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Telephone Systems Engineering in Brazil: Indigenous vs. Foreign Technology

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Abstract

Brazilian society was under authoritarian military governments from 1964 to 1985. Geographically larger than the continental United States, Brazil needed many actions towards development in the 1960s. With a low democratic profile, Brazilian government aimed at two great objectives: keeping the nation united through a common culture and language and developing indigenous industry and technology. One of the Brazilian government's main goals was establishing the necessary infrastructure for a modern countrywide telecommunication system. Thus, the government strategically divided this task into four phases: telephony equipment/telecommunication systems operation/maintenance, design/installation, manufacturing, and R&D. These four phases were successfully achieved in less than 20 years due to both the National Department of Telecommunication's (Ministério das Telecomunicações do Brasil) strong support and the large Brazilian market for telecommunication services. Brazilian manufacturing capacity shifted from an importer to a producer position in the world market. Using indigenous technology, Brazilian manufacturers could produce and sell not only the single telephone sets but also the whole system equipment. By the end of the 1980s, the country had established the competence for developing and manufacturing switching equipment, microwave antennas, and others. Brazil was the third country in the world to develop, manufacture, and produce mono mode optical fibers. After 1990, however, Brazil was unable to keep up with the necessary production and R&D investment due to economic and management difficulties. Thus, the Brazilian government obtained Congress' approval to sell all the telephone companies and government research centers. Most state-owned companies were sold to foreign telecommunication companies. This paper analyzes the impact of the Brazilian government's decision to give up the continuity of a successful approach to develop indigenous technology and engineering qualification, in exchange for socio-economic advantages of having foreign companies importing their own technologies into Brazil and manufacturing telecommunication equipment for the Brazilian market and for exports.
Keywords: Telephone systems, state companies, privatization.

Introduction

Establishing a complete telecommunication indigenous system with all the necessary infrastructure is a hard task for any country. Both know-how and facilities for designing, manufacturing, and operating telecommunications systems are expensive and not easy to acquire, especially for beginners. Moreover, training and qualifying the necessary human resources for supporting these activities can be extremely hard for a large country with no background on telecommunication development.

Brazil did succeed in this endeavor. It took Brazil approximately 20 years to change from a country with very poor communication to a completely integrated one. Among other kinds of high technology, Brazil used a domestic satellite for assuring coverage of even remote areas, such as the Amazon. However, it probably would not have happened if it were not under an authoritarian regime.

By the end of the millennium, the Brazilian government completely changed the route being used in the past towards telecommunication R&D. It shifted from a technology generator to a product importer, i.e., the Brazilian policy towards telecommunication took the road to both abolishing the development of indigenous telecommunication technology and becoming a heavy user country. Technologically, it ended up going backwards. The government sold all the telecommunication companies and infrastructure to private companies. Most of these purchasers were foreign companies.

This paper initially calls attention to all the historical causes, as well as efforts and policies that helped create telecommunication infrastructure in the country; then, it reports on the decision of aborting these objectives, entrusting to foreign companies the control of all telecommunication engineering and management in Brazil. It concludes with the launching of some questions on the future of technology in Brazil.

Political History Effects on Technological Development

Brazil is a large country. Colonized by the Portuguese people, it was under a monarchical system of government from independence in 1822 to the beginning of a Republican system, aiming for the U.S. democratic system in 1889. In the late 19th and early 20th centuries, the country had a large influx of immigrants from Italy, Germany, and Japan, as well as from U.S. southern farmers after the American Civil War in 1865.

Since the elite was mostly composed of Portuguese descendant land-owners, Brazil remained basically an agricultural country with no signs of active participation in industrial development until approximately the second half of the 20th century.

Nonetheless, Brazil was the single nation in the Americas who joined the United States on war efforts in Europe during World War II. Such an endeavor influenced Brazilians somehow. Naturally,

North American officers observed that despite the existence of such remarkable physical differences among Brazilian officers and soldiers due to both the long slavery period and the intense the immigration process, Brazilians shared the same space without conflict. On the other hand, Brazilian soldiers and officers also learned a lot from their fellow Americans.

