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International Cooperation in Science and Technology: Concepts, Contemporary Issues and Impacts on Brazil´s Future

By Maria Clotilde Meirelles Ribeiro
Federal University of Bahia, Canada

Abstract- This article discusses international cooperation in science and technology (S&T), analyzing crucial contemporary issues, as well as Brazilian-specific issues, based on the literature of the area and concrete examples of the field. It presents concepts, main terminologies and typologies, with contributions from specialists in different periods for the theme. Furthermore, it introduces a reflection on technique and human nature, exploring the vectors of the scientifictechnological cooperation and the technical cooperation. The paper also provides a short historical overview of international cooperation, notably in the periods separated by the Cold War. Through recent instances, it outlines key issues of international cooperation in S&T and the reality of Brazil with respect to the powerful tool of foreign governmental policy.

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I. Introduction

The concept of "informational economy" (Castells, 1992) is of great use in the presented text. In its core, the fundamental source of wealth generation is related to the ability to create knowledge and apply it to the productive sphere, through organizational and technologic procedures and information processing, which leads to scientific and technological knowledge to 1 Professor at Universidade Federal do Vale do São Francisco – Brazil and research member of the Political World Analysis Laboratory (LABMUNDO) at the Federal University of Bahia. Under the Doctoral Stage at the University of Toronto/Munk School of Global Affairs in the Innovation Policy Lab. constitute as the most determinant element of differentiation between people in the contemporary international context.

This differentiation, which according to Landes (1994 and 1998) divided the world between knowledge and wealth on one hand, and ignorance and poverty on the other, is based on the essence of an aphorism of Francis Bacon in Novum Oganum (1952, p 107), “knowledge and human power are synonymous”, seeing that the knowledge is an unequivocal condition for hegemony, be it political or economic. When it comes to political hegemony it is expressed in military power, whereas when in the economical hegemony, it is set in the power of creating market asymmetries, allowing their products to become more valuable. Given this, we can conclude that there is no international cooperation in science and technology (S&T) completely disinterested in the consequences for geopolitics and the external market. Also, this cooperation isn´t completely open to the point where the strategic knowledge of a nation-state may undergo the process of spillover effects; in other words, spill knowledge to other states, under S&T cooperation.

An analysis of international cooperation can focus from the conceptual aspects, involving efforts of systematization, up to the concrete cases, passing by motivating factors, interfaces, strategies and political alliances, as well as instruments, results, and their consonance with the policy guidelines of the countries involved. These, in turn, may lead separately to the examining of conditionalities, which will be co-responsible for the degree of empowerment of the recipients of the knowledge that shall be produced in this process. In the case at hand, it has defined the conceptual field as the approach field of this study, with emphasis on the aspects that this cooperation has taken in Brazil, including the case of the Brazilian Agricultural Research Corporation, EMBRAPA.

Considering the recent changes in the sphere of international relations – that has been redefining alliances, blocs and interests of any nature, economics, of macro-geopolitical and military power - how can one conceptualize the cooperation in S&T contemporarily, classify and understand it, especially the one that relates to a nation-state like Brazil, which operates as a donor and as a recipient? The text seeks to answer this question, initially focusing on the typological and conceptual foundations of international cooperation in S&T. In sequence, it takes a look at the changes in the focus that occurred in international relations, especially in the last two decades, and finally, explores the peculiarities and controversies on key issues related to the theme in the contemporary world, as well as in some specificities in the case of Brazil.

Author: Professor at University dade Federal do Vale do São Francisco – Brazil and research member of the Political World Analysis Laboratory (LABMUNDO) at the Federal University of Bahia.
e-mail: clotilde.ribeiro@univasf.edu.br

II. International Cooperation: A Conceptual Vision

There is no consensus in the literature about the concept of international cooperation. On a general level, cooperation corresponds to a joint activity for the result of competing actors that are moved predominantly by non-pecuniary interests, each of them conceiving each other as an agent and not a mere activity recipient. From the end of World War II, comes the "international cooperation for development" (ICD), which, according to Troyo (2003), includes the vectors of scientific and technological cooperation and technical cooperation. The insertion of the S&T dimension within the framework of the ICD is due to the fact of being exactly in the period of postwar that Schmookler (1966) related S&T, invention and innovation with economic growth.

