNDO CLICHÉ — Jornal do Brasil, quinta-feira, 9-3-68

BAGAGEM DO CONHECIMENTO

1970

- Alcebíades Vasconcelos, a student from the Civil Engineering Program, completes the first doctoral thesis at Coppe.
- Brazil wins the Soccer World Cup for the third time in Mexico.
- Coppetec is created.
- The Systems and Computer Science Program is created at Coppe.

1971

- Coppe is formally declared the supplementary body of UFRJ.
- The Biomedical Engineering Program is created at Coppe.

1972

- The Watergate scandal, which would lead President Nixon to resign in 1974, is uncovered in the United States.
- First color television broadcast in Brazil.

1973

- The founder and director of Coppe Alberto Luiz Galvão Coimbra is withdrawn from the institution.
- Coup d'état is launched in Chile, and President Salvador Allende dies.
- Yom Kippur War sparks and the first oil shock erupts.
- Professor Sydney Martins Gomes dos Santos occupies the position of Coppe director until 1975.

1974

- Petrobras discovers oil in the Campos Basin.
- General Ernesto Geisel occupies the Presidency of Brazil and begins a slow distension politics – a program of political liberalization.

1975

- Proálcool (the Brazilian National Fuel Ethanol Program), which was aimed at replacing the derivatives of crude oil by ethanol, is created.
- The area of Industrial Projects and Transportation within Production Engineering, which gave rise to the current Transportation Engineering Program of Coppe, is created.
- The Guanabara and Rio de Janeiro states are united.
- The first personal computer, Altair, is sold in the United States.
- The nuclear agreement between Brazil and West Germany is signed, predicting the construction of eight nuclear reactors and the incorporation of the German technology.

1976

- The Soweto uprising evidences the crisis of the apartheid government in South Africa.
- Many professors of the area of Urban and Regional Planning (PUR) are dismissed amid accusations by a colleague of spreading Marxist concepts in class.
- Capes evaluates graduate programs in Brazil for the first time.
- Professor Sérgio Neves Monteiro occupies the position of Coppe director until 1978.

1977

- The military government closes the Brazilian National Congress and issues the so-called Pacote de Abril (April Package), which was a set of authoritarian measures.
- The first victims of what would be called Aids in the following decade are hospitalized in New York.
- The American Space Shuttle Enterprise flies for the first time.
- Rachel de Queiroz is the first woman elected to the Academia Brasileira de Letras (the Brazilian Academy of Letters).
- The great partnership between Petrobras and Coppe for the development of the offshore technology, which later on would make Brazil the world's leader in deepwater oil production, is signed.

1978

- The AI-5 is ended and the liberalization of the military government in Brazil begins.
- Luiz Inácio Lula da Silva is the leader of the first labor strike since 1968 at the ABC paulista.
- The world's first test-tube baby is born in Bristol, in England.

1979

- The political parties Arena and MDB are dissolved and the multi-party system is resumed.
- The Brazilian Amnesty Law (Lei da Anistia) is approved, releasing political prisoners and receiving back the ones in exile.
- The Iranian Revolution takes place. The Ayatollah Khomeini assumes power.
- General João Baptista de Oliveira Figueiredo occupies the Presidency of Brazil.
- The second oil shock erupts: oil prices jump with the Islamic Revolution in Iran and the Iran-Iraq War.
- The Nuclear Engineering Program within the Interdisciplinary Energy Area is created. This program led to the creation of the Environmental and Energy Planning Program at Coppe.
- Professor Paulo Alcântara Gomes occupies the position of Coppe director until 1981.

CRISIS AND REINVENTION

It was the time of the so-called "Brazilian economic miracle", a period of rapid economic growth, between 1968 and 1973. In a decade known for great infrastructure works – power plants, bridges and shipyards – Coppe, with its expertise in various engineering areas, was increasingly calling the attention of the government and companies.

In the 1970's, the Universidade do Brasil was renamed as Universidade Federal do Rio de Janeiro (Federal University of Rio de Janeiro) – UFRJ – as the result of the University Reform Law. The first doctoral thesis of Coppe, entitled *O método dos elementos finitos: fundamentos teóricos – automatização – aplicações a problemas de placas e de elasticidade plana* (The Method of the Finite Elements: Theoretical Fundamentals – Automatization – Applications to Plate Problems and Flat Elasticity), was completed by Alcebíades Vasconcellos, a student from the Civil Engineering Program. Two new programs – The Systems Engineering and Computer Science (1970) and the Biomedical Engineering (1971) Programs – were added to the seven existing ones. Two new areas – the Transportation (1975) and the Energy (1979) fields – gave rise to new research opportunities. Years later, these two areas would become autonomous programs.

While the number of programs and research areas was increasing, Coppe professors were also being invited to provide consulting services and to carry out studies for private and state-owned companies. Coimbra knew that it was necessary to organize the partnerships outside the university, so that they could not interfere in the academic activities. Thus, in 1970, Coppe created the Coppetec Foundation (Coordenação de Pesquisas, Projetos e Estudos Tecnológicos – the Coordination of Research, Projects and Technological Studies), a pioneering initiative in Brazil.

Coppetec became responsible for administering the projects undertaken by Coppe for private and state-owned companies to guarantee that the contracts did not take great deal of time of the professors and that they could be financially profitable for the institution itself. Therefore, the financial resources could be allocated more easily and with more flexibility than the governmental resources. Coppetec, which years later would be transformed in a foundation, was a so successful initiative that it served as a model for similar bodies in other several universities in Brazil.

It was not the only pioneering organization to originate from Coppe's intellectual excitement and creativity. Coppe implemented new initiatives that afterwards would become new facilities within UFRJ. In 1971, the area of Urban and Regional Planning was created. Then it was recreated and today it is the Institute of Research and Urban and Regional Planning (Ippur). Coppe also created the Mathematical Engineering Program, the Electronic Computer Center (NCE) and the graduate course of the Institute of Economics.

In 1973, a group of professors from the Production Engineering Program, supported by the Ministry of Planning, created what would be the first Brazilian business school – Coppead. Based on the American business schools, it was Brazil's first graduate course in Business Administration. In 1980, it became autonomous and was renamed as Instituto Coppead da UFRJ (The Coppead Graduate School of Business).

The Price of Boldness

The second decade after Coppe's foundation was characterized by the great crisis that led to the withdrawal of Alberto Luiz Galvão Coimbra in 1973. The military government was at its peak. Conflicts and internal power disputes were favored by an environment of fear and accusation that would lead to threats and denunciations that would cross the university's boundaries and reach the safety agencies of the military government.

Coimbra's widely known boldness, which made him bring to Rio the best scientists from the Soviet Union or the United States, did not favor a dialog with the military government. As he was always eager to do what he considered to be the best for Coppe, he used to go on and ignore ideological polarization. The Russian professors had to leave at the end of the contract, in 1971. However, the faithfulness to science, and not to the military government, had been registered.

At the beginning of the decade, BNDE had changed the rules of its partnerships with research institutions. Instead of helping Coppe as a whole, BNDE established financial resources for each program. For practical reasons, the amount of money was still concentrated at Coppe and was administered by its board of directors. Most professors accepted that situation as they trusted in the director's leadership. They knew that Coimbra did not have patience for bureaucracy and that he worked to guarantee management efficiency and to give the best working conditions for the researchers, even if that meant that he would have to use the financial resources from one program to pay for something that was missing on the other program.

However, three professors who were invited by Coimbra to be the heads of the Biomedical Engineering, Systems Engineering and Electrical Engineering Programs did not agree with the progressive views of Coppe founder. Coimbra had built a unique institution at that time, which was comprised of integrated programs; the institution did not repeat the conventional formula of departments that are impervious to integration.

The financial management was the reason why the three coordinators, Drance Amorim (from the Biomedical Engineering); Celso Renna e Souza (from the Systems Engineering) and the General José da Fonseca Valverde (from the Electrical Engineering) expressed their opposition to the conception adopted by Coppe director. They questioned his management methods and provoked the creation of a committee of inquiry at the university. Shortly afterwards, the frightening Federal Police already knew about that committee.

That is how the repression bodies of the dictatorship got involved in the case, resulting in the withdrawal of the founder of Coppe. On May 18th 1973, the dean Djacir Menezes withdrew Coimbra and named Sydney Martins Gomes dos Santos, who was UFRJ's vice-dean and professor at the School of Engineering and at the Civil Engineering Program of Coppe, as the new director.

None of the inquiries has proven the accusations, which showed that if it had not been for the unfavorable political context, the inquiry would

not have continued. A distressed Coimbra was invited to be an adviser at Finep (Financier of Studies and Projects) by his friend José Pelúcio Ferreira, who had left BNDE. Coimbra would spend the following ten years there.

When Sydney Martins Gomes dos Santos became Coppe director, he knew that he had in his hands a fearful institution that was hurt. He attempted to settle conflicts and immediately withdrew the three coordinators who had accused Coimbra.

Sydney chose one of the professors who were close to Coppe founder, Carlos Alberto Perlingeiro from the Chemical Engineering Program, to be Coppe vice-director. Perlingeiro made great efforts to help him administer Coppe and especially to settle the conflicts. On one hand, Perlingeiro showed to the director the merits of Coimbra's ideas and actions. On the other hand, he would help the director to end the constant conflicts with faculty members.

In 1976, Coppe faced another crisis. A conflict in the area of Urban and Regional Planning (PUR), which was related to the Production Engineering Program, erupted. In practice, the area of Urban and Regional Planning was a program with its own coordinator. The area had been created supported by the federal government, by means of Banco Nacional da Habitação (the Brazilian National Bank for Housing). Differently from other programs, which mainly comprised engineers, the area of Urban and Regional Planning consisted of teachers and students of Architecture, Urbanism and Social Sciences. The members were more critical of the governmental policies.

A teacher in the area of Urban and Regional Planning accused his colleagues of spreading Marxist ideas in class. Coppe director, Sydney Santos, decided to fire 7 of 12 professors within the area of Urban and Regional Planning. As the other professors were not happy with the situation, they decided to leave in protest and, consequently, the area ended.

FOTO: CORREIO DA MANHÃ

REACTION TO THE MILITARY GOVERNMENT. STUDENTS AND TEACHERS PROTESTED AT UFRJ CAMPUS AT ILHA DO FUNDÃO IN SEPTEMBER 1966. THE GROUP IS HEADED BY MARIA YEDDA LEITE LINHARES (ON THE RIGHT, WEARING GLASSES), PROFESSOR OF THE THEN NATIONAL FACULTY OF PHILOSOPHY, WHO WAS A LEADER IN COMBATING DICTATORSHIP

Resistance

With Coimbra's traumatic withdrawal, the survival of Coppe was at risk. For a while, everybody feared that the institution would be dissolved within the university and that the courses would be divided into the different departments of the Schools of Chemistry and Engineering. The professors who were accused of protecting their students from the involvement in political activities were fired, and the unhappy professors resigned.

However, Coimbra's seeds resisted. Not only did Coppe survive, but it also underwent a great change regarding the academic production and the establishment of important partnerships. In 1977, Coppe and Petrobras signed their first major cooperation agreement to develop offshore technology, which years later helped to definitely change the scenario of oil production in Brazil and to make the country one of the world's leaders in deepwater oil technology.

Regarding the political scenario, there was hope at the end of the 1970's. In 1978, the AI5 ended and, in the following year, the Brazilian Amnesty Law was promulgated, which made it possible to release political prisoners, as well as to bring back the leaders and militants in exile. It was the beginning of the country's redemocratization process.

THE FRUITS OF COPPE AT UFRJ

Four institutions that originated within Coppe in its inception became independent within UFRJ: the Electronic Computer Center (NCE), the Coppead Institute, the Institute of Research and Urban and Regional Planning (Ippur) and the Institute of Industrial Economics (IEI). The graduate course of the Institute of Mathematics of UFRJ also originated at Coppe.

In 1967, at room 203 of block F of the Technology Center at UFRJ campus, an IBM 1130 computer was installed. The computer occupied a whole room, which needed to have air conditioner. General Tércio Pacitti, a professor at the Brazilian Air Force Technological Institute (ITA), was called to operate the computer. That is how the Department of Scientific Calculus of Coppe was created. Later on, it would be transformed into UFRJ's Electronic Computer Center (NCE). In 2001, it was renamed as Tércio Pacitti Institute of Computing Applications and Research, but the acronym NCE/UFRJ was maintained.

Faithful to the innovation inherited from Coppe, NCE played a major role in the creation of the undergraduate course in Computer Science.

In 1971, to offer graduate courses in Urbanism, an area named as Graduate Course in Urban and Regional Planning (PUR) was created at Coppe. This area lasted until 1977, when a conflict resulted in the dismissal of seven teachers accused of spreading Marxist concepts in class. Because of the dismissals, the course ended. But the original idea remained alive: in 1987, the Urban and Regional Planning was recreated by UFRJ under the name "Institute of Research and Urban and Regional Planning (Ippur)". The Institute is related to the Center for Law and Economics.

Coppead was created in 1973 as a program within Coppe by a group of professors from the Production Engineering. This group was aimed at creating the first business school in Brazil – the first graduate course in Business Administration based on the American business schools. In 1980, it became autonomous and was named as Instituto Coppead de Administração (The Coppead Graduate School of Business). The institute is directly related to UFRJ. Following the principles of its creator, Coppead requires full dedication of teachers and students. Since 2001, the institute has been listed in the rankings of the top 100 full-time MBA programs worldwide published by the Financial Times.

THE IBM 1130 COMPUTER WAS ONE OF THE DISTINGUISHING FEATURES OF THE DEPARTMENT OF SCIENTIFIC CALCULUS OF COPPE, CREATED IN 1967. THE DEPARTMENT GAVE RISE TO UFRJ'S ELECTRONIC COMPUTER CENTER (NCE), WHICH TODAY IS CALLED TÉRCIO PACITTI INSTITUTE OF COMPUTING APPLICATIONS AND RESEARCH

In the late 1970's, a group of professors from the Production Engineering, who offered a master's degree course in Economics of Technology, left Coppe to help to create the Institute of Industrial Economics of UFRJ. The graduate course began in 1979. In 1996, the Institute of Industrial Economics joined the Department of Economics of the then Faculty of Economics and Administration, giving rise to the Institute of Economics of UFRJ.

In 1968, on the initiative of Coimbra, the Mathematical Engineering Program was created at Coppe with the help from some professors, such as Carlos Alberto Aragão de Carvalho, Luis Adauto, and the renowned mathematician Leopoldo Nachbin. In the following year, the program was coordinated by Professor Guilherme De La Penha, who had just arrived at Coppe after having concluded his postdoctorate in the Department of Mathematics at the Carnegie Mellon University in the USA. At Coppe, Guilherme De La Penha started to study mathematical physics, with emphasis on the mechanics of continuous media and advised master's degree students. In 1971, the Mathematical Engineering Program was transferred to the Institute of Mathematics of UFRJ, giving rise to its first graduate course, which is recognized for its excellence in qualifying people.


O problema tecnológico
Uma solução pelo binômio universidade-empresa

COPPETEC

The Originality of Partnerships with Companies

In 1970, when Coppetec was created, once again Coppe showed courage and creativity when the institution introduced the concept of a "technology office" in the national academic scenario. Coordinated by the engineer Acher Mossé, Coppetec was created to manage the ongoing partnerships and research projects with companies, to organize the provision of consulting services by the professors of Coppe, as well as to produce financial resources for the institution.

Coppetec's first contract was signed with Furnas Centrais Elétricas in 1970 to implement a project coordinated by professor Rui Vieira da Silva, from the Civil Engineering Program. However, the great leap was made in 1977, when Coppe and Petrobras signed the greatest technical cooperation contract between a state-owned company and an academic institution. This agreement has established a long-term partnership that has helped to change the oil industry in the country.

In 1976, professor Flávio Grynszpan held Acher Mossé's position as the coordinator of Coppetec. Grynszpan took his doctorate in the University of Pennsylvania and had already revealed his talent for managing when he became the coordinator of the Biomedical Engineering Program under the age of 30.

"When I became the coordinator of Coppetec, I thought that a change was necessary. We changed from acting individually, providing consulting services, to developing more structured projects undertaken by teams. We also included more areas, such as the transportation and nuclear fields," Grynszpan recalls.

A Pioneering Foundation

Coppetec also introduced in the country the debate about innovation. In 1984, it created the Center for Technology Innovation in liaison with the National Science Foundation (NSF).

In March 1993, Coppetec was transformed into a private non-profit legal foundation. The foundation is pioneer in Brazil and has been responsible for great advances in the relationship among universities, companies and society. The concept of this new structure was formulated by professor Antonio MacDowell de Figueiredo, who was the director of Institutional Planning at Coppe. At that time, Coppetec was coordinated by professor Angela Uller and it was headed by professor Antonio Fernando Infantosi.

An Innovative Concept

"The concept that we adopted for the foundation was somewhat innovative. There was nothing similar to it at the Brazilian universities. It was a totally pioneering initiative, which was essential to implement an institutional model at Coppe," highlighted Figueiredo, a professor of the Mechanical Engineering Program.

Throughout these years, as a foundation, Coppetec has been supporting research projects of Coppe and of other institutions within UFRJ. Among its clients are governmental agencies and state-owned and private companies.

Until today Coppe has administered more than 13,000 contracts and partnerships with national and international private and state-owned companies, as well as governmental and non-governmental agencies. In addition to managing ongoing projects, Coppetec also administers patents and software registered by Coppe.