Brazilian officers enjoyed seeing their North American counterpart officer's actions, in terms of organization, broad military and civic views, and their determination to win. Thus, having learned about the American War College, young Brazilian officers decided to establish a similar organization in their home country after the war. They obtained support, help, and even direct participation and influence from North American officers for establishing the BrazilianWar College in Rio de Janeiro, *Escola Superior de Guerra*.

The Brazilian War College proved to be a remarkable institution for Brazilian high rank military officers. It also increased a strong anti-communism feeling, which Brazilian military officers had grown since the chimerical communist attempt—the so-called "*Intentona Comunista*," in November 1935. With Soviet Union help and orientation, the communist groups tried to make a socialist revolution in Brazil. Despite the fact that the attempt was a failure, it killed many Brazilian military personnel [1].

At Escola Superior de Guerra, high rank military officers above the level of Colonel, as well as similar ranking Navy and Air Force officers, spend a full intensive year program studying strategy, politics, economics, social science, and leadership. In this endeavor, they are joined by Brazilian civilians from high levels of government and private Brazilian institutions, as well. As a result, not only do civilians and military people learn a lot about their country, but they also end up learning about each others' ways of thinking and behaving. They actually build up mutual respect for each other.

Brazilian military people have been known for their alertness and willingness to take over the government whenever there were signs of political anxiety and turmoil in the country. Theoretically, they would be doing it for the sake of both the people and democracy. Brazilian history has seen it on several occasions.

One of the most important instances during the 19th century relates to the end of the Imperial period as a government system in Brazil. The military officers were responsible for putting down the monarchy in 1889.

Another occasion refers to the 1930 Revolution. The Armed Forces were responsible for the 1930 Revolution, which brought about a new reformist government. They were also responsible for putting down the same government in 1946. The president was an Army General from 1946 to 1951. The elected president, Getúlio Vargas, killed himself in August 1954 when he learned that he would be forced out of government by the military officers. The military people were also responsible for getting President Carlos Luz out of office in November 1955 [2].

In the 1960s, at the highest peak of the Cold War, Brazil had come to the edge of turning into a Communist country. As the Armed Forces realized that the country was in turmoil once again, they took over the government once more. They were expected to return the office to civilian government within three to six months, as the Armed Forces had always done before. However, now there were two important items that modified the political situation in Brazil.

First, there was the Cold War. The military government was very concerned with the danger of communist ideology. And second, there was Escola Superior de Guerra, which had assured most of the military high rank officers that they were better qualified to run the country than the old politicians who knew very little about economics, social expectations, and the real needs of the country. And, to top it all off, the point that most of them considered the most important was civilian politicians' weakness before the danger of communism.

Actually, the military personnel, as well as the country's elite, businessmen, and other civilians, thought the country needed continuous leadership and government. They provided the support the military people searched for, so they could decide and stay in power "a little longer" than every corner of society had imagined. They stayed in power for 20 years.

The military government aimed at economically and socially developing the country. They did succeed in several areas, since they could decide and enforce all governmental policies without accepting criticism. People had no rights to speak out at anytime. The media and the Congress were under strict surveillance in most occasions.

Under these conditions, with almost no freedom, it was easier for the government to reach certain goals, which seemed to mean development. Brazilian GNP, for example, grew at more than 10 percent, and they called it "the Brazilian Miracle."

Indeed, some development did occur in those areas given priority by the military government: higher education, steel production, shipbuilding, the airplane industry, nuclear energy, military weapons production and export, telecommunication equipment and systems, computer technology, and bio-energy (pro-alcohol program) [3, 4].

Development of Telecommunication Technology in Brazil

Expanding the telecommunication system in a country larger than the continental United States and which had almost no communication facilities was an insurmountable and challenging task. The military government aimed at developing indigenous technology mainly in the areas of microwave communications, telephony, switching, multiplex, microelectronics, and telecommunication computer software.

Initially, they established what was called the TELEBRAS System (*TELEcomunicações BRASileira*). The system was based on a state monopoly form. There was a state-owned telecommunication company in each Brazilian state. These companies were in charge of

providing all the telephony system services for the cities in that state. They were all linked to the national telecommunication holding company.