Studies on the ICD, have received approaches from different authors, with distinct views about the nature and interests crossings between donors and recipients. Amorim (1994) notes that such cooperation is an important assumption of the idea of "alterity", that is the respect of one state for the autonomous existence of the other. Galan and Sanahuja (1999) and Aylllon (2006, p.7) argue that the ICD consist of "a number of international interventions by public and private actors to promote economic and social progress of countries in the process of development (CPD) and achieve a more fair and balanced progress in the world, aiming to build a more secure and peaceful planet".

Aimed to common targets based on criteria of solidarity, equity, efficiency, mutual interest, sustainability and responsibility, the International System of Cooperation for Development (ISCD) is configured as a wide network of organizations of various kinds, among these, international bodies such as International Monetary Fund and the World Bank, governments, public institutions, non-governmental organizations (NGOs), businesses and other civil society organizations who plan and perform cooperative actions in the international arena, which includes an extensive multilateral network of funding and cooperation for development. The ISCD comprises strategies and resources underlying the principles and rules of the various branches of International Law, of the Right to Development and Human Rights.

In this sense, the primary purpose of the ISCD should be the eradication of poverty, unemployment and social exclusion, as well as the increase of the political, social, economic and cultural development levels in the CPDs, some of them today re-conceptualized on their stage of development, and also acting as donors in the international arena, as the case of Brazil. The ICD is situated in the broader field of international relations, and it is within this framework that one explains its birth and its structuring in the context of the Cold War and of the decolonization process.

The term has no validity for every time and place, because as a concept suffers changes, based on historical events, the thinking, the politics and objectives of the North-South relations. In the vocabulary of international relations, initially emerged the terms aid and technical assistance. According to Soares (1994), the Dictionnaire du Droit de la Terminologie International, published in 1960, defines "Assistance Technique" (free translation of the author) as:

Expression that designates the help provided under the aegis of the UN, by the States with advanced economic structure for countries that are insufficiently developed in order to make available the technical means that these countries lack, to promote their economies. The technical assistance consists of various forms of help, at no cost at first, distributed by international mechanisms for the benefit of developing States (Reuter, Institutions Internationales, p.100).

Many authors, such as Soares (1994), Lafer (1994) and Amorim (1994) highlight that such terminology and approach are inadequate nowadays, due to profound change in approach in international relations. The countries are no longer treated as underdeveloped or late industrialized, but as countries in developing process, featuring an ongoing process. Moreover, the notion of assistance linked to help, denoting a conception of perpetuation of dependence, is no longer contemporarily appropriate.

Thus, the concepts of aid and technical assistance were being replaced by cooperation technique, and more recently, by the transfer of technology (also used in contracts involving intellectual property rights), change that is observed in the terms of cooperation agreements. In the focus of the typology of ICD, Ayllon (2006) points out their instruments and objectives, the cooperation in S&T being one of them.

Table 1 : Instruments and aims of ICD

Type	Goal
Economic Cooperation	Strengthen the productive sector, infrastructure - institutional framework, service development.
Cooperation in S&T	Transfer and exchange of technologies for basic services in education, health, sanitation and research.
Financial Aid	Facilitation of access to capital, productive investment, preferential credit lines for imports, exchange, repurchase or debt relief.
Technical Assistance	Enhancing skills and technical capacities in the sou thern countries, exchange of experiences and knowledge .
Humanitarian Aid	Military assistance, relief, protection of human rights, monitoring of victims, humanitarian pressure, prevention and mitigation of natural disasters, epidemics etc.

III. The Term Science and its Meaning Over Time

Etymologically, the term derives from the Latin scientia and refers to "knowing" or "knowledge", not indicating that all knowledge would be scientific, according to Hessen (2000). Bazzo et al. (2003) remind us that the science in the traditional conception would be an "autonomous enterprise, objective, neutral and based on the application of a code of rationality oblivious to any outside interference," in which the scientific method would be the intellectual tool responsible for their products. Contemporaneously, from the classical work of Robert King Merton (2008), it was basically established as a consensus that the scientific production has numerous determinants, including social and political. The prestige achieved by the book The Scientific Life of Shapin (2008), with great inspiration in Merton, confirms this broad acceptance that science suffers multi determinations.