ACHER MOSSÉ:
THE FIRST ADMINISTRATOR OF COPPE

The carioca Acher Mossé helped the founder of Coppe, Alberto Luiz Coimbra, to implement Coppetec – which until then was a new initiative to manage contracts between universities and companies. Coimbra's intention was to have Francisco Nilo de Farias, the child of a bank director who would rather see his son on the financial world than in the academia, as the administrator of Coppetec. Francisco decided to accept his father's arguments and, therefore, Mossé became the first administrator of Coppe. He held this position from 1970, when the Coppetec Foundation was officially created, until 1974, when he went to work at Cepel/Eletrobras(the Electrical Engineering Research Center).

Mossé does not really know why Coimbra chose him to manage Coppetec, which was informally created in 1968. As he particularly enjoyed being with people, and as he was more inclined to administration than to the academic life, the engineer faced the challenge to organize the department, which initially consisted of a secretary, Mossé and a Volkswagen van.

Coimbra, Lobo Carneiro and other teachers came up with the idea of creating Coppetec when they realized that Coppe professors were being contacted by companies to solve technology problems. They decided to organize the professors' service renderings in an attempt to avoid letting them neglect the classes and other academic affairs, and to come up with additional financial resources. The teachers would devote some time to the projects hired by the companies and would receive a percentage of the amount paid by the contractor. Coppetec would be responsible for administering these partnerships.

At the beginning, according to Mossé, some teachers showed enormous enthusiasm, others were indifferent, and some others did not like the idea at all, as they thought that Coppe should be essentially academic. They were afraid that the institution would become a mere company of technical service rendering, without scientific content and technological challenges. However, with time, it was clear that the projects undertaken together with the companies had to do with the academia and with science and that the partnership between the university and the corporative world would be positive for both parties.

"I made some changes and thought that more structured projects undertaken by teams would be better."

FLÁVIO GRYNSZPAN,
former professor of Coppe and former director of Coppetec

"When I became the director of Coppetec, in 1990, the institution was already important to Coppe. In 1993, we thought that it was necessary to transform Coppetec into a foundation. By doing this, we were able to accelerate project management."

ANGELA ULLER, professor of Coppe and former director of Coppetec

1980

- The founder of Coppe, Alberto Luiz Galvão Coimbra, receives the IBM Award in the field of research and technological development.

1981

- Bomb attack occurs at Riocentro.
- IBM's personal computer is released.
- The founder of Coppe, Alberto Luiz Galvão Coimbra, is awarded the Prêmio Anísio Teixeira by the Ministry of Education.

1982

- Falklands War sparks between Argentina and Great Britain.
- The first direct elections since 1966 for state governments take place.
- Professor Sandoval Carneiro Júnior holds the position of Coppe director until 1985.

1983

- The Central Única dos Trabalhadores (The Unified Workers Central), CUT, is founded.
- Alberto Luiz Galvão Coimbra returns to university and starts to work at Coppe again.

1984

- The Movimento dos Trabalhadores Rurais Sem Terra (Landless Workers' Movement), MST, is created.
- The Brazilian movement entitled Diretas Já, for the right to vote for president in the 1985 election, starts.
- William Gibson coins the term "cyberspace" in the book *Neuromancer*.
- Apple releases Macintosh.
- The law that defines the Brazilian National Politics of Computer Science is approved by the National Congress.

1985

- Tancredo Neves is indirectly elected president and dies before taking office. Vice-president José Sarney holds the position.
- The Brazilian Ministry of Science and Technology is created.

1986

- A nuclear accident in the Chernobyl nuclear power plant, in Ukraine, takes place.
- President José Sarney launches economic plans called Planos Cruzado I and II to control hyperinflation.
- Space shuttle Challenger explodes.
- After having been elected by the academic community, Luiz Pinguelli Rosa holds the position of Coppe director until 1989.

1987

- Moratorium on the Brazilian external debt is announced.
- A nuclear accident occurs in Goiânia due to the leakage of cesium 137 from an old radiotherapy source.
- Coppe creates subsea robots to perform research and repairs in the platforms of Petrobras.

1988

- Chico Mendes, a Brazilian environmentalist and leader of the rubber tapers, is murdered in Acre.
- The new and democratic Brazilian Constitution is approved.

1989

- The Berlin Wall comes down.
- Tim Berners-Lee, a British researcher, develops the concept and the basic tools of the worldwide web (www).
- The Rede Nacional de Pesquisa (RNP), which today is called Rede Nacional de Ensino e Pesquisa (the National Research and Education Network) is created to establish internet networks for the Brazilian academic community.
- The partnership between Coppe and the European Organization for Nuclear Research (Cern) is established.

POLITICAL OPENING, ECONOMIC CUTBACK

The 1980's was called "the lost decade" of the Brazilian economy. In the last years of the dictatorship established in 1964, Brazil went from a miracle to a failure due to a combination of several international factors and the limitations and internal difficulties of the country. The crisis deepened the contradictions of the military government and offered a favorable scenario to the movements that would lead to redemocratization. Coppe had its hard times, but these times would also provide new opportunities.

The "economic miracle" failed due to the first and second oil shocks in 1973 and 1979, when the producers multiplied the international price of oil, thereby affecting the economy of the importing countries. In Brazil, the external debt aggravated, and the inflation turned out to be hyperinflation.

The oil shocks, however, revealed a positive effect: the goal to increase national production became major priority. In 1974, the discovery of the Garoupa field in the Campos Basin made it possible to explore the great oil reserves in the Brazilian continental platform. By signing a cooperation agreement with Petrobras in 1977, Coppe would play an important role in the history of offshore technology.

A National Technology

Coordinated by Fernando Lobo Carneiro and Agustín Ferrante, the cooperation between Coppe and Petrobras was promoted to develop specific computing systems to design platforms, thereby establishing a partnership that lasts until today. In 1985, there were already 33 fixed platforms in operation at shallower depths, which were designed based on the work of the team of Coppe. The project for the construction of the first seven platforms using Brazilian technology to operate in deep water was already being planned.

In the 1980's and 1990's there was a sequence of production records until the country became self-sufficient in 2006. By the end of 2014, the partnership between Coppe and Petrobras had resulted in more than 3,000 projects and hundreds of master's dissertations and doctoral theses.

The alliance formed because of the oil production was aimed at approaching the production industry, particularly the state-owned companies, by means of Coppetec. It was a strategy that was partially developed due to necessity. Federal grants for research were decreasing due to federal cutbacks made to tackle the economic crisis. But the increasing number of partnerships with the companies was also a result of the growth of Coppe. The institution was organized and prepared to produce technology and to act in interdisciplinary groups. For instance, in 1979, the Energy Interdisciplinary Area (AIE) was structured to combine efforts and knowledge from the Systems Engineering, Production and Nuclear Programs. As a result, academic advances were made and technological gains were achieved in the country.

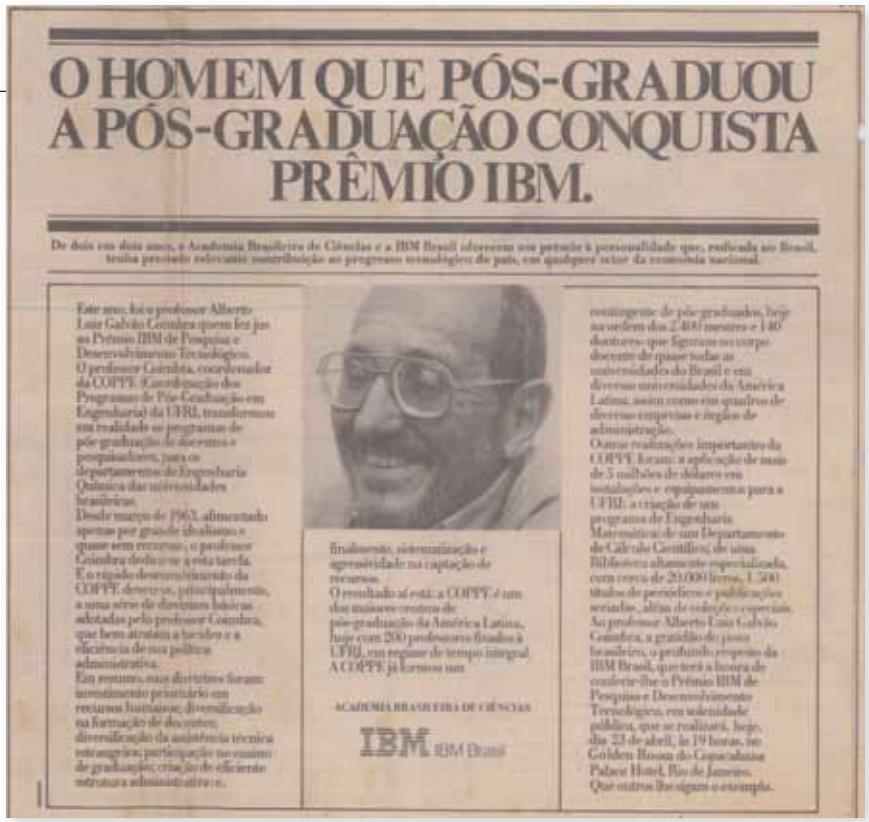
At the end of the 1980's, researchers of the Laboratory of Parallel Computing of Coppe developed the NCP I, the first high-performance parallel computer built in Brazil. This parallel computer was much cheaper than the ones produced in the United States and Japan and it started to operate in 1990, which made it possible to further scientific research and applications in the field of engineering, as well as the projects of high-performance computers in the country.

As Brazil was not part of the signatory countries to the Treaty on the Non-Proliferation of Nuclear Weapons, it could not import high-performance computers from those countries.

In the political scenario, the 1980's were marked by the transition to democracy. In 1978, the AI-5, the main instrument of a state of exception, was cancelled. In 1985, José Sarney assumed the Presidency and Brazil's president was again a civilian.

Mobilization

At UFRJ, the 1980's also brought more participation and political mobilization due to the organization of the professors in a teachers' association. After the 1973 intervention, Sydney Santos was replaced by Sergio Neves Monteiro (1976–1978) at Coppe board of directors. After Paulo Alcântara Gomes (1979–1981) assumed the position, the directors would be chosen by the university's dean based on a list with three names appointed by the institution. His successor, Sandoval Carneiro (1982–1985), reestablished the Deliberative Council – a body consisting of all professors and student representatives, which had been cancelled in Sydney's management.

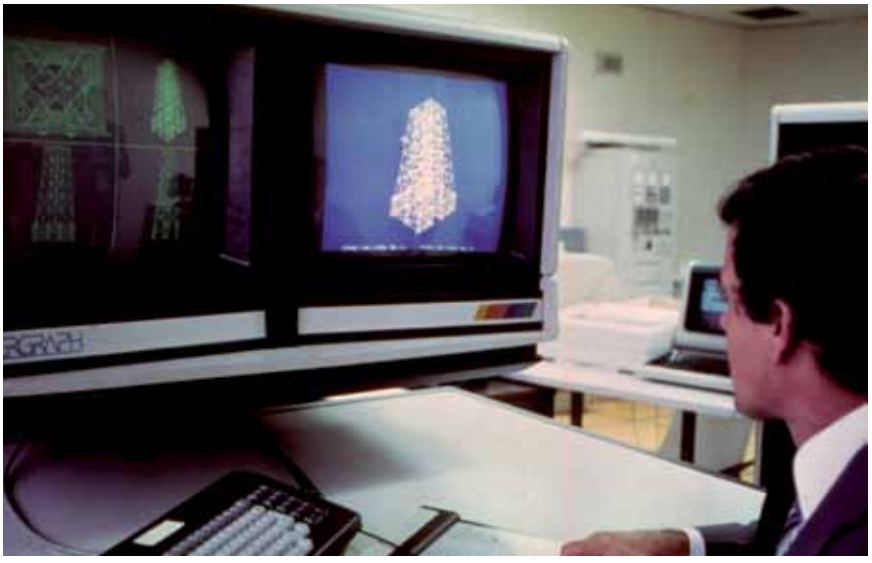


O HOMEM QUE PÓS-GRADUOU A PÓS-GRADUAÇÃO CONQUISTA PRÊMIO IBM.

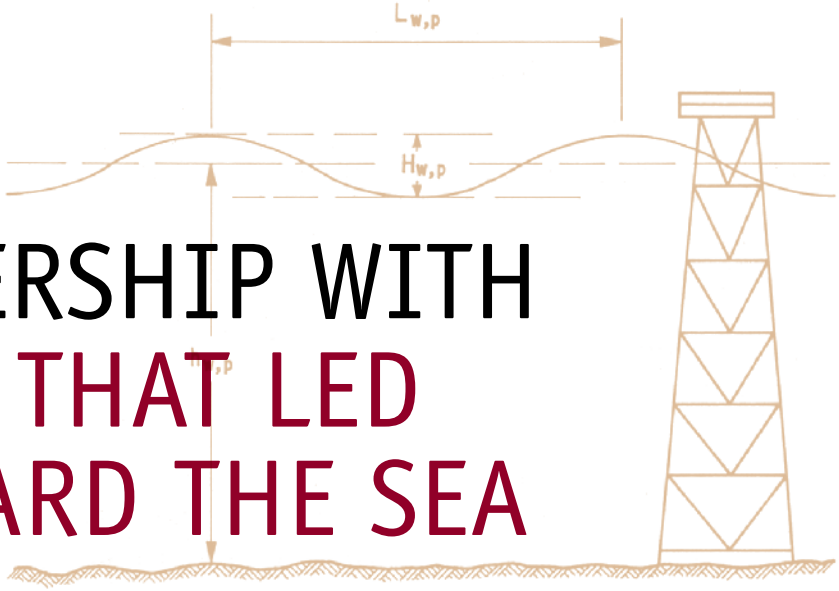
In 1986, Luiz Pinguelli Rosa assumed the position as Coppe director and he was the first director elected by direct vote. It would be the first of his five non-successive terms as director. During his terms, Coppe would increase the number of equipment and laboratories and would become not only a role model in technology and scientific knowledge, but also an important mediator in the public debates regarding environmental, social and infrastructure issues.

At that time, Coppe founder and first director had already come back from his professional exile. In 1981, still under the military government, he had left ostracism when the Minister of Education, Rubem Ludwig, awarded him the Prêmio Anísio Teixeira. In 1983, he returned to Coppe as a professor. He was 60 years old. In 1985, his colleagues paid a tribute to him and offered him to be the coordinator of the Chemical Engineering Program, a position that he had held until 1987. After that, he continued to teach until 1993, when he stopped and was given the title of professor emeritus.

In 1995, the institution imagined and created by Coimbra granted him one of the greatest recognitions one could receive in life. Coppe was renamed as Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia (Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering). However, the acronym Coppe, chosen by him 30 years before, continues to be used.



A RESEARCHER OF CENPES USES A SISPLOT VISUALIZATION MODULE OF THE ADEP (ANALYSIS AND MEASUREMENT OF STRUCTURES AND PLATFORMS) AND INPLA (PLATFORM INSTALLATION) SYSTEMS DEVELOPED AT COPPE IN 1977, FOR OFFSHORE PLATFORM PROJECTS AND INSTALLATIONS



THE PARTNERSHIP WITH PETROBRAS THAT LED COPPE TOWARD THE SEA

In 1974, after having been oppressed by severe dependency on imported oil and by the increase in oil prices, the Brazilian federal government accepted the challenge to run toward the sea and encouraged Petrobras to search for oil in the theretofore essentially unexplored Campos Basin. Three years later, a historical partnership between Coppe and Petrobras was established, which made it possible to develop a national engineering technology for oil production in high sea.

For Petrobras, the partnership inaugurated the tradition to search for support and stimulate the technological competence of universities and Brazilian research institutes. For Coppe, the partnership has fostered more than 3,000 research projects, has qualified hundreds of masters and doctors and has resulted in the creation of continuing professional education and specialization courses. The cooperation between Coppe and Petrobras made Brazil a world leader in deepwater oil exploration and saved billions of dollars for the country.

The Deep Waters

Petrobras found the first oil field in the Campos sea, the Garoupa field, in 1974. In the following years, Petrobras rapidly discovered the fields of Pargo, Namorado, Badejo, Enchova, Bonito and Pampo. However, the company faced a serious problem: each new discovery was more distant from the coast and the fields were located at depths (at depths of more than 100 meters) much greater than the ones of the small production fields in the Northeast of Brazil (depths of no more than 30 or 40 meters).

There was a lack of technology to explore great depths. Even in the shallow northeastern fields, the structural projects to construct the production platforms were ordered from foreign engineering companies. These companies considered the technical specifications of the American Petroleum Institute developed for the Gulf of Mexico.

At the same time, the Civil Engineering Program of Coppe began to study the use of computational methods to perform structural analysis. To design a structure, it is first necessary to analyze its ability to withstand loads. Structures in the sea are subject to a variety of dynamic agents, such as winds, waves and sea currents. In this case, computational methods are useful. In parallel, the Naval and Ocean Engineering Program was developing studies on hydrodynamic loads and monitoring techniques to guide inspection plans and maintenance of fixed platforms.

Coppe already had vast experience in structural analysis, a research area of Fernando Lobo Carneiro, who was the coordinator of the Civil Engineering Program. In 1976, he invited the Argentinian Agustín Juan Ferrante to join the Program. Ferrante had been working with a computational system called Strudl (Structural Design Language), developed in the United States. Ferrante had the idea of contacting Petrobras to offer Coppe services. After all, as Petrobras was heading toward deeper waters, the company would have to abandon the fixed platforms, which are built on the ocean floor, and begin using floating platforms.