There was one carrier with a monopoly for interstate and international telecommunication services, EMBRATEL (*EMpresa BRAsileira de TELecomunicações)*, the Brazilian Telecommunication Company. EMBRATEL held a relevant share of the INTELSAT System and, in 1975, had its own geo-stationary satellite, BRASILSAT, as well as several international underwater cable systems, such as BRASCAN (BRASil – CANarias Islands), connected to Europe and BRUS, (BRazil – United States submarine cable connection).

There was a holding company in charge of both centralizing power and taking care of all the country telecommunication policies. This company was TELEBRAS. TELEBRAS also had the largest and most advanced telecommunication research and development center in Latin America, TELEBRAS R&D Center, located in Campinas, SP.

The development of telecommunication technology and systems in Brazil required huge investments [5]. International companies went to Brazil to explore the large market generated by government incentives. Some of them were NEC from Japan, TELETTRA from Italy, Ericsson from Sweden, Siemens from Germany, and Standard Electric (ITT) from the United States.

These companies were compelled to start manufacturing plants in Brazil. Moreover, their commitment to increase manufacturing in Brazil was an important item in their bids. Importing telecommunication equipment was strictly controlled, being completely forbidden in the case that equipment or parts of it were manufactured in Brazil.

Development of Indigenous Technology in the Area of Telecommunications

Developing indigenous telecommunication technology in Brazil demanded a special strategy towards establishing efficiency to the point of industrial production capability [6]. For such, the government understood that there should be four phases, as we will explain below. What is very interesting to see is that the government perceived that the country should begin searching for capability for the final stages before the actual production. Thus, the first phase referred to maintenance, while the last phase referred to R&D. This process had four interrelated phases.

- **Phase 1: Operation and Maintenance**

In this phase, the government made the point that they would establish a modern and efficient infrastructure for telecommunications in the country. Engineers, as well as technicians, were trained for operation and maintenance of the telecommunication system and equipment.

The government started providing the modern telecommunication system for Brazilian cities and having engineers, as well as technicians, trained and qualified to understand their operation and maintenance.

Foreign companies would sell and install all the equipment, and it would be operated by personnel trained both in Brazil and abroad.

- **Phase 2: Systems Planning and Development**

Engineers who graduated from Brazilian universities were then able to understand how to design and set up telecommunication systems for interconnecting the country with telephony and television systems [7]. Most of these people would work for foreign companies established in Brazil, and they would have their training complemented by plant facilities in their company headquarters abroad. The government also stimulated the accreditation for new electric engineering programs in Brazilian universities [8].

As a young engineer, the author had extensive training at NEC (Nippon Electric Corporation) plants in Tokyo, Tamagawa, and Yamanashi and learned a lot about technical matters, such as digital microwave radios and time division multiplex, which were technical novelty in the early 1970s. NEC, as well as other foreign companies, used to be the top schools for learning engineering management at the time. This was a very effective way for the government to set up a team of experienced managers as telecommunication engineers.

- **Phase 3: Industrial Production**

Foreign multinational telecommunication companies were eager to supply the demand for equipment and systems to the rapidly growing Brazilian market. They received many benefits to manufacture equipment in Brazil. The most valuable of them was the market protection. When any product was manufactured in Brazil and approved by the government, all equivalent products were not allowed into the country. This was a big advantage since it meant the assurance of a protected market and a large demand for that product.

This procedure was good for the industry in Brazil because it meant less importation, more jobs, and the acquiring of technical skills. Because no company in Brazil was allowed to employ more than one-third of foreigners, many Brazilians received on-the-job training and improved their skills.
Moreover, there were many incentives for equipment with parts made in Brazil. Thus, searching for Brazilian suppliers to use Brazilian-made parts in their equipment worked also to the foreign companies' advantage.

Therefore, we can say that these regulations contributed for creating a domestic Brazilian telecommunication industry.

- **Phase 4: Research and Development**

TELEBRAS Research and Development Center (CPqD), located in Campinas, São Paulo, owned and sponsored by TELEBRAS, brought together scientists and university professors on leave from their government universities and companies. Most of them aimed at working on specific

high telecommunication technology projects, such as the Brazilian telephone set, switching equipment, microelectronic components for telecommunication, fiber optics, and so on.