The scientific development ceased, from these contributions, from being a regulated system by a rigid code of rationality, autonomous in relation to external social, political and psychological constraints. Thus, the classic empiricism that, according to Popper (2000), nurtured the scientific method of character strongly positivist, with roots, among others, on Francis Bacon (1952) and John Stuart Mill (1978), is no longer seen as dogma. The history of science shows that many scientific ideas arise from multiple causes, including inspiration, socio economics conditioning, or even luck or serendipity[2], without, necessarily following a regulated procedure as the positivism established.

Throughout the twentieth century many efforts were made to confer to science a definitive conceptualization. Despite their differences, they share a common core, that is what identifies it as a typically human activity in a systematic search of the knowledge of nature and its phenomena, including human behavior, and that, in general, begins with observation, followed by the description, experimentation and theorization. Depending on the type of object that is studied, the experimentation, (which is the attempt to reproduce the phenomena in the laboratory, in a controlled manner), may not exist, being replaced by an explanatory theoretical model of natural phenomena or social (Vieira et al, 2010). This concept deviates from logical positivism, which considers the scientific knowledge as produced with the method considered unique, idea strongly deconstructed by Feyerabend (1989) and Thuillier (1994).

Therefore the ant positivist reaction, as a result, creates fundaments in criticisms of other authors including Popper (2000) and Thomas Kuhn (2010). The latter was influenced by Merton (2008), and points out the matters of maintaining the traditional and rationalist assumptions. With these authors, the philosophy of science became aware of the importance of the social dimension and the historic roots of science. Kuhn (2010) undertakes an interdisciplinary style, in the wake of which the boundaries between academic specialties tend to be diluted. In the meantime, Bruno Latour (1997), in the framework of the social studies of science, understands the scientific activity as "a social process, regulated by no epistemic factors that would have relation to economic pressures, professional expectations or specific social interests" (Bazzo et al., 2003 p.18).

IV. Conceptualizing Technology

It seems a consensus among anthropologists that sociability, linguistic ability and technical skills were instrumental in the humanization process, especially in transition from the nomadic condition, in which Homo sapiens is stated, to the condition of established in the territory, after the first agricultural revolution (Albergoni, 1995; Fabietti, 1995; Godelier, 1995 and Piggott s/d).

The limited physical conditions of the human anatomy, due to the process of evolution of the brain and loss of physical strength and tearing body parts, like claws and fangs, made man use those skills in building artifacts to enhance the ability to hunt, to modify materials and make them build initially, rudimentary tools and weapons, essential to the cultural evolution. At that stage, beginning at hundreds of thousands of years ago, when the Homo sapiens began his adventure on earth, the technical knowledge was the one that underlaid the evolution of civilizations. The genesis of science would be given during the classical antiquity, for some historians, or during the Scientific Revolution post-Renaissance. The first encounter with reciprocity between these two entities happened in the Hellenistic Period. During the Middle Age there was a discontinuity and a close cooperation is consolidated only from the Scientific Revolution (Baiardi, 1997).

According to Soares (1994), the technology defined as the study of techniques, including its evolution, is the pursuit of the knowledge of how to produce and develop artifacts that constitute a set of tangible and intangible assets. Throughout history, from cultural and economic advantages, a group of countries has shown more skills in accumulating favorable potentiating in production factors and especially reproduction and innovation even of the technologic goods. Vis à vis other territories, in those ones emerged, in a greater extent, a number of economic agents with stronger propensity to take risks and to invest productively. This meant that they were pioneers in generation of innovations that established the fundamental differentiation between countries that are

[1] Numerous texts from the history of science dealing serendipity as an essential insight into certain discoveries.

more and less industrialized (Landes, 1994 and 1998). The most accepted contemporary definition for technology is that used by the current that it is in the field of innovated economics and it is denominated as neo-Schumpeterian or evolutionary, whose reputation is from 1989 to the Release of the work of Technical Change And Economic Theory. In this community, see Dosi (1990), Stokes (2005) and Rosenberg (2006), technology would be a "body of knowledge, possibly derived from scientific knowledge, that applies to a particular branch of activity" or "set of special cases relating to a particular industry or art." For these authors, the dimension of application is present on the technology, which does not occur in science. The interdependence between science and technology has widened to the point that no one can discuss the acronym S&T, often plus I, S&T & I, which suggests that technology entails, beyond the applicative dimension, the marketing dimension.

Notwithstanding this interdependence, authors such as Rosenberg (2006) call attention to the richness of causal chains between science and the economic and social life and from this latter to the technology. Others, like Stokes (2005), claim that the linear model that relates science to the market (Basic Research → Applied Research → Development → Production → Operations) is far from being the only and the most adapted to the reality of causal relations.