The Coppe/Petrobras Partnership

Coppe's proposal was to develop, in liaison with Leopoldo Americo Miguez de Mello Research & Development Center (Cenpes/Petrobras), and based on the Strudl system, the computer programs that would allow Petrobras to design its own platforms. To do so, the company's employees had to be qualified; there-

fore, the company sent its engineers to take master's and doctoral degree courses at Coppe. The conversations resulted in an agreement entitled Recursos Computacionais de Engenharia *Offshore* ("Offshore Engineering Computational Resources"), which was signed in the second semester of 1977.

A major boost to the Coppe/Petrobras partnership came in 1979, after a rupture on a processing tower located on a production platform designed in the United States for the Garoupa field. The interruption of oil production aggravated major loss of earnings in Brazil exactly when the Arabian countries promoted the second oil shock, resulting in a new price rise.

During the investigations into the responsibility for the failure, the analyses performed by Coppe showed that the project of the American company had design flaws. As the American designers were used to the calm seas and strong storms of the Gulf of Mexico, they did not take into account the differences of the sea in Campos, which lacks calm seas and strong storms, but constantly has rough seas throughout the entire year. Furthermore, the project did not take into account the continuous action of small waves. In addition, the structure containing the tower was connected to a ship, which produced increased pressure on the tower and accelerated wear on the material. Coppe professionals also warned that the same might happen to the other tower used for loading.

Thanks to Coppe's technical report, Petrobras was subsequently reimbursed by the American company. Petrobras was so impressed by the institution's efficiency, and, by extension, by the Brazilian university in general, that it began to interact with universities on an increasingly frequent basis.


Dando ciência ao Brasil

THE FIRST NATIONAL PLATFORMS

The first 100% national platforms were designed for the so-called Northeastern Pole of the Campos Basin. They were installed in the shallow waters of the fields of Pargo (PPG-1 A/B, two interconnected platforms), Vermelho (PVM-1, 2 and 3) and Carapeba (PCP-1, 2 and 3). These platforms were designed at Cenpes, where Coppe's team played an important role in the construction of structures and in the hydrodynamic analyses.

By 1985, there were already 33 fixed platforms in operation, based on work carried out at Coppe. These platforms were installed in water depths varying from 10 to 48 meters, in the Northeastern Pole, in the south of Bahia and in the state of Espírito Santo. That same year, plans were in the works for the first seven platforms entirely produced in Brazil, which would operate at water depths of approximately 100 meters.

By this point, the cooperation between Petrobras and Coppe had become increasingly diversified and highly productive. Dozens of professors and students from the Civil Engineering Program and the Naval and Ocean Engineering Program, as well as from other programs, participated in the company's projects in many different areas. Some of them spent a great deal of time at Cenpes. There were so many researchers that there wasn't enough space for all of them. The youngest researchers had to use the employees' workstations at Cenpes after the regular workday had ended. These researchers were very enthusiastic and would spend whole nights running computer programs and discussing solutions for the various challenges that would come along.

One of these challenges was the so-called "piling case". To use less steel, the pilings that would support the seven platforms in the Campos Basin had been designed by Petrobras in a slightly different way, in order to save steel. When the specifications of the construction project were being outlined, the company's engineers verified that the strength capacity of the pilings in the soil of the region was different from what had been expected. The costs with piling would more than triple, and the installation of the platforms would not be economically feasible.

Coppe professionals then helped Cenpes to find a solution – a new concept of piling. The new pilings had conical ends, just like a pencil, which would allow for greater contact with the soil. Under the supervision of Cenpes, Coppe participated in the experimental studies and conducted tests and measurement activities. After the platforms were built, Coppe monitored the performance of each platform. Petrobras patented the pilings with conical ends.

TECHNOLOGY ALLOWED ADVANCES INTO THE DEEP WATERS

When the digging operations reached depths of more than hundreds of meters at the Campos sea, it was necessary to abandon the fixed platforms driven into the seabed and begin to use floating structures. During this process, the knowledge of the research group from the Naval and Ocean Engineering Program on the hydrodynamics of marine floating structures helped to increase the specific understanding of the Brazilian sea.

Floating structures are held in place by several kilometers of anchorage cables. The deeper the water, the greater is its exposure to pressure and wear, and the greater is the complexity of their installation and monitoring.

A Lighter Anchorage

An example of the challenge met by Petrobras with the help from Coppe was the replacement of steel for polyester in the anchorage cables. Polyester is a lighter material, which has helped the state-owned company surpass the water depth of 600 meters. A platform operating at this depth needs to be anchored by 12 cables laid at a horizontal distance of 1,800 meters, forming a web. If this web were made of steel, it would require almost the entire floating capacity of the platform, making polyester more appealing. In addition, Coppe was responsible for analyzing the reliability of the material, which allowed Petrobras to convince the risk assessment agencies to accept its use.

In 1989, Coppe launched its first hyperbaric chamber to simulate pressures equivalent to those found at depths of up to 1,000 meters. Afterwards, other chambers were built to simulate pressures and temperatures found at a depth of 5,000 meters. In these chambers, researchers performed tests that made it possible to enhance projects and prototypes to build equipment used in deep and ultra-deep waters on large scale.

Another innovative project developed in the beginning of the 21st century was the rigid riser of the P-18 platform, which was being used for the first time. Rigid risers are pipes that conduct the oil from the subsea region to the platforms. This project is part of the effort to find solutions for the extremely costly flexible risers that are used today.

Predictive Maintenance

The long experience gained by Coppe is also applied to what is called predictive or proactive maintenance. It consists of monitoring equipment to identify a problem at its initial stages and detect the moment in which it is necessary to repair it. Coppe researchers developed a system to monitor the turbocharger, which is a machine used to compress the natural gas extracted from the subsea region before transporting it to land.

Research developed at Coppe also helps the operation of the platforms. One example would be the offset diagrams, which consist of a study of the maximum distance that a platform can drift without affecting production. These diagrams were implemented at the Campos Basin in 2007.

There is an increasing tendency in the offshore oil industry to use intelligent technology. The increasing complexity requires the mobilization of researchers from different areas. That is how other programs within Coppe joined the first two programs to carry out projects for Petrobras. This partnership has resulted in more than 3,000 projects.

Brasil cria tecnologia para a exploração do fundo do oceano

Tanque da Coppe reproduz condições de águas profundas

PLATFORM IN OPERATION IN THE PARGO FIELD, WHICH WAS DISCOVERED IN 1975 IN THE CAMPOS BASIN

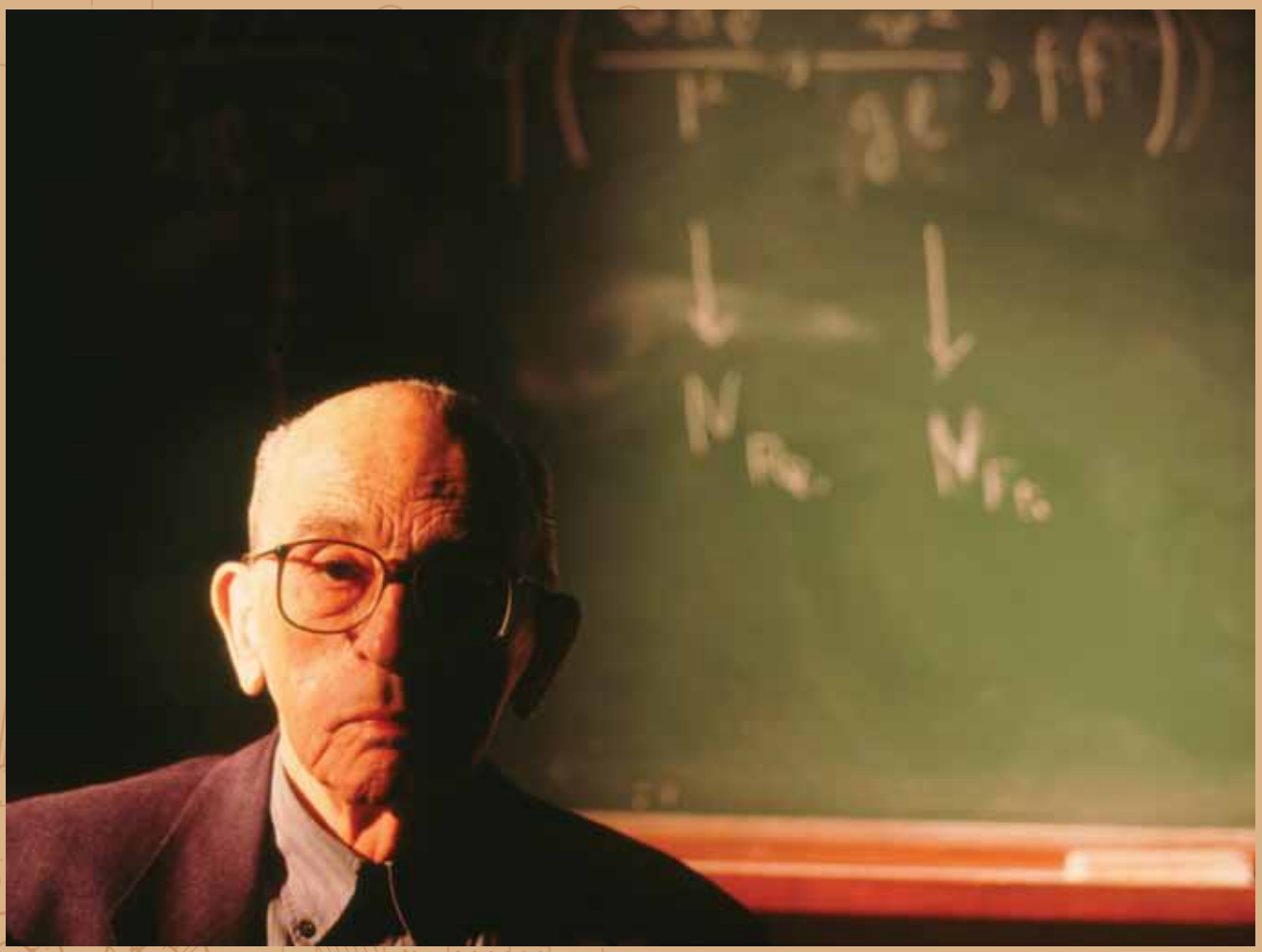
LOBO CARNEIRO:
FOR A SOVEREIGN COUNTRY

The carioca Fernando Luiz Lobo Barboza Carneiro (1913–2001) was a simple and discrete man, a professor loved by his students, and a scientist respected by his colleagues, but who was not known by most people. However, he played a fundamental role in the courses of teaching, research and practice in civil engineering in the country. He was also a brave warrior in the fight for Brazil's political and technological sovereignty in oil exploration and production.

When he arrived at Coppe in 1967, Lobo Carneiro, as he was called by his students and friends, already had a career and history. He was a civil engineer who had graduated in 1934 from the then Universidade do Brasil, which was renamed as UFRJ, and who was retiring from the Brazilian National Institute of Technology (INT), where he developed his expertise in structures. In the 1940's, he was respected in international engineering for having developed an experiment to test tensile strength on concrete. The method is still known abroad as "the Brazilian test" in the United States and "l'essai brésilien" in France.

Years before, in 1939, Lobo Carneiro spent some time in Montevideo to learn everything he could about the operation of oil refineries. His uncle, General Horta Barbosa, who was the first president of the theretofore recently-created Brazilian National Council of Petroleum, made him go on this mission. The general was worried about the Brazilian dependence on imported fuel.

Back to Brazil, Lobo Carneiro used his technical knowledge in the political militancy. Between 1947 and 1953, he fully and actively participated in the



PROFESSOR LOBO CARNEIRO (ON THE RIGHT) IS AWARDED THE PRÊMIO PESQUISADOR EMÉRITO (THE RESEARCHER EMERITUS AWARD), DURING THE CEREMONY TO CELEBRATE THE 58TH ANNIVERSARY OF THE BRAZILIAN NATIONAL INSTITUTE OF TECHNOLOGY (INT), IN 1979, AT THE ENGINEERING CLUB. IN THE CENTER IS ISRAEL VARGAS –THE FUTURE MINISTER OF SCIENCE AND TECHNOLOGY

campaign "O Petróleo é Nosso" ("the oil is ours") for the creation of the state monopoly of oil exploration and production. He studied the issues related to the theme thoroughly and was not afraid of controversies. By using technical arguments, he refuted the views of those who used to contest the national capacity to build the country's own oil industry, and made great effort to inform the public opinion. He even accepted to be a substitute for a congressman just to hold his position when the Congress was going to discuss the bill that would create the oil monopoly and Petrobras. In 1953, after having helped to create Petrobras, he discreetly went back to his researches at INT.

The Oil Maestro

At Coppe, the engineer-researcher would also become a professor. He started to work at the theretofore recently-created Civil Engineering Program and began his second professional career. He was the adviser of master's and doctoral degree students and built the important Laboratory of Structures, one of the most modern laboratories in the world at that time. One of his great academic deeds was the introduction of the studies on non-linear dynamic analysis, a knowledge field that began in the 1970's and which was almost unknown in Brazil. The non-linear dynamic analysis uses heavy computation to deal with problems involving multiple variables whose behavior is difficult to predict, such as the platforms and vessels floating on the sea, subject to the action of waves, winds and storms.

Together with foreign professors and Brazilian students, Lobo Carneiro formed a very strong group, thus convincing Petrobras to bet on Coppe's proposal: to jointly develop national technology to design structures of oil platforms to operate in high seas. At that time, the company was installing the first production platforms in the Campos Basin, which had been projected abroad, based on parameters that were more suitable for the Gulf of Mexico and the North Sea than for the Brazilian sea.

The partnership between Petrobras and Coppe, established in 1977 and coordinated by Lobo Carneiro for so many years, was never interrupted. Thanks to this cooperation, Coppe has actively participated in the development of technology that has made Brazil leader in deepwater oil production.

Not even the advanced age changed Lobo Carneiro's mood and enthusiasm to study new things. On August 20th 2001, one of Coppe professors who had been his student was walking by the external area of the Technology Center when he met his former teacher. Lobo Carneiro was 88 years old, had been retired for quite a long time, but was still teaching classes in the Civil Engineering Program once a week.

"Where are you going, Fernando?," the professor asked. "I'm one of the members of a doctoral examination board in the Mechanical Engineering Program. Actually, I'm the co-adviser of the work," answered Lobo Carneiro.

"What is the thesis about?," asked the professor again.

"Acoustics. A very interesting issue on acoustics," he explained.

The student who was concluding his doctorate was 23 years old. Together with his adviser, who was 65 years older than him, he had been working for one year on the mentioned acoustics issue, until a solution was found. Almost three months later, on November 15th, 112 years after the Brazilian Republic had been proclaimed, the heart of the Brazilian Fernando Luiz Lobo Barboza Carneiro stopped beating and he could finally rest in peace.

AGUSTÍN FERRANTE:
A PIONEER IN THE USE OF COMPUTERS FOR OFFSHORE STRUCTURES

Agustín Juan Ferrante (1938–2009) was born in Buenos Aires and was a pioneer in using computation in structural engineering in Brazil. But, above all, he was the man, who, together with Professor Lobo Carneiro, paved the way for research toward the sea. He had the initiative to contact Petrobras and offer a joint work to qualify the employees and develop computational tools for offshore structural engineering.

It was not easy to convince the company's engineers. But, after constant insistence, the agreement was finally signed in 1977, therefore establishing a partnership which today, almost 40 years later, still involves Coppe researchers of almost all engineering areas and of other areas, as well.

In 1964, the young Augustín was an undergraduate student of the Mechanical Engineering Course of the University of Buenos Aires, when the professor of the subject entitled Structures proposed that he should go on an internship in the Massachusetts Institute of Technology (MIT), in the United States. After four months of internship, he was invited to take the master's degree course within a research project whose name reminds us of a German sweet: Strudl – an acronym for Structural Design Language – to develop a system to use computers in structural engineering, which was absolutely novelty at that time. Ferrante ended up staying for four years at MIT, until he completed his doctorate.

Invited by the Federal University of Rio Grande do Sul, Ferrante moved to Brazil. In 1973, at a conference in Buenos Aires, he met Lobo Carneiro, who invited him to teach a course at Coppe as a visiting professor. From that moment on, every year he would escape from the cold weather in the south of Brazil and would spend the winter in Rio teaching courses and advising doctoral students. In his luggage, he would bring the Strudl system, which was renamed by him as Lorane. Ferrante adapted the system created at MIT so that it could run in various types of machine.

With two doctoral students, Nelson Ebecken and Edison Castro Prates de Lima, he developed versions for the application of non-linear and linear dynamic analysis, which is the area of knowledge introduced at Coppe by Lobo Carneiro.

In the end of 1974, Petrobras had announced the first great oil discovery in the Campos Basin. In 1976, Ferrante moved to Rio and started to contact the engineers of Petrobras. He insisted on the opportunity to establish a partnership between Petrobras and Coppe. However, talks did not advance until an engineer called Sergio Mueller became the head of the Engineering Division. For Ferrante's surprise, the new negotiator was firm, objective and fast, asking for a concrete proposal. The desired cooperation agreement between Coppe and Petrobras was signed in the first semester of 1977.

In 1979, an accident with the processing tower in the Garoupa field has proven to Petrobras that Coppe could contribute to find technological solutions. Coppe researchers helped to show that the American company that designed the platform had made a mistake in the project.

Although this may seem a minor episode, in 1979 and 1980 one had to be bold to confront an internationally renowned engineering company, and that is what a young group of Brazilian engineers in their early thirties did.

In 1992, Augustín Ferrante moved to Italy with his family. He used to come frequently to Brazil, as he had an apartment in Rio. He passed away in 2009, in Italy.