TELEBRAS CPqD was very successful, and many of their patented products were sold by Brazilian manufacturers to TELEBRAS System companies. By the mid 1980s, Brazil could do research and generate knowledge in the area of telecommunication. Systems were designed and set up in Brazil, using many equipment and/or parts designed and manufactured domestically.

The Selling of the Successful TELEBRAS System

The military finally returned the government to civilians in 1985. Economic conditions were very difficult then. There was very high inflation, and industrial production was low. The Brazilian Miracle had disappeared due to the high prices of oil worldwide, resulting from OPEP policies. Furthermore, Brazil was tremendously indebted to foreign banks. Such foreign debt had been caused mainly by government spending, especially on large projects such as the ITAIPU hydroelectric plant (the largest in the world at the time); the Rio-Niteroi bridge, named after a hard line military president General Costa e Silva (1967–1969); and by very heavy investments in weapon development, steel plants, airplane manufacturing development, and on telecommunication engineering development.

In the case of telecommunication, the technology and services were the most advanced in the world, but the system could not supply the very high Brazilian demand for telephone lines. It would take approximately three or four years for a subscriber to get a telephone line. This would make people transfer their rights to have a telephone line for compensation. People used to say they would “buy” a telephone line from someone else, and depending on the location, the price for a “telephone line transference” might be as much as $3,000 U.S. Thus, the result of all those government efforts was a modern and efficient telephone system in place, but not for poor people. Most Brazilians did not have immediate access to such modern and helpful technology, such as a simple telephone line.

Telecommunication technology was developing much more by the 1980s and 1990s. Cellular phones were introduced worldwide, but a new system was necessary. This new system required huge investments. On the other hand, the Brazilian government could not afford to further invest in telecommunication. Then, the Brazilian government came to the decision to sell the TELEBRAS System to private enterprises, regardless of their origin (Brazilians or foreigners), who could bid and pay for it. This was a finishing stroke on all the knowledge and technological capability which had hardly been established and developed during the previous 30 years.

TELEBRAS R&D Center, CPqD, became useless since new telephone companies operating in Brazil would now bring their own technology. Currently, there are many foreign companies manufacturing cell phones in Brazil and even exporting them, but their designing and manufacturing carry absolutely no Brazilian technology.

Most of the Brazilian companies' engineers and managers, especially those who worked for the TELEBRAS System, have now retired. They were not substituted for a new generation of well-skilled telecommunication engineers. As a matter of fact, not so many young people take telecommunication or electric engineering programs anymore.

On the other hand, even under the loss of technology and engineering competence, selling the TELEBRAS system companies had a positive social result. Foreign companies invested in commercial activities to supply the market for telephony in Brazil, and they had a great return. Contemporary subscribers can use their own telephone line on the same day they sign-up for one. Most people in Brazilian cities can afford to have a cellular phone, despite their social or economic conditions.

Today, the fee for a telephone call is much higher than it used to be in the beginning because it is not subsidized by the government any more. However, most people can afford to have a telephone line. Actually, selling TELEBRAS resulted in better access to telephones for the common Brazilian. Selling TELEBRAS hurt the country technology and engineering capability but provided the common Brazilian with the chance to use a product, which may be considered a right that every citizen should be entitled to.

Final Remarks

This condition, unaccepted by most Brazilians, had a social consequence: it allowed all economic and social levels of Brazilian society to make use of telecommunication facilities. As we have said before, most Brazilians could not have a telephone line during the period that the country could generate telecommunication indigenous technology.

Most Brazilians will say that selling the TELEBRAS System in 1997 was the wrong decision. They will say that dismantling the TELEBRAS System was a Brazilian government mistake, which would come and damage national technology and indigenous understanding.

Actually, these actions stood for a full stop on the Brazilian telecommunication technology journey. However, Brazilians benefited from it in their everyday life. Despite their economic or social level, most Brazilians can now afford some kind of telecommunication services by having easy access to telephone communication, either home or mobile phone lines.

Whether exchanging the capability for generating the technology in the country for allowing everybody to have easy access to telephone communication was the right government decision remains to be seen. As far as the impact of such decisions on Brazilian technology and society, only history will tell.

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Biographies

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