Bazzo et al (2003) points out that there are authors for whom it is the relationship between science-technology that differentiates the technique of technology, leading to the conceptualization of the technology as applied science. The term "technique" would reference the procedures, skills, artifacts and developments without the aid of scientific knowledge, whereas "technology" would refer to the developed systems from the scientific knowledge. However, the thesis of the absolute dependence of technology in relation to science has been widely disputed, even by neo-Schumpeterian, most currently, difficult to defend. Contemporaneously, evidences reveal that a scientific investigation independent of possible applications, i.e. with no horizon to come to contribute with technology, does not correspond to the types of research projects to be funded with no restrictions (Delors, 1994). It happens because the theoretical scientific components and the practical technological components are inseparable from the social context, and underlying this finding is the character of technology as a system, denoting their conditions of no autonomy with exchange of technical aspects and those of its administration.

Thus, given the importance of technological innovations in component products and processes, there is a clear requirement of strict priority investments in research and development (R&D), in order to allow certain countries to remain engaged in the global competition, especially those who based their competitiveness in low work force compensation, which has ceased to be a comparative advantage over automation.

Troyo (2003) points out that the trajectory of development since the last half of the twentieth century happened outside the international system, resulting much more from technological innovations generated by R&D structures and their implementation into international trade than by concerted decisions in multilateral forums. This reality has huge implications for emerging countries that are still basing their competitiveness, in part, in low-paid workforce, inflation, excessive protectionism and non-customs barriers. Like this block of countries is unequal on the ability to perform R&D and on the competitiveness indicators, it is desirable that the identity in other aspects, and that spawned the international forum called BRICS, come to be a facilitator of international cooperation between them. This cooperation would not be asymmetric in all cases, because China, Russia, India and South Africa, have some competitive sectors. In this context, Brazil would assume undisputed leadership in R&D focused on plant and animal production.

On this stage of development of capitalism - a) when large International corporations are able to acquire powers before taken by the State; b) when the national question is no longer relevant in R&D investments, given that a Corporation allocates resources, researchers and facilities where there is critical mass to generate innovations, no longer being the priority its home base; c) when generalizes the worldwide practice to outsource R&D, R&D outsourcing (which has become common in India as a service provider) - we must rethink the terms of international cooperation in S&T, given that this reality may establish new paths and shortcuts to the old ways (and BAIARDI e BASTO, 2013).

V. International Cooperation in the Axis of Science and Technology

As already reminded, science and technology are not born together. The science has genesis in ancient wise advice that grouped philosophers, priests, wise men and scribes, and the technology, while an area of knowledge related to improvement of artifacts that sought to provide the precision to the observations of nature, appears hundreds of millennia of years after humans have discovered the technique. During the Hellenistic period the relationship between science and technology had deepened as evidenced by thermodynamic and hydraulic experiments at the School of Alexandria. The Middle Age with its prevalence of scholastic paradigm was not lavish in this relationship, causing a discontinuity, although it registers the discovery and development of countless artifacts, mainly aiming to save labor force, as well as the experience of the medieval guilds, which were, at the

same time, a school of technological learning and a stronghold of international cooperation of knowledge (Epstein; Prak, 2009). The Renaissance as a forerunner of the Scientific Revolution fostered this relationship, and examples of telescopes, barometers, thermometers etc. show that this knowledge of science and technology would then work together forever, which was facilitated by the discovery of movable type, which revolutionized the press, allowing teaching techniques. This teaching now was not happening anymore "man to man" in the workshops and guilds (Baiardi, 1997 and Vieira, Baiardi and Baiardi, 2010). The exponential growth of research and production of knowledge in this field in recent decades is justified by the relevance that the issues related to science and technology have in the definition of human life conditions.

The relation of societies with what is denominated technoscience, technologies strongly dependent on the scientific progress, constitutes one of the criteria for the classification of societies. For Ortega y Gasset (2005), today's society is characterized by its character of indispensability that the technique occupies in it, and by the consciousness that the man acquires about it. In this line, Bazzo et al (2003) emphasize that science and technology influence social formations, which is reinforced by the fact that S&T come increasingly encroaching the international agenda, which is also justified by its extensive interaction and transversal character.

Troyo (2003) distinguishes three types of cooperation, scientific-technological (S&T), technical and educational, and delineates their specificities (see Table 2).