BUILDING TRUST

THE LONG-TERM PARTNERSHIP BETWEEN COPPE AND PETROBRAS REQUIRED A SLOW AND PATIENT PROCESS OF BUILDING TRUST. INDUSTRIES AND UNIVERSITIES IN BRAZIL WERE NOT USED TO WORKING TOGETHER. IT WAS NECESSARY FOR PETROBRAS TO BELIEVE THAT IT WAS WORTH SEEKING FOR NATIONAL SOLUTIONS FOR THE COMPANY'S PROBLEMS. COPPE'S RESEARCHERS RECALL HOW THEY ESTABLISHED THIS PARTNERSHIP.

"The teams of Coppe and Petrobras really trusted each other. It was an important opportunity to share experience. In the successful case of the pilings with conical ends we saved US$ 22 million at that time. There were economic interests against this new partnership idea. The company in charge of fixing the pilings for Petrobras was interested in using its own solution. Our technology ended up being adopted in most of the platforms."

NEY ROITMAN, professor of the Civil Engineering Program

"The partnership with Petrobras was a shift of conception. The usual practice was to search for help from foreign institutions. But, with that partnership, it had been proven that the Brazilian engineering had conditions to carry out leading-edge projects also in the sea. From that moment on, Coppe formed three master's degree classes consisting of Petrobras engineers who were qualified to work on the company's projects on the sea."

SERGIO SPHAIER, professor of the Ocean Engineering Program

"I can tell that I participated in a great challenge which has changed the history of partnerships between companies and universities. We believe in the development of a national technology, with the best solutions for the Brazilian features. We were aimed at reducing the external dependence. I have always believed that it was possible to produce everything in Brazil."

LUIZ LANDAU, professor of the Civil Engineering Program

"With Petrobras, we were able to overcome certain distrust of universities among the companies. The partnership was something new. When we traveled abroad, people used to be admired about the fact that we had a partnership with Petrobras. It was common practice to hire people from universities, but it was not common to hire a university to work on projects."

NELSON EBECKEN, professor of the Civil Engineering Program

1990

- Fernando Collor de Mello assumes the Brazilian Presidency as the first President elected by direct vote since 1964.
- Mobile telephone services are launched in Brazil.
- The Human Genome Project for DNA sequencing is launched.
- The Hubble Space Telescope starts its operation.
- Professor Nelson Maculan Filho holds the position as Coppe director until 1991.
- Coppe releases the first high-performance parallel computer developed in Brazil – the NCPU I. The computer is a hundred times cheaper than similar computers manufactured in the United States and Japan and it was built by researchers of the Laboratory of Parallel Computing at Coppe.

1991

- Finnish Linus Torvalds creates the operational system Linux.
- The first tests on HDTV are performed in the United States.
- The Catalysis Center (Nucat), an excellence center that provides relevant services to the national chemical industry and to research centers, is created.
- Professor Luiz Bevilacqua holds the position as Coppe director until 1992.

1992

- President Fernando Collor de Mello is impeached. Vice-president Itamar Franco assumes his position.
- Rio-92, the United Nations Conference on Environment and Development, takes place in Rio.
- Under the technical supervision of Coppe, the Rio Network of Computers, which is the first exclusive internet source to Brazilian research institutes, is created.
- Professor Antonio Fernando Catelli Infantosi holds the position as Coppe director until the following year.

1993

- Sociologist Herbert de Souza, best known as Betinho, founds the Citizen's Action Movement against Hunger and Poverty and for Life.
- Massacres are committed in Vigário Geral and Candelária in Rio de Janeiro.

1994

- The Real Plan is set up to combat hyper-inflation.
- Commercial operation of the internet begins in Brazil.
- Brazil wins the Soccer World Cup for the fourth time in the United States.
- Coppe creates its Company Incubators.
- Coppe Forum takes a document to the Federal Government and the National Congress warning about the risk of electricity shortage.
- Professor Luiz Pinguelli Rosa holds the position as Coppe director for the second time until 1997.

1995

- A committee to manage the Internet is created in Brazil.
- Fernando Henrique Cardoso assumes the Brazilian Presidency.
- The Ministry of Education (MEC) creates a national exam to evaluate the students who have graduated from the university.
- Joseph Rotblat, a British physician who was awarded the Peace Nobel Prize, gives a lecture at Coppe.
- Coppe receives Cray, the supercomputer.
- Coppe is renamed as Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia (Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering). The acronym Coppe is maintained.
- Coppe creates its Technological Incubator of Popular Cooperatives (ITCP).

1996

- The Brazilian National Agency for Telecommunications (Anatel) is created.
- The new law called Lei de Diretrizes e Bases da Educação, which organizes the Brazilian educational system, is established.
- In his first visit to Brazil, the American linguist and activist Noam Chomsky gives lecture on "World Orders Old and New" at Coppe.
- After heavy rains that had devastated Rio de Janeiro, a seminar conducted at Coppe results in the publication of the book *Tormentas cariocas* ("The Tempests in Rio") and influences the creation of a prevention system called Alerta Rio.
- The newsletter *Planeta Coppe* is created on the official website of the institution.

1997

- A crisis is triggered in the international financial market as a result of the currency devaluation in the so-called Asian Tigers.
- Research on the cloned sheep Dolly is published.
- The American Sojourner rover arrives in Mars.
- Google is released.
- Coppe participates in the debates on the privatization of Vale, preventing that the company in charge of the sales modeling buys the company.

1998

- The Brazilian National Agency of Petroleum, Natural Gas and Biofuels is created.
- Coppe launches the I-2000, the greatest laboratorial complex in Latin America, with more than 80 laboratories.
- Professor Segen Farid Estefen holds the position as Coppe director until 2001.

1999

- President Fernando Henrique Cardoso is re-elected and assumes the presidency for the second time.
- The Italian sociologist Domenico de Masi gives a lecture about "Business management, work and creativity".
- The euro is adopted as the currency of the European Union.

THE SOCIAL PERSPECTIVE

The commitment of Coppe to considering social, environmental and economic issues of the country has taken on a new dimension in the 1990's. A re-democratized Brazil was searching for solutions for its socioeconomic issues. Organizations of the civil society were multiplying and demanding new approaches to social conflicts and contrasts.

In this turbulent period of re-organization of the country, Coppe became nationally renowned as a voice of criticism about the public policies and official development strategies. At the same time that it became relevant in the debate on great national topics, the institution was modernizing its infrastructure, taking its laboratory complex to an international level.

Twenty five years after the military government in March 1964, the first president elected by direct vote, Fernando Collor de Mello, assumed the presidency. The unpopularity of the economic measures adopted by him, such as the freezing of savings account, and the accusation of corruption led to the impeachment of the President, who was replaced by the Vice-president Itamar Franco in 1992. The control of inflation would be obtained with the Real Plan, set up in 1994, when Fernando Henrique Cardoso was the minister of Finance. Because of that, he would end up being elected to assume the presidency in the following year.

The privatization of state-owned companies, which started in Collor's government and continued in the following governments, divided the country and mobilized Coppe researchers, who studied various aspects of the topic. Accusations from Coppe researchers prevented Vale, which was one of the most desired companies, from being privatized in a fashion in which the business that sets up the sales is also candidate for purchasing the company.

The Announced Blackout

At Coppe, the Energy Planning Program supervised the sales processing of state-owned companies. This program was formally created in 1992 and was originated from the Energy Interdisciplinary Area (AIE), which was created in 1979. Based on its studies, Coppe was systematically warning the government and the society about the threat of a severe crisis in the electricity supply, as the investment in expanding the electricity sector had been reduced. The institution conducted seminars and promoted debates about the topic with the participation of experts in the academia, public bodies and companies.

The risk was always denied by the authorities, but in 2001 Coppe proved to be right, and the government was obliged to ration electricity. Some electricity shortages were planned, and the period was known as "apagão", that is, the blackout of the electricity sector.

The debate over energy also involved environmental aspects. During the United Nations Conference on Environment and Development in Rio, Rio-92, a hypothesis that the hydroelectric power plants emitted greenhouse gases was put forward. Coppe researchers decided to investigate this hypothesis, which could be confirmed eight years later. This research led to the creation of the Laboratory of Renewable Energies and Environmental Studies.

Topics of local interest equally called the attention of Coppe researchers. In February 1996, torrential rains reached the metropolitan area of Rio de Janeiro and left 6,500 thousand homeless. Some days later, Coppe and the Committee of Public Entities in the Struggle against Hunger and for Life (Coep) conducted a seminar "Prevention and Control of the Effects of Heavy Rains in Rio de Janeiro", with the participation of technicians, scientists, NGOs and public managers to discuss solutions. This meeting resulted in the book *Tormentas cariocas* ("The Tempests in Rio"), which, among other proposals, suggested the creation of a system of meteorological warnings, implemented in the state government in September of that same year. In 1997, the Laboratory of Water Resources at Coppe started to participate in the formulation of the Iguaçu Project, which was the state government plan to store the environment and control flooding in the Iguaçu, Sarapuí and Botas rivers, in the Baixada Fluminense (a low lying urban area in the metropolitan area of Rio de Janeiro).

Coppe was gaining public visibility, was increasing its dialog with various groups of society, as well as enhancing the publicity about its activities. As a result, in 1995, Coppe implemented a professional press office headquartered in the institution.

Coppe was increasing its service renderings to companies and state bodies. In the previous decade, the reduction of

VI- ALERTA PARA A CRISE E PROPOSTAS DE MEDIDAS

OCTOBER 2000. COPPE DIRECTOR'S LETTER TO PRESIDENT FERNANDO HENRIQUE CARDOSO,WARNING HIM ABOUT THE IMMINENT ENERGY CRISIS THAT RESULTED IN THE 2001 BLACKOUT

official financial resources for research had made Coppetec, which was responsible for managing external contracts, an important financing source. In 1993, the federal government had implemented administrative control procedures that made Coppe lose autonomy. The solution for that problem was to transform Coppetec into a foundation, thus avoiding bureaucratic delays. The financial resources of Coppetec were applied through clear and rigid norms and helped to finance the installation of a new laboratory complex in the campus of UFRJ.

The engagement of Coppe in seeing that the research developed at the institution was useful for the production and consumer goods sectors led to the creation of its Incubator for Technology-based Companies in 1994 – a very rare initiative in Brazil at that time. The incubator receives companies created in the research groups from various areas within UFRJ, most of which from Coppe. These companies remain in the Incubator until they can operate autonomously in the market. Until 2010, 50 companies had already become autonomous.

In the end of the 1990's, Coppe also considered those who were on the edge of informal economy. Coppe was one of the institutions that, in 1993, founded Coep, which was aimed at promoting actions against hunger and misery. In 1995, Coppe created the pioneering Technological Incubator of Popular Cooperatives (ITCP), which uses management and production engineering techniques to support the cooperatives. The initiative was an example for similar enterprises in Brazil and abroad.

Still in the 1990's, Coppe launched two laboratories focused on social initiatives and projects: the Laboratory of Technology and Social Development (LTDS), in 1996, and the Laboratory of Work and Qualification (LT&F), in 1999.

I-2000

In 1997, Coppe launched the I-2000: an impressive building of 10,000 square meters, the greatest complex of its kind in Latin America. The place has more than 80 laboratories of different areas. Official financing instruments, such as Pronex, also made it possible to modernize the existing facilities. One of the improvements was the purchase of the Cray EL-94 supercomputer in 1995. With this new equipment, Coppe launched the Shared Access Program to Supercomputation, which benefited other facilities within UFRJ and various academic institutions in the country, such as the Brazilian Center for Research in Physics (CBPF) and the University of São Paulo (USP).

In 1999, a lecture delivered by the American linguist, philosopher and activist Noam Chomsky, professor of the Massachusetts Technology Institute (MIT), has marked the inauguration of the International Virtual Institute for Global Change (Ivig) of Coppe, which was created to integrate knowledge with competence to solve global problems.

With all these initiatives, Coppe was preparing itself to face the challenges of the upcoming new millennium.

THE PRESIDENT OF COEP, HERBERT DE SOUZA (ON THE LEFT), AND THE DIRECTOR OF COPPE, LUIZ PINGUELLI ROSA, ATTENDING A SEMINAR ABOUT THE EFFECTS OF HEAVY RAINS IN RIO DE JANEIRO. THE EVENT TOOK PLACE AT COPPE AFTER THE TRAGEDY THAT OCCURRED IN 1996, RESULTING IN THE PUBLICATION OF THE BOOK *TORMENTAS CARIOCAS* (PHOTO OF THE COVER), RELEASED IN 1997 AND ANNOUNCED WITH PROMINENCE BY *JORNAL DO BRASIL* (IMAGE BELOW).

GROWING PRESENCE IN THE AGENDA OF NATIONAL AND INTERNATIONAL DEBATES

It was in the 1990's, during the so-called "perverse" decade, due to a wave of neoliberalism sweeping the world, that Coppe gained prominence in the national agenda. The institution dove right in the debates about several important issues in the country, such as the privatization of companies, the increase of the unemployment levels, the risk of electricity rationing and climate change.

In the 1990's, Coppe stimulated discussions about central topics. In 1995, one week before being awarded the Peace Nobel Prize, the British-naturalized Polish physician Joseph Rotblat (1908–2005), known for his scientific contributions and fight to end nuclear weapons, was invited by Coppe to come to Rio to give a lecture about the 50th anniversary of Hiroshima and Nagasaki atomic bombing. His visit had great repercussion among the scientific community and the public opinion, as it marked the reopening of Brazil's adhesion to the Treaty on the Non-Proliferation of Nuclear Weapons. In 1998,

COPPE DIRECTOR GREETS AMERICAN INTELLECTUAL, NOAM CHOMSKY, AFTER THE CONFERENCE THAT ATTRACTED THOUSANDS OF PEOPLE TO THE UFRJ CAMPUS. ON THE LEFT, THE ARTICLE PUBLISHED IN *JORNAL DO BRASIL* REPORTS THE LECTURE GIVEN BY THE PHYSICIAN JOSEPH ROTBLAT

three years after the meeting between Rotblat and former President Fernando Henrique Cardoso, with the presence of Coppe director, Luiz Pinguelli Rosa, Brazil finally adhered to the treaty.

In 1996, the American linguist and activist Noam Chomsky, which is thought to be one of the most important thinkers alive, was invited by Coppe and the Faculty of Languages to come to UFRJ. In his first visit to Brazil, Chomksy gave two crowded lectures: "New Horizons in the Study of Language and Mind" and "World Orders Old and New". The lectures attracted more than 2,000 people from Brazil and South America.

PINGUELLI PRESENTS STUDIES ON THE PRIVATIZATION OF VALE. IN THE FRONT ROW, WE CAN SEE THE ECONOMIST MARIA DA CONCEIÇÃO TAVARES

Criticism against Privatizations

In the 1990's, the privatization program in Brazil expanded its scope in Fernando Henrique Cardoso's two terms, with the offer of major state-owned companies in the energy, telecommunications and mining industries. In 1997, Coppe was the protagonist of a memorable episode, when Vale was being negotiated. The institution denounced a purchase program of the Brazilian company by a multinational group which owned the subsidiary responsible for modeling the sale. Afterwards, the group left the auction.

REPRESENTATIVES OF ENTITIES OF THE CIVIL SOCIETY PARTICIPATE IN THE DEBATE PROMOTED BY COPPE. AROUND THE TABLE, IT IS POSSIBLE TO SEE THE ARCHBISHOP OF CNBB (THE NATIONAL CONFERENCE OF BRAZILIAN BISHOPS), DOM LUCIANO MENDES DE ALMEIDA; THE PRESIDENT OF SBPC, SÉRGIO HENRIQUE FERREIRA; THE PRESIDENT OF THE ENGINEERING CLUB, RAYMUNDO DE OLIVEIRA; THE PRESIDENT OF THE MOVEMENT FOR THE DEFENSE OF THE BRAZILIAN NATIONAL ECONOMY, MARIA AUGUSTA TIBIRIÇÁ, AND THE PRESIDENT OF CREA (THE REGIONAL ENGINEERING AND AGRONOMY COUNCIL), JOSÉ CHACON DE ASSIS. FERNANDO PEREGRINO, THE SUPERINTENDENT OF THE COPPETEC FOUNDATION, IS HOLDING THE MICROPHONE

The privatizations of the energy industry were also advancing with the sales of the electricity distribution companies of Rio de Janeiro, Light and Cerj (today called Ampla), and of part of the Eletrobras generation system, among others. Because of the privatization of the energy industry ordered by the government in Brasília, the companies could not advance their investment programs. In the beginning of 1998, the cariocas had to deal with the "blackout summer", due to the overload on the electricity distribution network. Two years later, the director of Coppe, Luiz Pinguelli Rosa, sent a letter to the minister of Mines and Energy warning about the risks of an energy crisis. His prediction was confirmed in 2001, when the federal government had to develop a plan called "blackout" for rationing energy.

A Shelter for New Innovative Companies

Incubators were somewhat new in Brazil when Coppe created its own in 1994. Technology-based incubators are aimed at providing a stimulating environment to support the creation and growth of new companies that develop products and innovative services of high aggregate value, until they are able to act autonomously in the market.

The Incubator of Technology-based Companies of Coppe/UFRJ mainly comprises UFRJ's research groups, most of them from Coppe. In the last two decades, 77 companies have been part of the incubator and have introduced more than 100 products and services, resulting in the generation of more than 1,000 job positions for highly-qualified professionals.

Among the 77 companies supported by the incubator, 51 were already operating autonomously in 2014, i.e., they did not need the support from the incubator any more. These incubators are considered to have "graduated". The 26 companies comprising the Incubator, which are called "residents", employ 150 people.

The evolution of the joint revenue of the 77 companies that had been part of the incubator or that were still in the incubator in 2014 is quite significant. The numbers were multiplied by four in ten years: from R$ 60 million, in 2003, to R$ 100 million, in 2007, and to R$ 236 million, in 2013.

THE INCUBATOR OF COPPE HAS SUPPORTED 77 COMPANIES IN THE LAST TWO DECADES

Another reason to celebrate is Coppe performance in the national index created by Sebrae (the Brazilian Micro and Small Business Support Service). According to this index, approximately 40% of the companies that started their activities in incubators in Brazil survive in the first three years. In the case of the Incubator of Companies of Coppe/UFRJ, the survival rate is of 90%.

The Invention of the "Engineering of Employment"

With high unemployment rates in the 1990's, the perverse logic brought together with the privatization and new technologies – such as bank computerization and the use of robots in the factories – was of great concern, as they were responsible for reducing job positions. With an eye on the national scenario, Coppe created, in 1995, the Technological Incubator of Popular Cooperatives (ITCP)

to show to low income communities how to organize and control their own affairs and generate income.

With the proposal of a pioneering model for work organization, in its first year of creation, the ITCP consisted of ten cooperatives, with funds from Finep and Fundação Banco do Brasil. The first cooperative was the Cooperative of Manguinhos Workers (Cootram), which was hired by the cleaning service of Fiocruz. Today there are more than 700 enterprises. In 1997, the ITCP helped to create the National Program of Popular Cooperatives. It also stimulated and helped the creation of the University network of Incubators of Popular Cooperatives in 16 Brazilian universities.

Among several challenges, the ITCP participated in the organization of cooperatives within poor communities, in the Favela-Bairro Program, an intervention program in the slums of the city of Rio de Janeiro. It also created a free course that would prepare the sons of the workers at the Fundão campus or the young inhabitants of its surroundings to take the university entrance test. The ITCP also built a network for social insertion through work for people with mental disorders.

The ITCP was originated in the classrooms of the university, and on the first years of its existence, due to its experience in creating popular cooperatives during historical moments, it was considered one of the ten most important actions in the fight against poverty in Brazil by the World Bank and the Getulio Vargas Foundation. Today the ITCP is breaking barriers and serves as a role model for other initiatives in Brazil and in Africa.

BELOW, ART AND SKILL IN PIECES CREATED BY THE MARÉ ARTISANS IN RIO DE JANEIRO. ON THE TOP, A WOMAN IS SEWING AT COOSTURART, A COOPERATIVE HEADQUARTERED IN SANTA CRUZ, IN RIO DE JANEIRO

"POLITICS IS INSEPARABLE FROM UNIVERSITY"

Luiz Pinguelli Rosa arrived at Coppe in 1968, as a master's degree student. The person named Luiz who today holds the position of director of Coppe does not hide his respect for the other Luiz who used to occupy it in the past. In the talk about Coppe, the former director is frequently mentioned. In fact, both of them have some things in common. Like Coimbra, Pinguelli is not afraid of taking risks and considers bureaucracy to be an evil.

However, there is one difference between him and the former director: Pinguelli's political inclination, which has given Coppe an important role in major national and regional issues and which has put the institution in the middle of public controversies, such as the privatization of state-owned companies and the end of the state oil monopoly. Coimbra, who usually says that his is "only a militant when talking about soccer, specifically about Botafogo," gives his blessings to Pinguelli. "It's really important for the institution to have someone like Pinguelli, who has a flair for politics and also political experience. In addition, he has academic knowledge and knows Coppe well."

Pinguelli was born in 1942, in the city of Rio de Janeiro. He says that part of his knowledge is due to the conversations about politics he used to listen to at his father's tailor workshop. "I

think I learned more in the tailor's shop than at school," he says. Pinguelli has a master's degree in Nuclear Engineering from Coppe (1969) and a doctoral degree in Nuclear Physics from PUC-Rio. He is a member of the Brazilian Academy of Sciences, former president of Eletrobras and executive secretary of the Brazilian Forum on Climate Change.

In the 1960's, he went to the Military Academy of Agulhas Negras, where he was particularly interested in physics and engineering. He reached the position of captain, but left the Brazilian Army after having declared being against the military coup that overthrew president João Goulart. In 1986, right after the end of the military government, Pinguelli's election to be Coppe director for the first time was part of the re-democratization process. "The first thing that we did was to invite the professors who had been expelled by the military government to come back to the institution," he recalls.

In his five terms as director, Pinguelli has encouraged the increase in numbers of contracts with companies, which has resulted in financial resources for Coppe. He was also responsible for installing the greatest laboratory complex in Latin America, the I-2000.

How was Coppe when you arrived in 1968?

LPR – It belonged to Coimbra. His presence was dominant, and Coppe was much smaller. The Ilha do Fundão, where the campus is located, was a rural place. When we had to cross the street to go to a restaurant, the scene was indescribable. When it was raining, there was mud everywhere, and when it wasn't raining, there was dust all over the place. A goat ran after me once. The roads were not even paved. There were already some buildings, such as the dean's office, the hospital and the building where there are the Institutes of Physics and Chemistry... Coppe's office used to be where today is the Technology Center. Early in the morning, Coimbra used to stay by the door to see the professors arriving. If he noticed the absence of any professor, he would send them a note asking them to explain themselves. He ran the institution with an iron fist. Everything was extremely neat. Each professor had its own office, with wooden dividers and air conditioner. Some secretaries spoke English. It was a small structure. Coimbra used to say something somewhat curious: "When I arrive at a professor's office and I don't see a plant, I get worried." If the employee had a plant in his office, it meant that he liked that place....

> UNIVERSITIES ARE NOT PLACES FOR PURE ACADEMY AND SCIENCE. THEY ARE ALSO A PLACE TO BE CRITICAL, WHERE IT IS POSSIBLE TO THINK ABOUT WHAT HAPPENS.

People say that at that time Coppe already had a DNA. What does that mean?

LPR – Coimbra was responsible for what Coppe is today. He made the professors dedicate themselves fully to the university. He would manage to raise money to supplement the professors' very low salaries. One would find a career at Coppe. He also focused on productivity: his desire was that the professors supervised their students' theses and that they worked with their students. His other demand had to do with national technology. His desire was that Brazil produced technology. So, he encouraged the relationship between the university and the company, and this is what we see at Coppetec. Today there is a similar situation to what happened with Coimbra at that time. He suffered the consequences of being bold enough to create a productive institution within a backward university. Because of that, he faced accusations, as everything that is productive in the public service is considered to be irregular. What is normal is to do nothing. This lack of attitude is stimulated. Today we face the same problem with CGU, TCU and AGU, which are federal offices in charge of controlling, investigating and sanctioning corruption and malpractice of public funds. I mean, all these offices have bureaucrats who want to disturb the public service.

Do you think the opinion about what a university should be is under dispute?

LPR – I think there is an ideology behind that. I think it is a mixture of stupidity from the left wing with the smartness of the right wing. The ideology is not to have any type of relation with companies. It would be a sin. But how come can engineering not have relations with companies? The engineers would be cut off from reality! It would be as if the doctors did not see the sick patients. Rumor has it that a huge American business group in the market of undergraduate education is settling in Brazil. This rumor is aimed at destroying the federal universities.

Do you think Brazil has not understood yet what is at stakes?

LPR – Brazil must understand what is going on. The public service is full of lawyers that hold extremely well-paid job

THE COPPE PILOT PLANT PRODUCES BIODIESEL

positions and who are not committed to what they do; they only worry about how they do it. Our culture is juridicist and formalist and it is inherited from the 19th century. For the public service, this is real hell. Most of the works to build hospitals and schools are worthless because of the huge bureaucracy that makes it difficult to do everything. Brazil is technologically backwards, except for some institutions, such as Petrobras, Embraer and Embrapa. But most of the Brazilian industry is technologically dependent. It imports, but it does not develop. Since Coimbra's era, we have Coppe's DNA, that is, we are eager to establish a relationship to stimulate the use of national technology.

Coimbra says that you have brought the political action to Coppe. Do you agree?

LPR – Coimbra already had a political personality. It is worth mentioning that at the time of dictatorship there were serious problems. The course of Urban and Regional Planning (PUR) was ended, there were persecutions, and Coimbra's attitude was perfect. A professor who had finished his master's degree at Coppe and who was taking his doctorate in the Institute of Mathematics was arrested by the military government. His employer cut his salary. Coimbra invited him to go to Coppe, so that he could at least have a salary after having left jail. He invited the physicist and professor Plínio Sussekind to teach at Coppe, even though he had been withdrawn from university by the AI-5. On several occasions, he was at the entrance of Coppe to fight against the invasion of the police who were harassing the students. Politics is inseparable from university. Universities are not places for pure academy and science. They are also a place to be critical, where it is possible to think about what happens. Coimbra already had politics in his DNA, although he was not militant.

How was the crisis provoked by Coimbra's departure?

LPR – Coimbra's departure was a major blow. I was abroad at that time and when I came back, he had already left. We were afraid that Coppe would end. Our first concern was to take the first positive step. Brazil was in a really bad moment, even economically speaking. There was no more Brazilian miracle, it was necessary to make things happen... Basic stuff, such as building a decent auditorium, supporting laboratories, searching for funding, financial resources...

How was the Energy Planning Program created?

LPR – Within the Institute of Physics, I tried to create the Energy Planning Area, but it was not approved. So, I created the "interdisciplinary area of energy" at Coppe, which was originated based on the nuclear debate and on the so-called oil risk contracts. To do so, I was supported by professors Adilson de Oliveira and Lizardo de Araújo. We were critical of these two initiatives by Geisel's government.

The debate on nuclear energy had considerable repercussion. The area called the attention of some good students and, although very small, it was dynamic. The area was turned into a program and within this program we participated in the debate about the privatizations. We were against the privatization of the energy and oil industries.

What was the position taken?

LPR – We thought that the presence of the State was necessary in all strategic sectors, to guarantee the development of the country. In the telecommunications sector, we were also against the privatization. If we wanted to develop technology in the country, the state-owned companies would be important and, in fact, they were. Petrobras has much more technology developed than other sectors, like the telecommunications industry. At the time of privatization, Brazil was taking a wrong position and, in addition to the more academic meetings, we participated in the conversations and brought people from abroad who had had a similar experience... We had a great partnership with Bariloche, in Argentina, and with Grenoble, in France. We became a strong group and wrote some books about the privatization in the energy and telecommunications area and of Vale.

Do you think you somehow influenced in their decision? The privatizations occurred...

LPR – We helped to avoid the privatization of Furnas by showing with tech-

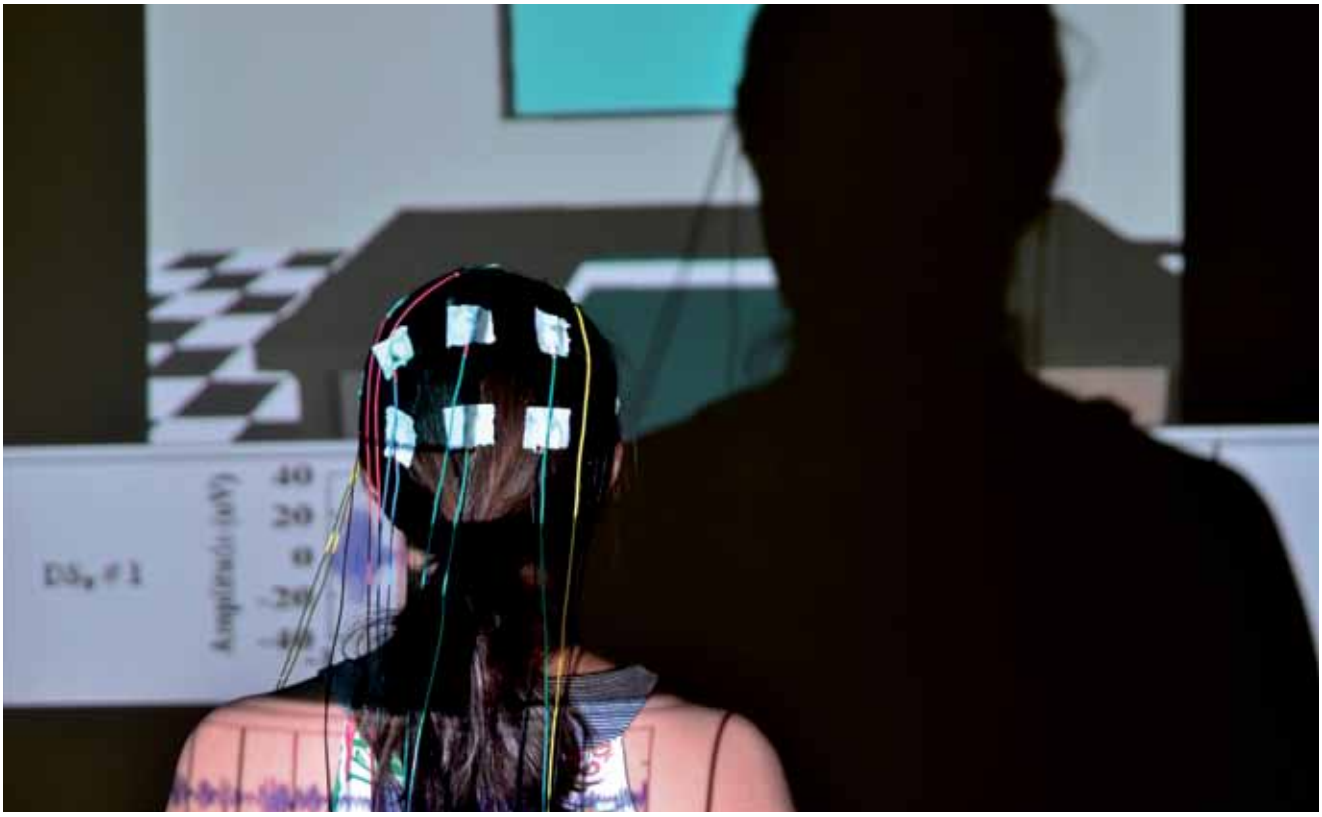
nical data the relationship between energy rationing and the lack of investment. The government was privatizing the electricity companies and didn't let them make investments. In the very beginning of this privatization process, there was a blackout and electricity shortage in several capitals. During a meeting in the Senate, the then Minister of Mines and Energy explained that a lightning strike had occurred in the city of Bauru, causing a power outage. I had some materials with me showing the map with the lightning strikes of that day, and no lightning strike had occurred in Bauru. I contested the explanation in the press and it came as a bombshell. The minister called for my resignation, but that couldn't happen, because I was a public employee. We also influenced the privatization process of Vale. We could not access the database of BNDES with all the information about Vale's sale. In order to do so, we had to pay a huge amount of money. So, we suggested that the congressman Miro Teixeira create a commission in the House of Representatives, supported by Coppe, so that we could have access to the database.

What did you want to show?

LPR – We showed that Vale was being sold for abargain price. Vale had huge orebodies that could be explored for more than 30 years and they were simply being donated. We found out that the big multinational that was going to buy Vale, together with a Brazilian company, had a subsidiary responsible for modeling the sales. In other words, they modeled the sale and were buying the company. We denounced that, and the news was published in the first page of *Jornal do Brasil*. As a consequence, the company had to leave the auction. Then, they came up with a new plan to control Vale, and the Companhia Siderúrgica Nacional, a Brazilian steel-maker company, is one of Vale's main controllers.

Coppe has had an important role in the major national debates.

LPR – Before, the major national issues were tackled without dialog. How could we discuss national issues in the military government? Then, with the civil governments, it was possible to establish a dialog, and national issues could be better discussed.



THE LABORATORY OF SIGNAL PROCESSING AND MEDICAL IMAGES (LAPIS) PERFORMS STUDIES AIMED AT MONITORING THE BRAIN ACTIVITY, DURING, FOR EXAMPLE, VIRTUAL DYNAMIC VISUAL STIMULATION

How did you improve the facilities of Coppe?

LPR – The buildings in the Technology Center, which house Coppe and other facilities of UFRJ, are divided in blocks labeled with letters. There was this huge Block I, a type of construction that would never be built again. And many of our laboratories would occupy a very large run-down building. Coppe vice-director, professor Carlos Alberto Consenza, gave an interview to Globo TV, and the news showed that the laboratories were in very poor conditions. Afterwards, together with my colleague Segen Estefen, I showed this interview, which was aired in Jornal Nacional, to the minister of Education, Murílio Hingel, and to the minister of Science and Technology, José Israel Vargas, of the government of Itamar Franco. Murílio Hingel helped us a little, but Israel Vargas immediately called Joel Rennó, the former president of Petrobras. "Hi, Rennó. Pinguelli, from Coppe, and other colleagues are here with me. One building at UFRJ must be restored. Isn't there a laboratory that was going to be used by a petrochemical company that was privatized?," he asked. The building was not ready and it belonged to Cenpes, the Research Center of Petrobras, at UFRJ campus. I had a run-down building and I got an unfinished building, without having money to finish it. In addition, the deal was not good for Cenpes because Petrobras wanted to use this building to expand its space. So I proposed to Rennó: "I'll give back to you the space that belongs to Cenpes, and you help me to restore Block I." So, we built the I-2000. The laboratory complex has changed Coppe. The institution was a little bit shy and its facilities were a little bit hidden and not appropriately installed. We did not spend money on buildings, but on equipment. It was not possible any more to fit in that small space. Since then, we built several other laboratories.

LAUNCHED IN 1997, THE I-2000 HAS HOUSES MORE THAN 80 LABORATORIES

What is the influence of Coppe on the graduate courses in Brazil?