In the S&T cooperation, the author supposes equivalence of technical and scientific competence among the cooperators and a goal that goes beyond the transfer of knowledge, understanding innovation for the economic development. The amount of knowledge changes significantly throughout the process, and it is assumed that the joint action of the partners will bring results that are not easily obtained in the research standalone. There is also equivalence between the motivations of cooperation and the politico-diplomatic objects of broad reach.

Table 2 : Specificities of international cooperation

Scientific Technological	Techniques	Educational
Vertical spread of knowledge	Horizontal spread of knowledge	Intellectual exchanges (students and teachers)
Innovation of processes and product	Definition of trenc by the transmitte funding performed main by this.	Training of human resources
Co-funding and joint development activities	Adherence to programs and/or areas previously defined by the transmitter	University middle and scientific cooperation
Support or promotion of centers of excellence	" Excellence " is not a pre-requisite for all partners	Scholarships
Countries and institutions of high sectoral technological development	Tendency to programs targeted to social base problems (basic roots)	Technical schools, training of qualified personnel

Technical cooperation, for him, has an assistencia list character and "marks a process of simple transfer of knowledge, expertise, equipment, human resources etc... Available to an agent relatively less developed, allowing jumps in pursuit of training" (Troyo, 2003, p.108). Idealistically speaking, aims at leveling the quality of international research and production in a specific area, not necessarily increasing the stock of knowledge, because there isn´t a concern to innovate. Educational cooperation would be a particular case of technical cooperation, acting mainly through exchanges and scholarships.

A peculiarity of magnitude for which Troyo (2003) points out, in the case of a cooperative activity whose raw material and essential product is the knowledge, is that, notwithstanding the goals are set jointly, which one search, despite the according protocols, is subject to distinct interpretation and appropriation, and therefore to different scientific, technological, political, economic and social gains by the different cooperating countries. Furthermore, the cooperation activities involve knowledge that, in principle, could not be seized only by traditional methods of international trade. The author adds that the scientific and technological cooperation before the Cold War was based on many traditional ways of exchange of teachers, joint studies and participation in scientific events, period in which your technological component was not yet fully recognized as a decisive factor for increasing productivity. On the other hand, technical cooperation aimed at its purest design, leveraging social and economic development of the country "receiver", was defined as a mechanism parallel to the relations strictly economic or trade between developed countries and countries in developing process. Troyo (2003) emphasizes that the mechanisms that arise from those concepts in vogue in the decades of 1960-70 are now overcome and new arrangements of technical cooperation tend to arise.

Soares (1994) explains that the concept of international technical assistance focuses on cooperative movements that have occurred since the

establishment and recognition of inequalities between nations, including sending experts, granting of scholarships, internships, training seminars and creation establishment of pilot institutions. The author argues that today the international technical cooperation is not a target of universal understanding, and the inadequacy of the terminology "technical assistance" today is due not only to a mere vocabulary issue, but also to a change of focus in international relations. This was not connected to humanitarian issues or legitimization of unilateral actions of the industrialized countries in the CPDs, but to the assertion of a right to development of those states, coupled with the duty to cooperation from industrialized countries, within the principles of the Charter of UN. He also points out that although the name of the phenomenon of transfer of resources between countries, both in its bilateral as well as the multilateral basis, has received the expression of international technical cooperation, the terms "aid", "assistance" and "technical assistance" not disappeared, expressing mainly the modality of training of technicians, administrative staff and managers of CPDs, by countries industrialized or more developed countries.

Focusing on criteria for classifying forms of international technical cooperation, Soares (1994) identifies three types: a) the source of funds of donors, which may be public or private, with subcategories within each one of them; b) the nature of relations between the participating states, generating multilateral and bilateral cooperation c) the objective that cooperation has in view, that may take two modalities: c.1) transmission of knowledge in the forms of technical assistance and technology transfer, and c.2) transfer of capitals by the means of ONU system organisms or by the transfers of regional organizations or yet, direct transfers from senders and the ones from private banks, individually or in consortiums form.