LPR – Coppe is a pioneer. It served as an example of full and exclusive dedication of university professors, which was something new. The institution also had influence on the graduate courses in engineering. Similarly to Coppe, Zeferino Vaz created a graduate course at Unicamp and Lynaldo Cavalcanti created another in the Department of Electrical Engineering in the campus of Campina Grande in the state of Paraíba. There was an interchange of ideas between the institutions and Coppe had influence on them and on other places. But there is nothing similar to Coppe in Brazil, as the institution combines academic excellence with the participation in projects undertaken with the industry. Everything that we conquered is because we mobilized resources and used them for the university. We invest on the university.

You are the director of Coppe for the fifth time. What are the most important accomplishments?

LPR – The most important one is the vitality of Coppe. In addition, there is the fact that the institution has good facilities, enthusiastic teachers, as well as students who want to study and do a good job. We developed the magnetic levitation train, the hydrogen bus, biofuels and the second generation bioethanol. We also established a partnership with China to develop new technology on biodiesel for studies about renewable energy and climate change. We also carry out cutting-edge researches aimed at the health area, such as the production of biopharmaceuticals and nanoparticles to treat cancer and other diseases. There are plenty of important things to study.

How much important is the partnership between Coppe and Petrobras in the development of Brazil in the field of oil production?

LPR – Coppe has become an example of technology development for Petrobras. We have been working with this company also in the exploration of the pre-salt layers. We have established an important partnership in various areas, particularly in the production of oil in the sea. Of course that Petrobras uses knowledge from other institutions, but most of the projects in this area are undertaken together with Coppe.

One of the contributions of Coppe was the stimulus to the platform construction industry.

LPR – The platforms were being built in Asia, between Korea and Singapore.

We thought that they should be built in Brazil. Coppe actively participated in the discussion. Regarding the oil issue, in fact, the government has changed its import policy of platforms and has increased a lot the production of national equipment. This was greatly positive.

Let's talk a little about the agreement with China. How was this partnership established?

LPR – We were greatly encouraged by the Ministry of Foreign Affairs. I was with President Lula and President Dilma Rousseff in their visits to China. Coppe has partnerships with several universities worldwide. The difference in the case of China is that Coppe created the Brazil-China Center, with an office in Beijing. The Chinese come to Brazil mainly because of the petroleum engineering. Students come to take their doctorate course here. Some of our students have already worked there, most of them for short periods. The cooperation is manifold. It includes pure research, as well as knowledge application. Now we are discussing if we establish a similar partnership with England.

How can knowledge be applied? How can we convince a public manager or an entrepreneur to adopt these technologies?

LPR – There are two case types. In terms of resources, the most important case is when the company contacts us. Sometimes, we contact the company. With Tractebel, we developed a technology to generate energy from wave motion and we built a prototype that was tested in Ceará for two years. Nowadays, the prototype is deactivated. The Brazilian companies are too shy regarding technology. We are discussing with the Ministry of Science, Technology and Innovation about a program to stimulate investments from companies in technology. The Ministry wants to support the liaison between universities and companies in joint projects, and that is exactly what Coppe does.

THE PUBLIC BODIES ARE ALSO BEHIND WHEN WE TALK ABOUT PROFITING FROM ALL THE CAPACITIES OF THE UNIVERSITY. WE DEVELOP IDEAS, BUT THE PUBLIC MANAGERS HAVE TO UNDERTAKE THE INITIATIVE TO IMPLEMENT THEM.

And what about the governments?

LPR – The public bodies are also behind when we talk about profiting from all the capacities of the university. It takes years to implement some projects. Rio-Bus, the project aimed at organizing the traffic in Rio, was developed in the turn of this century and only recently some of its proposals have been implemented. We developed the hydrogen bus and the magnetic levitation train, which are non-polluting vehicles, and which can be a relief for the traffic jams. We develop ideas, but the public managers have to undertake the initiative to implement them. That is why Coppe is developing a project to make the UFRJ campus a green place. After all, 90,000 people come to the campus every day. It can showcase the technologies developed by Coppe and also show that they can and must be applied.

THE LABORATORY OF CELL CULTIVATION ENGINEERING DEVELOPS THE FIRST BIOPHARMACEUTICALS PRODUCED IN BRAZIL

Which strategy should Coppe adopt in the next years?

LPR – Coppe should follow its own way. It should search for new topics, stimulate people's intelligence and creativity... An immediate objective is to bring the undergraduate and the master's degree courses closer. I think there is a huge barrier between the two that should be eliminated, so that the student finishes the undergraduate course in Engineering and immediately starts the master's degree course. Young students are very important; they bring new blood. But, again, the bureaucracy at universities also creates difficulties.

2000

- The first sequencing of human genome performed by an international group of researchers is concluded.
- The 500th anniversary of the discovery of Brazil is celebrated.
- Coppe sends a study to President Fernando Henrique Cardoso, warning about the risks of power outage in the country.

2001

- Energy crisis in Brazil leads to energy rationing.
- Terrorist attacks against the World Trade Center and the Pentagon take place.
- The United States and their allies invade Afghanistan.
- Apple releases iPod.
- Wikipedia is launched.

2002

- Brazil wins the Soccer World Cup for the fifth time.
- Luiz Inácio Lula da Silva is elected president of Brazil.
- Professor Luiz Pinguelli Rosa assumes the position of Coppe director. In the same year, he leaves to assume the presidency of Eletrobras.
- The exhibition entitled "Science, Technology and Human Development"marks the beginning of the activities in the Coppe Miguelde Simoni Space.
- Professor Luiz Fernando Loureiro Legey assumes the position of Coppe director until the following year.

2003

- Space shuttle Columbia is destroyed when re-entering the atmosphere of Earth.
- The United States and their allies invade Iraq and depose Saddam Hussein.
- Coppe launches, in the presence of president Luiz Inácio Lula da Silva, the Laboratory of Ocean Technology (LabOceano), which has the deepest tank in the world.
- Coppe launches the Laboratory of Cell Culture Engineering to develop processes of production and purification of biopharmaceuticals and vaccines.
- Professor Angela Maria Cohen Uller assumes the position of Coppe director until 2007.

2004

- A tsunami in the Indian Ocean devastates cities of several Asian countries.
- Orkut is created.
- Coppe, in liaison with the Polytechnic School of UFRJ, creates four new undergraduate courses: Automation and Control Engineering; Environmental Engineering, Computer and Information Science and Engineering, and Petroleum Engineering.

2005

- Hurricane Katrina devastates New Orleans, in the United States.
- Terrorist attacks take place in London.
- The Kyoto Protocol, on climate change, enters into force.

2006

- Brazilian Marcos Pontes travels to the International Space Station and becomes the first astronaut from South America to go into space.
- Petrobras announces the discovery of oil in the pre-salt layer.
- Coppe's student Cláudio Patrício Ribeiro Júnior is awarded the Capes Greatest Award for Doctoral Thesis. In the first edition of the prize, the student Jorge Henrique Prodanoff was also awarded in the area of Engineering I (Civil, Sanitary and Transportation Engineering).

2007

- President Luiz Inácio Lula da Silva begins his second term.
- Developed at Coppe, Luma is the first Brazilian robot to dive into the waters of Antarctica.
- UN's Intergovernmental Panel on Climate Change (IPCC), in which several researchers of Coppe participated, is awarded the Peace Nobel Prize for its efforts to evaluate climate changes.
- Kindle is released.
- Professor Luiz Pinguelli Rosa assumes the position of director of Coppe until 2011, when he was re-elected for another term until 2015.

2008

- Fidel Castro grants power to his brother Raúl Castro, after almost 50 years as the leader of the country.
- Real estate speculation in the United States leads to a global financial crisis.
- After feasibility studies conducted by Coppe, an obligatory addition of percentages of biodiesel in the diesel consumed in Brazil is initiated.
- Coppe participates in the Atlas experiment, which is the main detector of Cern's particle accelerator, which will be used to search for Higgs boson.
- Two of Coppe's students were awarded the Capes Thesis Award in 2007: Fabrício Machado da Silva, in the area of Engineering II (Mining, Materials and Metallurgy, Chemical and Nuclear Engineering), and Miguel Benedito Furtado Júnior, in the area of Engineering IV (Electrical and Biomedical Engineering).

2009

- Pandemic H1N1 flu spreads.
- Eighteen of the Brazilian states were affected by a blackout during several hours.
- Barack Obama assumes the Presidency of the United States.
- Coppe launches, in the presence of president Luiz Inácio Lula da Silva, the Laboratory for Non-Destructive Testing, Corrosion and Welding (LNDC).
- The city of Rio de Janeiro is chosen to host the 2016 Olympic Games.
- At the UNFCCC's 15th Conference of the Parties, in Copenhagen, Brazil presented voluntary goals to reduce carbon emissions. Coppe participated in the establishment of these goals.
- Coppe creates the Brazil-China Center for Climate Change, Energy and Innovative Technology, in liaison with Tsinghua University.

2010

- Oil spill causes an environment disaster in the Gulf of Mexico.
- An earthquake in Haiti kills thousands of people and leaves thousands homeless.
- iPad is released.
- Coppe launches the H2, the first hybrid oxygen bus with a 100% national technology.
- Science magazine announces the creation of a functional synthetic bacterial genome in laboratory.
- The Arab Spring begins. A wave of popular demonstrations overthrows dictatorial governments in the North of Africa and in the Middle East.
- Two of Coppe's students are awarded the Capes Thesis Award in 2009: Eduardo Rocha de Almeida Lima, in the area of Engineering II(Mining, Materials and Metallurgy, Chemical and Nuclear Engineering), and Juliana Braga Rodrigues Loureiro, in the area of Engineering III (Mechanical, Production, Naval and Ocean, and Aerospace Engineering).

2011

- Dilma Rousseff is the first woman to assume the Presidency in Brazil.
- Coppe sends to the presidency a proposal to create a research center on engineering and climate, after the tragedy in the mountainous region in the state of Rio de Janeiro.
- An earthquake in Japan, followed by a tsunami, kills thousands of people and leaves many people missing and homeless.
- The terrorist leader Osama bin Laden is captured and killed by the American militaries.
- The Ciência sem Fronteiras (Science without Borders) Program is launched.
- Coppe's student Augusto Cesar Vieira Getirana is awarded Capes' Greatest Award for Best Doctoral Thesis in 2010. In the same year, the student Carolina Palma Naveira Cotta, also from Coppe, received the Capes Thesis Award in 2010, in the area of Engineering III (Mechanical, Production, Naval and Ocean, and Aerospace Engineering).
- Professor Luiz Pinguelli Rosa is re-elected and assumes his fifth term as Coppe director, a position he still holds today.
- The partnership between Coppe and the Polytechnic School of UFRJ allows undergraduate students who are about to graduate to study disciplines in the graduate courses so that they can conclude their master's degree course faster.

2012

- Coppe shows technologies and promotes debates in Rio+20, UN's conference about sustainable development. At the event, Coppe launches the H2+2, the second version of its hybrid hydrogen bus with 100% national technology.
- The Higgs boson is discovered at Cern, as a result of a joint international effort of which Coppe is part.
- Curiosity rover lands in Mars and begins the exploration of the planet.
- UN recognizes the State of Palestine.
- Coppe launches the Polymer Pilot Plant, called Engepol, the only one in the country to develop nano scale polymers.
- Three students of Coppe receive the Capes Thesis Award in 2011: Tiago Roux de Oliveira, in the area of Engineering IV (Electrical and Biomedical Engineering), Joecila Santos da Silva, in the area of Engineering I (Civil, Sanitary and Transportation Engineering), and Aline Souza de Paula, in the area of Engineering III (Mechanical, Production, Naval and Ocean, and Aerospace Engineering).
- Coppe's student Wallace Alves Martins receives the Capes Thesis Award 2012, in the area of Engineering IV(Electrical and Biomedical Engineering).

2013

- UFRJ launches the Laboratory of Bioethanol in liaison with Coppe/ Institute of Chemistry to develop second generation ethanol.
- Popular demonstrations, which initially were organized in protest of the rise of the bus fare, spread throughout Brazil, and the population claims for investments in education and health.
- Edward Joseph Snowden, former American systems analyst, reveals confidential information on electronic surveillance of the governments of the United States and the United Kingdom.
- Brazil conducts an auction for the Libra field, the first pre-salt licensing round.
- The Nanotechnology Engineering Program, Coppe's 13rd course, is created.
- Two of Coppe's students are awarded the Capes Thesis Award in 2013: Luciano Nóbrega Xavier, in the area of Engineering I (Civil, Sanitary and Transportation Engineering), and João Paulo Bassin, in the area of Engineering II (Mining, Materials and Metallurgy, Chemical and Nuclear Engineering).

THE 21ST CENTURY
Looking into the Future

The turn of the millennium has urged us to face the energy and environmental crisis. In 2002, Brazil approved the Kyoto Protocol to reduce the emission of greenhouse gases. In 2007, UN's Intergovernmental Panel on Climate Change (IPCC) confirmed the relationship between human activities and global warming. At the same time, the Brazilian economy was growing again, thus increasing energy demand.

Equipped with reference laboratories, Coppe focused on developing more efficient projects on renewable energy production and on materials and processes. As the institution was aware of the importance of working out ample and strategic solutions, it also discussed national and global policies and used its knowledge and expertise to contribute to endorse several of them.

Since the beginning of the 1990's, Coppe had been acquiring knowledge about climate change and the institution has contributed to the formulation of the Brazilian proposal for the United Nations Conference on Environment and Development, Rio-92. In 1999, the creation of the International Virtual Institute for Global Change (Ivig) suggested the strategy to contribute to solve global issues by bringing together knowledge networks and institutions. At that same year, Coppe was invited to participate in the compilation of the First National Greenhouse Emission Inventory and has made a pioneering estimation regarding the contributions from the hydroelectric power plants to the problem.

In 2000, the Center for Integrated Studies on the Environment and Climate Changes was created to monitor gas emissions in cities such as Rio de Janeiro and São Paulo. In 2004, the institution started to headquarter the Brazilian Forum for Climate Change (FBMC), which was headed by the Brazilian president, with the participation of ministers, governmental and academic institutions, as well as of the civil society. The FBMC was created to stimulate the debate and formulate the solutions for the issues related to climate change. By means of the Forum, Coppe actively participated in the formulation of policies and in the Brazilian National Plan about Climate Change, which was sanctioned in 2008, as well as in the formulation of voluntary goals to reduce greenhouse gas emissions, announced by the Brazilian government in 2009, in the 15th Conference of the Parties in Copenhagen.

The structure that made it possible to broaden the institution's horizons had been available since 1997, when the I-2000 was launched. Ample laboratories replaced improvised installations, and many of them were built according to a new model of partnerships with companies. That is how Coppe launched, in 1991, the Catalysis Center (Nucat), one of the most success-

ful centers in the world. In 2003, Coppe launched the Laboratory of Ocean Technology (LabOceano). Even before the confirmation of the Brazilian oil reserves in the pre-salt layer, Coppe was building two more huge facilities to carry out researches and find solutions for the challenges of oil and gas exploration in increasingly deep waters. The facilities were the Laboratory for Non-Destructive Testing, Corrosion and Welding (LNDC), launched in 2009, and the Interdisciplinary Center of Fluid Dynamics (NIDF), which began its activities in 2013.

As a consequence, Coppe saw a new dynamics of knowledge production and transfer being implemented in the institution. The LabOceano was the first facility in the Technological Park in Rio created to stimulate the implementation of companies that make intensive use of technology and of its research centers. And it did not take long to achieve the results. In 2004, the LabOceano (there are only three similar tanks in the world and LabOceano is the deepest tank) was used for the first tests of the prototype of a wave plant capable of generating energy from the sea motion. Tractebel Energia was a company that believed in the project and, by means of the National Agency of Electrical Energy (Aneel), invested on the pilot plant developed by Coppe, which was installed in 2012 and tested during two years in the port of Pecém, in the coast of Ceará.

COPPE HAS CONTRIBUTED TO THE DEVELOPMENT OF ANALYTICAL STUDIES AND MODELS AND TO THE CREATION OF PRACTICAL SOLUTIONS FOR ENVIRONMENTAL AND DEVELOPMENT PROBLEMS.

THE FIRST PLANT TO CONVERT WAVE MOTION TO PRODUCE ELECTRICITY IN SOUTH AMERICA WAS TESTED IN THE PORT OF PECÉM, IN THE STATE OF CEARÁ. THE TECHNOLOGY HAS TRACED THE PATH FOR DEVELOPMENT OF OTHER PROJECTS TO HARNESS WAVES TO PRODUCE ELECTRICITY

THE MAGLEV-COBRA WILL TRANSPORT STUDENTS, PROFESSORS AND EMPLOYEES IN A 200 METER DEMONSTRATION LINE BUILT BY COPPE AT THE CAMPUS

The wave plant was only one of the innovations developed in the laboratories of UFRJ. In different areas, Coppe has contributed to the development of analytical studies and models, as well as to the creation of practical solutions for environmental and development problems. The institution has played an important role in providing efficient and non-pollutant solutions for urban mobility.

Sustainable Vehicles

In 2005, based on a study conducted by Coppe researchers on the feasibility of the use of biodiesel in vehicles, the government implemented the national program to partially replace diesel with this biofuel. Even more daring projects have become prototypes at UFRJ and it is hoped that they can be permanently used in the streets. One of them is the H2+2, a hybrid hydrogen bus with electric powertrain. The bus is silent and it is a zero-emission vehicle. The other solution is the Maglev-Cobra – a magnetic levitation train that floats along the rails.

In an increasingly interconnected world, Coppe's international performance has also gained visibility and institutionality. Since 2007, the participation of Coppe professors in the UN's IPCC has been increasing. Coppe professor Suzana Kahn Ribeiro is one of the panel's vice-presidents. The Brazilian office of the international panel, the Brazilian Panel on Climate Change (PBMC), is headquartered at Coppe. In 2009, Coppe inaugurated its first formal cooperation institution with a foreign country: the Brazil-China Center for Climate Change, Energy and Innovative Technology, headquartered in Beijing. The partnership between Coppe and Tsinghua University is supported by the Chinese and Brazilian governments.

Coppe also participates in the European Organization for Nuclear Research (Cern), which investigates the origin of the universe. Headquartered in Geneva, Cern is the world's greatest laboratory of particles, where researchers have proven the existence of the Higgs boson. Because of this discovery, the authors of the research were awarded with the Nobel Prize in Physics 2013. Coppe, in liaison with the Institute of Physics at UFRJ, coordinates the Brazilian team responsible for Atlas, which is the largest of the two detectors of Large Hadron Collider (LHC), the most potent particle accelerator developed by Cern.

In 2014, Coppe launched its 13rd program and began to offer master's and doctoral degree courses in Nanotechnology Engineering, a promising field that can be the next great revolution in the industry, in communications and in medicine.

With an eye in the world and the future, Coppe develops and helps Brazil to grow.

SEARCHING FOR LOW CARBON

Anticipating the future of low carbon, Coppe develops technologies for Brazil of the 21st century. The institution carries out various studies and projects, from hydrogen buses and magnetic levitation trains to technologies that use waste and sewage as a source of energy (biofuel); from plants producing electricity from wave motions to houses built with alternative materials and planned to be energy-efficient. From techniques to manage urban transportation, including encouraging the population to use bicycles and public transportation, to nuclear power plants that produce less radioactive waste.

Wave Power Plants: the Energy that Comes from the Sea

Knowledge acquired by the Laboratory of Subsea Technology in conducting research to produce oil in deep waters has given rise to a totally new plant that harnesses wave motion to produce electricity. With an installed generation capacity of 100 kW, the pilot plant installed in the port of Pecém, in the state of Ceará, started its operation in 2012. The prototype was successfully tested during two years. A second demonstration plant is being developed to be installed at Ilha Rasa, an island 14 kilometers away from Copacabana Beach in Rio de Janeiro.

Conceived and designed using Brazilian technology, the wave power plant installed in the state of Ceará is South America's first one. It was entirely developed according to the Brazilian sea conditions: with waves that are not so high, but which are constant throughout the year. The wave power plant lies in the coast and has a float on the sea 22 meters away. The up and down motion by the waves moves the float, which pumps the freshwater through a high-pressure closed circuit that generates a pressurized water in the form of a jet which in turn drives the turbine attached to the generator. This generator converts mechanical energy into electrical energy.

The main distinctive feature of the Brazilian technology is exactly this high pressure system. Coppe learned how to master this technology by developing solutions so that Petrobras could operate in the deep sea to extract oil from wells located 3,000 meters below the surface of the Campos Basin. The pilot plant in Ceará was financed by Tractebel Energia S.A., within the national Agency of Electrical Energy (Aneel).

The plant under development in Rio de Janeiro is the result of a partnership between Furnas and Seahorse Wave Energy, a company installed in Coppe's Incubator of Businesses. The technology was developed to operate more distant from the coast than in Ceará. In the future, this type of structure may be used to power oil rigs operating in the distant pre-salt fields.

Hydrogen Bus: Energy Efficiency

H2+2, the hybrid hydrogen bus with electric powertrain developed by the Laboratory of Hydrogen at Coppe, is a pioneering initiative in the south hemisphere. The second version of the vehicle was entirely developed by Coppe researchers and built by Brazilian industries. It looks like a conventional bus, but it moves using electricity just like conventional electric vehicles and also the electricity produced aboard by a fuel cell fed by hydrogen.

The technologies applied resulted in a silent vehicle, with energy efficiency greater than that of the diesel buses. In addition, it is a zero-emission vehicle. Only water vapor exits the exhaust pipe and it is pure enough to drink.

Due to the technological innovations introduced in Coppe's project, H2+2 is ahead of similar buses tested in other countries, as it is more energetically efficient, thanks to the use of fuel cells and to energy storage and management devices available aboard.

A Train that Levitates

The Maglev-Cobra is a light, silent and fast train without wheels that levitates using superconductors. This technology is already being tested in the UFRJ campus.

In comparison to other means of transportation, such as airplanes, subways, conventional trains with wheels and tracks, and cars, the Maglev-Cobra causes less visual and noise pollution. In addition, it has less physical impact on the places by which it passes. Above all, it is more energetically efficient. Unlike cars and buses, Coppe's magnetic levitation train does not emit greenhouse gases.

Maglev-Cobra was developed at Coppe's Laboratory of Applied Superconductivity of the Electrical Engineering Program. A 200 meter demonstration line was built in the UFRJ campus to transport professors, students, employees and visitors from the Technology Centers 1 and 2.

Sustainable Construction

The cement industry alone accounts for 7% of global CO_2 emissions. Each kilogram of cement is equivalent to one kilogram of carbon dioxide sent to the atmosphere. Researchers from the Civil Engineering Program at Coppe have been developing new types of concrete that can replace up to 40% of conventional cement mixture. They have used ultrafine ashes of sugarcane bagasse and rice husk; civil works residues with ceramic wastes and tile powder, and even sludge and garbage ashes obtained from the sewage treatment stations and wastewater treatment plants.

The green concrete was successfully tested in constructions at Coppe. The houses were built using green construction techniques (green materials and architectonic concepts). The houses are actually three open laboratories.

The Second Generation Ethanol Biofuel

Two major initiatives to innovate and radically increase the production of biofuels using enzyme catalysis are being undertaken by Coppe in liaison with other institutes of UFRJ. The first one is to develop technology to produce the so-called second generation ethanol biofuel, or the 2G ethanol based on the enzymatic hydrolysis of cellulose present in agro-industrial residues, such as sugarcane biomass (bagasse and straw), which are abundant raw materials in Brazil. Estimates indicate that it is possible to double the Brazilian production without increasing the current acreage – and, therefore, without competing with food production and, consequently, with no need to cut down forests for new agricultural frontiers.

The Bioethanol Laboratory, which is the result of a partnership between Coppe and the Institute of Chemistry of UFRJ, is starting tests on a semi-pilot scale using Brazilian technology for all stages of 2G ethanol production, beginning with the production of enzymes to hydrolyze the cellulose – that is, to break the cellulose molecules into glucose that is converted into alcohol via fermentation.

RESEARCHERS TEST SECOND GENERATION BIOFUELS. ETHANOL (PHOTO ON THE TOP) IS AIMED AT DOUBLING THE PRODUCTION WITHOUT INCREASING THE CURRENT ACREAGE OF SUGARCANE, AND BIODIESEL (PHOTO ABOVE) USES ENZYMES TO PERFORM THE TRANSESTERIFICATION OF VEGETABLE OILS

The second initiative is the 2G Biodiesel Project, which is the result of the partnership between Coppe and Tsinghua University, in China, supported by the international company called Novozymes. The technology that the 2G Biodiesel Project is aimed at developing is based on the use of enzymes to perform the transesterification of vegetable oils.

Energy Hidden in Garbage and Sewage

Today, in the north hemisphere, there are approximately 2,000 waste treatment plants to produce energy. Together, they produce electricity equivalent to what residential consumers use. The plants that today are just solid waste and sewage treatment plants will be increasingly producing thermal and electrical energy in the future. At Coppe, the International Virtual Institute for Global Change (Ivig) is working to make Brazil part of this tendency.

Since 2006, the world's first facility using all types of effluents from a sewage treatment station for energy production has been operating in Rio de Janeiro. The effluents include biogas resulting from anaerobic digestion of organic material present in the sewage, grease collected by skimmers and dry sludge, which are processed and converted into natural gas, biodiesel, bio-oil and bio-coal.

The pilot plant operates at the Alegria Sewage Treatment Plant (ETE), in the neighborhood of Caju, in Rio, and is owned by the Rio de Janeiro State Water Utility (Cedae). The energy produced by this plant is used for its own illumination and for equipment supply.

THE TESTS PERFORMED IN LABORATORY HAVE CONTRIBUTED TO TECHNOLOGICAL ADVANCES, ESPECIALLY IN THE NAVAL AND OIL AND GAS INDUSTRIES

EXPANDING THE FRONTIERS OF MARINE KNOWLEDGE

The Laboratory of Ocean Technology (LabOceano), launched in 2003, houses the deepest ocean tank in the world, which is 40 meters tall, 30 meters wide and 15 meters deep. In addition, its central well is even 10 meters deeper. With capacity for 23 million liters of fresh water and height equivalent to an eight-story building, Coppe's ocean tank is capable of reproducing the main features of the sea environment and of simulating the phenomena that occur in water depths of more than 2,000 meters.

After a decade, the tank has helped to develop several technological innovations and to improve the performance of equipment produced by national and international industries headquartered in Brazil. In the tank, it is possible to accurately simulate the environmental conditions to which the systems that are used offshore will be submitted in the sea. It is also possible to generate multidirectional waves of up to 0.5 meter high in periods of 0.3 to 5 seconds. In a scale of 1/100, the tank can generate, for instance, waves equivalent to 30 meters high, reproducing, in this case, an extreme situation, similar to the one found in the ocean environment of the North Sea.

Fans next to the water mirror produce winds at a speed that may reach 12 meters per second, with pre-programmed variations. Such equipment allows us to submit the models to winds equivalent to hurricanes that can reach 150 km/h in the sea.

The simulations and tests performed at the LabOceano are fundamental to prevent and reduce the economic and environmental risks regarding the operations performed at sea. They also advance research and result in technological innovations and solutions to companies, especially those in the naval and oil and gas industries.

REVITALIZING THE NAVAL INDUSTRY

AFTER HAVING GENERATED 60,000 JOBS IN RIO DE JANEIRO IN THE DECADES OF 1970 AND 1980, THE NAVAL INDUSTRY, SUPPORTED AND ALWAYS PROTECTED BY THE INITIATIVES OF THE GOVERNMENT, WITH ACCESS TO SUBSIDIES AND FUNDING, UNDERWENT A PERIOD OF WEAKNESS FROM THE LATE 1980's TO 2002. ALMOST TWO DECADES WERE LOST. THE SCENARIO WAS DISCOURAGING AND THE ACTIVITIES WERE STAGNANT.

Coppe participated in the formulation of strategies to boost the naval sector in the period from 2002 and 2003. Coppe researchers believed that the country could build equipment within its own borders without losing the opportunity to include Brazil in the market aimed at constructing floating platforms.

Several challenges had to be tackled. In 2001 and 2002, Coppe promoted debates that have aroused the interest of part of the industry that was rapidly becoming scrap. Coppe professors Luiz Pinguelli Rosa, Segen Estefen and Giuseppe Bacoccoli had a meeting with the then presidency candidate Luiz Inácio Lula da Silva in 2002 to show that it was possible to build platforms in Brazil. The idea was to make the Brazilian naval industry competitive to compete with the leading countries in the market, such as South Korea, Japan and the United States. The candidate included the proposal in his government plan and, after being elected, he implemented it.

Revitalizing the Naval Industry

The debates at Coppe also put forward the proposal to create a fund for the naval industry which would give rise to the Fund for Waterway Transportation and Naval Building, of the Ministry of Science, Technology and Innovation.

The effort has resulted in the revitalization of the Brazilian naval industry and therefore in the increase in the number of job positions (from 2,000 employees in 2000 to more than 56,000 in 2010) and in the increase of annual funding from the Merchant Navy Fund (from R$ 300 million in 2001 to R$ 2.4 billion in 2009).

But, besides the development, the naval industry is undergoing a stagnant period, as the industrial policy is not pursuing a technological qualification. Entering again national debates, today Coppe proposes the creation of a technology center for the naval industry in the vicinity of the Technological Park at UFRJ to concentrate resources and efforts available in the country. The objective is to generate sustainability to the Brazilian industry, so that it can be competitive in the future, with well-established strategies, and within an innovative environment.

THE SOCIAL DRAMAS OF THE NEW CENTURY

THE 21ST CENTURY HAS BROUGHT THE CHALLENGES OF GLOBALIZATION, WHICH INCREASED EVEN MORE THE SOCIAL DIFFERENCES. COPPE DID NOT BECOME DISTANT TO THE DEBATES AND DECIDED TO HELP BRAZIL TO TACKLE THE NEW AND OLD DEMANDS FOR A FAIR AND INCLUSIVE ECONOMIC, SOCIAL AND TECHNOLOGICAL DEVELOPMENT.

The Iguaçu Project is an example of what a cutting-edge engineering, the one practiced at Coppe, can give. The project is the result of an intense collaboration between the state government of Rio de Janeiro and the researchers from the Laboratory of Hydrology and from the Civil Engineering Program. This partnership resulted in a comprehensive project that adopted innovative solutions to the phenomenon of flooding in an area of 726 square kilometers, home to 2.5 million people in six municipalities in the Baixada Fluminense (low lying urban area in the outskirts of the city of Rio de Janeiro: Nova Iguaçu, Mesquita, Belford Roxo, Nilópolis, São João de Meriti and Duque de Caxias).

Unlike other projects, the Iguaçu Project has tackled the flooding issue by means of an integrated observation of the physical, environmental and social reality of the region. Only afterwards were the interventions to control flooding and to undertake the environmental restoration of the hydrographic basins designed. The interventions were a combination of civil works, including drainage; damming; reforestation of hillsides; recuperation of sources; control measurement regarding the use of the soil and creative urbanization of areas of risk that were inadequately occupied once.

In 2009, Coppe and Coep (the Committee of Public Entities in the Struggle against Hunger and for Life) launched the Hebert de Souza Technology and Citizenship Laboratory. Researchers conduct studies in this laboratory to find out what are the necessities of the low-income population living in these areas of risk, as well as to verify if the problems are related to climate changes. Not only does the laboratory contribute to the entities that deal with poverty and social inequalities by sharing Coppe's scientific and technological knowledge, but it also helps to include these topics in Coppe's researches and studies.

READY TO FACE THE PRE-SALT CHALLENGES

THERE ARE STILL LOTS OF SECRETS TO UNCOVER IN THE PRE-SALT AREA. IT IS NECESSARY TO OVERCOME THREE LAYERS: WATER, WHICH CAN REACH DEPTHS OF 3,000 METERS, A LAYER OF SEDIMENTS, OF ABOUT 2,000 METERS, AND A LAYER OF SALT OF ABOUT 2,000 METERS. IN THE LAST YEARS, NEW AND SOPHISTICATED FACILITIES WERE INSTALLED AT COPPE'S LABORATORY COMPLEX, AND NEW RESEARCH LINES WERE CREATED SO THAT THE RESEARCHES COULD TACKLE THE CHALLENGES. ONE OF THE PURPOSES IS TO HELP PETROBRAS TO REACH THE GOAL OF PRODUCING 4.2 MILLION BARRELS/DAY IN 2020.

Among the areas of knowledge under development, it is possible to mention the mechanics of rocks, the production in carbonate rocks, the mechanics of salt, high-resolution geophysics, new materials for well coating, offshore structure engineering and special materials for equipment and ducts submitted to high pressure and temperatures in chemically hostile environments. Tests, modeling and simulations are essential to reduce the risks and operational costs and to evaluate new concepts and methodologies.

A Battle against Wear and Corrosion

The idea to build the Laboratory for Non-Destructive Testing, Corrosion and Welding (LNDC) started in 2001, but it only became a reality in 2009, when it was launched, after the discovery of massive pre-salt reserves in the Santos Basin.

The LNDC is the only laboratory in Brazil capable of examining large-scale equipment used in oil exploration. The LNDC building occupies an area of 9,000 square meters and has two large testing tanks (a water tank and a dry tank) for non-destructive testing. Simulation of the field's conditions occurs in a water tank, which is 12 meters tall, 6 meters wide and 7 meters deep. This simulation is used to test the strength of all equipment used in the oil exploration and production at depths of up to 7,000 meters below the water surface. The tank has been designed to be able to test a piece of equipment up to its breaking point. The dry tank blocks radiation and is designed to perform tests with gamma rays and X-rays. It also has a particle accelerator that registers X-ray images

THE LABORATORY FOR NON-DESTRUCTIVE TESTING, CORROSION AND WELDING TESTS THE STRENGTH OF MATERIALS AND EQUIPMENT THAT WILL BE USED IN THE EXPLORATION OF THE PRE-SALT LAYERS, BY SIMULATING CONDITIONS AT WATER DEPTHS OF UP TO 7,000 METERS

of the equipment and searches for cracks and fissures.

The tests performed in the laboratory may contribute to reduce losses of hundreds of thousands of dollars by the companies due to the corrosion and deterioration of equipment. The LNDC may also contribute to the strengthening of the national industry, as it makes it possible to develop, in Brazil, materials and technology that nowadays are imported by the oil industry.

Separating Oil, Gas and Water

In 2013, Coppe launched the Interdisciplinary Center of Fluid Dynamics (NIDF) to find solutions to explore oil and gas in increasingly deep waters. The center consists of three laboratories installed in a total area of 5,400 square meters. It is the first center in Brazil to house in one place a set of laboratories aimed at studying the process of oil and water flow in an integrated and complementary way.

The NIDF conducts studies and tests related to the process of drilling and completion of wells, artificial elevation and primary separation. This research may help Petrobras to increase its oil and gas production thanks to, for example, the development of processes that reduce the time of separation of oil from water. The new laboratories have the most modern equipment specifically dimensioned for research developed there.