In another direction, Baiardi and Ribeiro (2011, p.596) analyze reasons for transfer of knowledge and competencies in the sphere of international S&T, highlighting: I) create or extend a competitive advantage of the territory in the economic, military, sports and cultural sphere ii) to share resources and possibilities arising from the appropriation of natural resources or created through interventions as infrastructure, engineering works, etc. iii) create an innovative environment for favoring companies iv) face threats, natural disasters, disease, aggression,. v) as a vehicle of diffusion of knowledge, VI) for the construction of national and regional innovation systems vii) in order to promote the division of labor of basic or applied research, viii) to networking or create research groups for strengthening competencies in certain areas etc.

VI. Brief Historic Overview

The current system of international relations established at the end of the Second World War and embodied in the collective security system under the aegis of United Nations (UN) has marked difference compared to the current system in the interwars, with the League of Nations, and even more striking difference compared to previous centuries systems. If the previous concern was to establish negative rules in international relations (i.e., rules that would ensure the peace through prohibitive standards for disruptive actions), from the UN system the emphasis falls on establishing rules for constructing behaviors that encourage cooperation (Smith, 1994).

The twentieth century testifies to three periods of international cooperation. In the beginnings of the century, it obeyed the universalist aspirations of scientists of the XIX century, and the scientific activity was seen as belonging to the universal domain and of universal exercise, despite this universalism was constrained by national interests. The idea of science gave itself very little of economic interpretation, according to Troyo (2003), and more to the biology, physics, chemistry, mathematics, astronomy and geology. Thus, the Cooperation before the Great Wars was characterized by an institutional exchange and governments participating in these activities in an accessorized way.

In the period beginning from the First World War until the Cold War the international cooperation sought international knowledge - oriented goals to Military-geopolitics interests and the notion of the community of scientists was replaced by the idea of geopolitical alliances that used S&T as a tool for approximation. The prevalence of politico-ideological factors remained and one imagined that the scientific-technological findings could be threats as much as aids to the development and to the security of the countries. More than in the nineteenth century, there was the presence of researchers colonizers of countries in their colonies, which led to some scientific development. However, in this case one cannot speak of international cooperation, as the colonized territory could be up to a nation, but it was not a nation-state, according to Gaillard (1994).

Contemporaneously with the emergence of an international order in which economic and commercial factors prevail, the same perspective comes to govern international cooperation, implying that actors of S&T, especially research centers and companies can no longer remain isolated. For Brazil, it represents significant change because since the beginnings of the Republic until the consolidation of the scientific activity in Brazil in the 1950s, the attention was focused mainly on basic science.

From another perspective of analysis, focusing on bilateral and multilateral plans for cooperation in times marked by the Cold War, it appears that the activities in the bipolar period were differently developed, comparing with the current system of undefined polarities, as summarized in the Table 3.

Table 3 : International cooperation before "versus" after the Cold War Cold War Post Cold War

Cold War	Post Cold War
Prevalence of "exchange" on cooperation	Prevalence of cooperation on "exchange"
Prevalence of nation-state over civil-society	Prevalence of civil-society about nation-state
Prevalence of "action" on "cooperation"	Coexistence between "action" and "cooperation"
Politically oriented activities	Economically oriented activities
Ideological orientation	Ideological disorientation
Goal is geopolitical alliance	Goal is the conquest of markets

These differences demonstrated in the temporal plane, clearly marked by a first moment of politico-ideological orientation that surpasses that of economic-commercial character that comes on to become hegemonic in post-Cold War, are reflected in the Brazilian reality in its foreign relations. These two moments show a clear political and strategic reorientation of the governments. While in Brazil in the 1950s the relationship with the USA was more devoted to staff technician training (in Brazil and abroad) and was focused on operating machinery and equipment manufactured in U.S. and purchased by bilateral trade, in the 1990s the cooperation prioritizes the axis of new technologies, such as the connection of communication electronical networks. Already in the South-South plan, Brazil before sought simply prestige that will guarantee political leadership in the developing world, whereas in the 1990s this relationship becomes oriented towards a "Brazilian presence in the vicinity of South African political and economic epicenter, marking the revival of economic Southern Africa" (Troyo 2003, p.95).

At the multilateral level the picture shows that, before the mechanisms provided by the United Nations Program for Development (UNDP) allowed the CPDs for the use of funds for welfare purposes, whereas in the 1990s these mechanisms are progressively replaced by structures, like the Work Groups on information technology (IT) of the UN Commission on S&T for Development, that together with the Information for Development Program (INFODEV) of the World Bank become preponderantly to shape the multilateral treatment given to the ITs.