EXPLORING THE PRE-SALT DEPTHS

It is possible to say that one has to meet two types of technological challenges to explore oil and natural gas in the pre-salt layer. The vertical challenge is to drill until the reserve is reached, passing through water, sediment, and salt layers. Each layer behaves differently, and their temperatures vary from 80°C to 150°C at high pressure and saturated with corrosive gases. It is also necessary to consider the way back to the surface, in which the oil and gas from the well must be transported, without obstructing the ducts or provoking oil leakage that causes environmental accidents.

The horizontal challenge is to transport the oil and gas from the production area (300 km off the coast) to the coast by ship and gas pipeline, and to take the personnel, equipment and supplies to and from the platforms.

Everything is performed in a non-static environment. Platforms, ships and piping are not stable and may be worn down by the wind, tides and sea currents. Sediments build up on the drilling rigs that drill the wells. Furthermore, salt can block the passage recently opened by the drilling rigs. Even the movement of oil and gas discharged from the pipes can damage the pipe materials and cause disruption.

Ultimately, this endeavor reveals several problems that begin with the great depth of the water, continues on to the coating of the drill holes with soft, unconsolidated sediment, then reaches the difficult passage through the thick layers of salt, and finally arrives at an area with extremely high pressures and temperatures, saturated with corrosive gases.

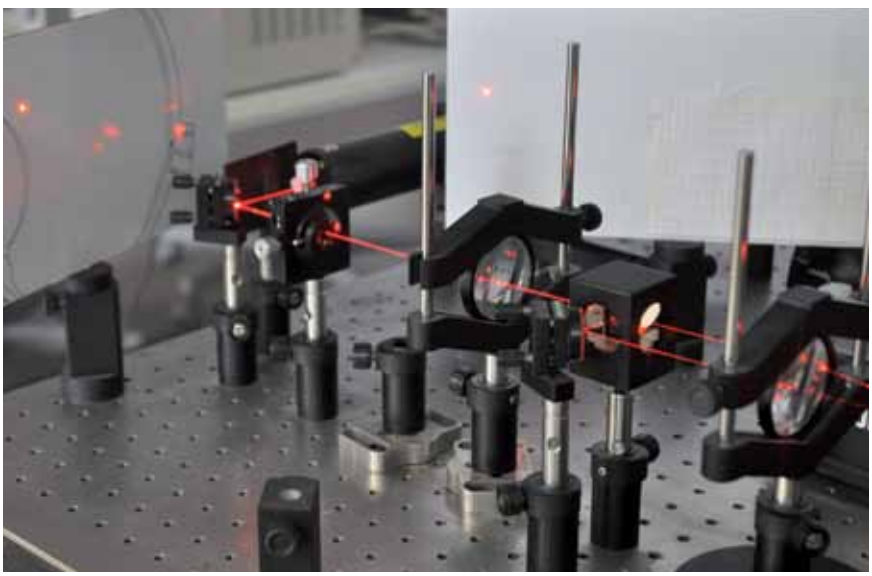
Logistics for the Pre-salt Exploration

The oil and gas reserves of the Brazilian pre-salt layers lie 300 kilometers off the coast. This is twice the distance of the most isolated oil wells in the Campos basin, which are no more than 140 kilometers from the coast. This means that it is necessary to deal with new logistics issues during the operations. It will be necessary to create alternatives for transporting equipment, people and goods to the production areas.

The current solution, which is to transport people and light cargo by helicopters, places restrictions on the transportation to remote areas such as the pre-salt region. Intermediate structures on the route to the pre-salt area are necessary. One of the proposals being discussed is the construction of huge floating structures equipped with hangars, storage facilities, accommodations, docking stations, and helipads (with a capacity to receive several helicopters simultaneously). These intermediate bases would then function as enormous artificial islands.

Another possibility is to construct a kind of "archipelago" (i.e., to construct various structures, but smaller in scale), which would theoretically be easier to install and maintain in place. Since the conditions at sea are more severe in the pre-salt region than in the Campos Basin, it will be necessary to develop specific projects and numerical and physical simulations with reduced models to evaluate what kind of structure will be able to best withstand the action of the waves, sea currents and winds.

Another area than can benefit from these simulations is that of the approach, connection and the offloading maneuvers, which consist of transferring oil from platforms or oil tankers to the offloading tankers that take oil to the coast. These operations involve large-scale vessels that need to approach with safety, connect to the platforms and maintain their position,



THE *LASER DOPPLER* ANEMOMETER MEASURES THE VELOCITY OF FLUID (GAS OR LIQUID) FLOW. THE PROTOTYPE ABOVE WAS BUILT IN THE INTERDISCIPLINARY CENTER OF FLUID DYNAMICS (NIDF)

LAUNCHED IN THE SEA IN 2013, THE ROBOT DIVERS AND BUOYS PROVIDE DATA TO AN UNPRECEDENTED OCEANOGRAPHIC OBSERVATION SYSTEM

countering the action of the wind, waves or sea currents.

With the LabOceano, inaugurated in 2003, Brazil has entered a new era of hydrodynamic studies to evaluate the behavior of complex systems consisting of subsystems that together react to wave action. Most of the physical simulations with reduced models that will help the operation in the pre-salt layers may be performed in the tank of LabOceano at Coppe.

Projeto Azul: Uncovering Secrets from the Sea

One of the opportunities created by the challenges posed by the exploration of the pre-salt layers is the stimulus to investigate the characteristics and behavior of the wide Brazilian sea. Coppe is developing an unprecedented oceanographic observation system in Brazil. Called Projeto Azul (Blue Project), the initiative gathers information and data collected by robot divers directly from the sea.

The project is being set up in the Santos Basin, where the pre-salt fields are located, and it is gathering information about the sea, from the surface to water depths of up to 2,000 meters. This is the first time that the oceanographic parameters of the region are being studied systematically at this depth.

The first equipment to gather information – the robot divers, buoys and profiling devices – were launched in the sea in 2013. Data collected are combined with image captured by satellite. The results are useful not only for the oil industry, but also for environmental monitoring, fishing, navigation and scientific research in general, including the studies on climate change.

Funded by the BG Brasil company, the project is conducted by the Laboratory of Computational Methods in Engineering (Lamce/Coppe), in liaison with the National Institute for Space Research and the Prooceano company. To carry out this project, Lamce used its vast experience in the development of technology to identify and trace oil spill in the sea, by combining environmental computational modeling, satellite images and analyses of meteorological, oceanographic and geological data.

> “We are prepared for the challenges facing the exploration of the pre-salt layers, and I think we are even more prepared than we were at the time Coppe signed the historical agreement with Petrobras in the 1970’s. We have a leading complex of laboratories and it will be difficult to find a similar one in the area of oil and gas in another institution in the world. We need to work hard to improve some research areas, as we will be working distant from the coast, in order to guarantee more safety, as well as protect the oceans and human life.”
>
> **Segen Estefen, professor of Ocean Engineering at Coppe**

EXPANDING HORIZONS

ALWAYS LOOKING TO THE FUTURE, COPPE HAS BECOME A NATIONAL AND INTERNATIONAL REFERENCE FOR ENGINEERING TEACHING AND RESEARCH, AND HAS HELPED THE COUNTRY TO FACE THE MOST IMPORTANT CHALLENGES IN ITS RECENT HISTORY. IN THE LAST TWO DECADES, THE INSTITUTION HAS BEEN INTERNATIONALLY RECOGNIZED AND HAS TAKEN PART IN PROJECTS AND INITIATIVES ALL OVER THE WORLD.

Coppe at the IPCC

In the international scenario, Coppe has projects in liaison with renowned scientific institutions. Many of its professors are members of committees and research entities from several countries and multi-lateral bodies, such as the Intergovernmental Panel on Climate Change (IPCC), which is an entity created by UN in 1998 to provide scientific support to global governance mechanisms, after a scientific consensus has been reached.

The IPCC publishes periodic reports – the so-called assessment reports – and scientists around the world contribute to these reports. The first one, published in 1990, resulted in the creation of the United Nations Framework Convention for Climate Change, signed in 1992.

Coppe professors have been constantly participating in the IPCC reports for more than 20 years, when they joined the group that produced the second report. In 2007, they were part of the group that released the forth report, which won the Nobel Peace Prize. Among the Brazilian scientists chosen in 2010 by the IPCC to participate as authors of the 2014 assessment report, seven work at Coppe. It is the largest Brazilian representation.

The Interaction with Cern

The partnership between Cern (the acronym in French for the European Organization for Nuclear Research) and Coppe was established in 1989, with the participation of some of the institution's researchers in the development of analogical and digital circuits for the Spacal particle detector. One year before, a group formed by Coppe professors Zieli Dutra, Luiz Calôba, Antonio Carneiro de Mesquita Filho, Ana Regina Rocha and Jano Moreira visited Cern's facilities, next to Geneva, in Switzerland for the first time. When they saw the magnitude of the researches developed at Cerne, they accepted the challenge and joined the project. The partnership was established and since then several joint projects have been developed and several researchers and students of Coppe have been continuously working at Cerne.

In July 2012, an important step was taken to search for the explanation for the origin of the world. Cern announced the discovery of a new particle, the Higgs boson, also known as "the God particle". Gathering scientists from 85 countries, Cern started up in 2008, in Geneva, the Large Hadron Collider (LHC), the greatest particle accelerator built to date, to identify the mentioned particle. The LHC managed to create an explosion called by the scientists as "the mini-Big Bang". Of the resultant particles, one was identified as the Higgs boson.

Atlas, the greatest particle detector of the LHC, played a major role in the identification of the Higgs boson and it was built with great collaboration by Coppe. It was operated with the help of an international collaboration of 38 countries. The team of Coppe's Laboratory of Signal Processing (LPS), headed by Professor José Manoel Seixas – who together with Fernando Marroquim, from the Institute of Physics of UFRJ, coordinates the Brazilian team in charge of Atlas – acts in three areas vital for the performance of LHC: calorimeter, filtering and computation. The calorimeter measures the energy and identifies the composition of the particles produced in the explosion. The filtering process separates the particles that are more relevant for the experiment. The computational system processes the data mass generated.

CERIMONY IN BEIJING. COPPE DIRECTOR, LUIZ PINGUELLI ROSA, GREETS THE ENERGY DIRECTOR, HE JIANKUN, FROM TSINGHUA UNIVERSITY. BETWEEN THEM IS COPPE DIRECTOR OF TECHNOLOGY AND INNOVATION, ROMILDO TOLEDO

The Brazil-China Center

In 2009, Coppe broadened its scope of international action with the creation of the Brazil-China Center for Climate Change, Energy and Innovative Technology, in partnership with Tsinghua University, the major Chinese university in the field of engineering. The center is headquartered in the Tsinghua University campus, in Beijing, where an office is maintained for the coordination of activities and the establishment of contacts with Brazilian and Chinese companies interested in the technologies that are jointly developed.

The Brazil-China Center began its activities by conducting projects in the areas of climate change and biofuel, but in July 2013 Coppe researchers and Tsinghua University announced that both institutions will develop studies related to urban sustainability.

The studies will also count on the participation of researchers from the University of Virginia, in the United States. Created by UN during the Rio+20 Conference in 2012 and headquartered at Coppe, the World Center for Sustainable Development (Rio+ Center) will support the studies and help to find international funding to conduct research. The proposal is to carry out comparative studies in Rio de Janeiro, Beijing and Washington.

THE PARTNERSHIP BETWEEN COPPE AND THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN) IS MAINTAINED UNTIL TODAY. THE PHOTO BESIDE SHOWS THE LCH, THE GREATEST PARTICLE ACCELERATOR EVER BUILT

INNOVATION AND INTEGRATION OF KNOWLEDGE

INNOVATION AND INTERDISCIPLINARITY PERMEATE COPPE SINCE 1963, WHEN THE INSTITUTION WAS CREATED. MORE RECENTLY, THE NUMBER OF INITIATIVES TO FAVOR AND SUPPORT KNOWLEDGE SHARING AMONG DIFFERENT AREAS, WHICH IS ESSENTIAL FOR SCIENCE DEVELOPMENT AND THE INTRODUCTION OF INNOVATIONS, HAS INCREASED.

The year of 2013 represented an important milestone for the history of Coppe: its 13rd program, in Nanotechnology Engineering, was launched. Essentially, it is an interdisciplinary program whose first course was taught in March 2014. The new Program started its activities with score 5 according to the evaluation by Capes, which is the maximum score attributed to recently-created programs.

The Nanotechnology Engineering Program was created to be responsible for the inclusion of Brazil in the group of countries that produce materials, equipment and processes based on nanotechnology – the major field of innovation nowadays. The creation of the program was motivated by the fact that ten laboratories at Coppe were already developing research in the field. The Nanotechnology Engineering Program gathers 18 professors from seven programs within Coppe: the Chemical Engineering, Metallurgical and Materials

INSTALLED IN THE LABORATORY FOR SURFACE ENGINEERING, THE PHOTOELECTRON SPECTROSCOPY EQUIPMENT PERFORMS THE CHEMICAL ANALYSIS OF MATERIALS WITH HIGH PRECISION

“Brazil is far behind regarding education in nanotechnology. We need to make up for lost time. It is a leading-edge technology, and engineering is responsible for building the bridge between basic knowledge and its application. We were already working with nanotechnology in some programs, but on an individual basis. I have no doubt that this program will achieve excellence just like the other programs of Coppe.”

Sergio Camargo, professor of Coppe and coordinator of the new program in Nanotechnology Engineering

ON THE TOP OF THE PAGE, THE RESEARCHER USES AN ELECTRONIC MICROSCOPY EQUIPMENT OF HIGH-RESOLUTION TRANSMISSION CAPABLE OF INCREASING THE OBSERVED OBJECT BY 1.8 MILLION TIMES. THE PHOTO ABOVE SHOWS THE STUDENTS OF THE FIRST CLASS OF THE NANOTECHNOLOGY ENGINEERING COURSE OF COPPE

Engineering, Mechanical Engineering, Electrical Engineering, Civil, Engineering, Nuclear Engineering and Production Engineering programs.

A Strategic Area

By gathering its competences to qualify people highly specialized in nanotechnology, Coppe intends to contribute to the creation of national technology in the field and foster innovation in a strategic area. Estimates show that the global market in nanotechnology is worth US$ 1.6 trillion per year. The annual total investment by governments in nanotechnology in the world surpasses US$ 10 billion. If we add private investments, it almost reaches US$ 0.25 trillion. In Brazil, the investments are still modest, and engineering programs are not much involved.

Coppe's initiative matches one of the government's proposals. The government decided to create the System of National Laboratories in Nanotechnology (SisNano), of the Ministry of Science, Technology and Innovation, which gathers 26 laboratories from different Brazilian institutions. The objective is to promote scientific development and innovation in the area, in addition to optimizing the infrastructure, the qualification of people and making the country capable of developing programs of international cooperation. Coppe's Laboratory for Engineering and Surface of Nanostructured Materials is already part of the SisNano network.

COPPE DIRECTORS FROM 1963 TO 2015

ALBERTO LUIZ GALVÃO COIMBRA (1963–1973)
Coppe/UFRJ director and founder

SYDNEY MARTINS GOMES DOS SANTOS (1973–1975)

SERGIO NEVES MONTEIRO (1976–1978)

PAULO ALCÂNTARA GOMES (1979–1981)

SANDOVAL CARNEIRO JUNIOR (1982–1985)

LUIZ PINGUELLI ROSA (1986–1989)

NELSON MACULAN FILHO (1990–1991)

LUIZ BEVILACQUA (1991–1992)

ANTONIO FERNANDO CATELLI INFANTOSI (1992–1993)

LUIZ PINGUELLI ROSA (1994–1997)

SEGEN FARID ESTEFEN (1998–2001)

LUIZ PINGUELLI ROSA (2002)[1]

LUIZ FERNANDO LOUREIRO LEGEY (2002–2003)[2]

AQUILINO SENRA MARTINEZ (2003)[3]

ANGELA MARIA COHEN ULLER (2003–2007)

LUIZ PINGUELLI ROSA (2007–2011)

LUIZ PINGUELLI ROSA (2011–ATÉ O MOMENTO)

(1) He left the position to assume the presidency of Eletrobras.
(2) He served as acting director in January 2002 until another election was conducted.
(3) He served as acting director, from June to July 2003, until the new director held the position.

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COPPE IN NUMBERS

13 graduate course programs
(master's and doctoral degrees)

Biomedical Engineering Program (PEB)
Chemical Engineering Program (PEQ)
Civil Engineering Program (PEC)
Electrical Engineering Program (PEE)
Energy Planning Program (PPE)
Mechanical Engineering Program (PEM)
Metallurgical and Materials Engineering Program (PEMM)
Nanotechnology Engineering Program (PENt)
Nuclear Engineering Program (PEN)
Ocean Engineering Program (PENO)
Production Engineering Program (PEP)
Systems Engineering and Computer Science Program (Pesc)
Transportation Engineering Program (PET)

Total number of titles issued
(up to December 2013)

10,695 master's degrees
3,558 doctoral degrees

Academic Production
(in 2013)

14,253 master's dissertations and doctoral theses
(total number from 1963 to December 2013)
409 master's dissertations
179 doctoral theses
1,433 scientific papers

Infrastructure and Human Resources
(in August 2014)

349 teachers with PhDs
2,634 students (1,327 master's students and 1,307 doctoral students, including 100 foreign master's students and 135 foreign doctoral students)
105 post-doctoral researchers
350 employees
124 laboratories
1 incubator for technology-based companies
1 technology incubator for popular cooperatives (ITCP)
1 core service in high-performance computing (Nacad)

Interaction with Society
(up to August 2014)

13,625 contracts
125 patents filed
18 softwares registered

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