A study carried out by Cervo (1994) in the 1990s examines the UNDP multilateral cooperation with Brazil and the bilateral cooperation received by this country in the decades from 1960s to 1990s. The results show a superiority of the UNDP cooperation, particularly in view of its strategic planning function, the flexibility and connection of their programs to the UN bodies, the universality of its operations and a certain ideological and political mindset. The author stresses that the UNDP programs contributed to consolidate some important research centers in Brazil, among them the Brazilian Agricultural Research Corporation - EMBRAPA, the Brazilian Institute for Forestry Development - IBDF, and the national control system for quality drugs and medicines, then responsibility of the Adolfo Lutz Institute, currently Oswaldo Cruz Foundation - FIOCRUZ.

Based on 401 technical cooperation projects received and approved until 1990 by UNDP and the foreign governments involved, Cervo (1994) concluded the existence of five subareas of action of this cooperation in Brazil in that period: I) Agricola, focusing on food, irrigation, forests, livestock, dairy technology, horticulture, fisheries, and pest control, ii) Industrial, focusing on telecommunications, electric power, metallurgy, nuclear applications and steel; iii) Engineering in their various branches and iv) diversified objects (R&D, training, planning, technologies, education, regional development and environment).
On the other hand, the projects of bilateral technical cooperation received by Brazil in the 1970s and 1980s were spread into subareas of activity, denoting weakness in drafting joint programs that prioritize national development. Generally, they were small projects that exchanged experts and trainees or provided advices to Brazilian agencies. Notwithstanding, there is a more robust guidance from Italy in transport by rail, from Japan in agricultural research, from France in scientific cooperation with universities, and Germany in advanced technological areas (CERVO, 1994).

In contemporary times, Troyo (2003) points out that in Brazil the international cooperation (especially on the axis of S&T) started dialoguing with research institutions and policy formulators, distributed in various Ministries, state departments of S&T institutions, such as the FIOCRUZ, ITAL, Institute of Food Technology of the State of Sao Paulo, Chambers of Industry and Commerce, among others. Indeed, the recognition that investment in R&D has become critical to economic competitiveness and increased well-social welfare expands the dialogue in the area and leads municipalities, federal states and civil society to constitute as qualified interlocutors aimed at international cooperation in S&T. The reality that almost every state and many municipalities in Brazil have created departments of science and technology, and within them established an organizational structure dedicated to the international cooperation is emblematic of this huge change (BAIARDI, 2004; RIBEIRO, 2009).

However, the introduction of conditionalities and thematization of cooperation (thematic cooperation, with programs that emphasize ethnic, gender and cultural aspects, instead of the competitiveness of emerging

countries), contributes to the erosion of the traditional cooperative activities. Thus, the civil society, including the organized scientific community, is no longer expecting the Government for promoting cooperation. In view of that, "interinstitutional" agreements proliferate contemporarily, marginal to the intergovernmental agreements, i.e. without legal validity by the Public international law. This framework leads to rethinking that now a new dialogue is necessary between state and civil society, and between the country and the international cooperation.

VII. Crucial Issues of International Cooperation in S&T Today

One obstacle to the achievement of international cooperation lies in deepening the dialogue between nations of different cultures, respecting their identities and different visions about development. The established relationships may impose concessions that may lead to dependence of the recipient country, and may also define conditional constraints. Moreover, the difficulties with resource constraints for International Cooperation have been increasing.

Another challenge lies in the legal and political issues that permeate the international transfer of technology, and towards that Soares (1994) reminds us that the field of intellectual property is one of the most controversial and problematic issues that the international technical cooperation faces today. According to Brazilian regulations for Property Law Industrial 9279, of 1996, the field encompasses both properties, industrial (patents, trademarks of industry, of commerce and of service, and expressions or advertising signs), as the new aspects of copyright (and in particular, the legal regulation of the software). The concept of "transfer", by the nature of the phenomena involved, involves knowing to what extent the "transfer" would mean the assimilation and reproduction capacity of inputs or goods by the proper force of the CPDs. This concern stems from the fact that both, the original production of technology and the maintenance processes based thereon, are conditioned on all a set that includes an industrial park base, centers of basic and applied research and, above all, organizational attitudes, attributes with different variations in the CPDs. So, to what extent a technology transferred, indirectly or directly to a CPD, means a real contribution to its development or a simple introduction of a good, whose maintenance would require continuity of technical assistance by the industrialized countries, leading to perpetuate in the CPD a relationship of dependencies of the industrialized countries? Even if one can establish a policy of transfer of appropriate technologies that are adequate to the development level of the beneficiary country, there is the risk of transfer of obsolete knowledge or a product in a experimentation phase in industrialized countries, such as the case of drugs. Expecting to receive adequate technology, CPDs risk becoming deposits of unprofitable technologies from industrialized countries, or becoming experimental laboratories for those countries.

Risks in this direction are shown in studies cited by Losego and Arvanitis (2008), which seek to explain the low appropriation of science oriented products industry in the peripheral countries, stressing that in these countries the research is guided by the logic that follows the international mainstream, to the detriment of the local utility. The local programs focus on problems and objects of "theoretical models "type, which offer them greater international scientific visibility, as the case of "Chagas" disease" (barber bug fever). Notwithstanding having been elevated to the category of public health problem since the 1950s, this epidemic disease is in the list of the neglected industries drugs, and is treated according to the scientific logics: even if the national goal is practical (designing vaccines and remedies), the research teams not deviate from fundamental scientific research and collaborate very little locally. That research seeks international partners and uses the parasite just like biological model, chasing models and no solutions. Having in view the growing inter-institutional cooperation, if it presents, on the one hand, the advantage of avoiding the lengthy interactions with governments, on the other it poses risks to the developing countries. Such risks can lead the relationship to serious legal errors, or promote harmful relationships to the interests of the CPDs. These may lend themselves to" colonization" by the foreign institution, and to be used only as "outpost" of their research abroad, without sharing the results, or "open the doors" to foreign technicians allowing them to map their capabilities in S&T and to collect materials for unilateral research, corroborating concerns.

On the other hand, Soares (1994) shows difficulties with the high costs of technology, especially the cutting-edge technology, and activities related to R&D, implying in measuring its price in foreign currency, with the consequent difficulty to the CPDs to have them. Focusing on the technology transfer and the types of contracts and their regulation, the author draws attention to the insurmountable difficulty to reconcile the reality of the world of contracts governed by private law, with the reality of a right to development, supported by the Public International Law. The thematic relates to rights attached to transfers of goods or services, and even to capital that are beyond the direct control of the states involved, given that they are rights of individuals or companies (among these, multinational companies), strongly protected at the international level with the privilege of representing a monopoly ownership, use and availability of intangible property embedded in transferred goods or services. The author emphasizes, however, the possibility of a direct transfer of the

intellectual property rights, emphasizing that even in this interventionist States the will to protect such privileges is present, especially at the international level, in view of the naturally protectionist attitudes toward the national S&T.

Other risks of cooperation in S&T are pointed by Silva (2007) as the loss of freedom of action and creation of dependencies, increased managerial complexity, political risks, risks of "unwanted" transfer of sensitive technology and involuntary help that would create or strengthen future competitors. Amorim (1994), in turn, adds that the challenge for the CPDs is matching efforts to increase their own absorption capacity and technology generation, for which measures are indispensable to guarantee the protection of their industries - without losing sight of the opportunities of international cooperation.

Major dilemmas arise in decision making processes of international technical cooperation, against whom Medeiros (1994) highlights: a) concentration versus dispersion of efforts, being pivotal to the establishment of priorities and programs that address not only how to do research, but also how to use their results; b) definition of the actors to be engaged in setting priorities and programs: complex question considering the multiplicity of actors involved in the process c) State, civil-society and NGOs: what role should they play in the process and how such relationships should be led and conducted? d) concrete short-term results versus developing local capacity in the medium and long term outcomes: this dilemma arises from the presence of short, medium and long term development programs in the field of S&T, which compete with each other under tension, by different time horizons, and, finally, e) sectorial specialization versus integrated approaches to development: in the move from scientific and technological knowledge to the application of this knowledge for solving concrete problems difficulties can arise, because the former is organized into areas of sciences and disciplines, while real-life problems are not confined to such spaces - the reality is much more complex and multifaceted.

VIII. Brazil Toward International Cooperation in S&T

Cervo (1994) argues that the objectives of the Brazilian technical cooperation planning had evolved in the last decades of the twentieth century. He adds that in this period, while it was possible, one tried to extract from the UNDP the transfer of S&T to sectors considered strategic and little affected by the bilateral cooperation, since the provider countries of this type of cooperation were afraid to do it to not hurt their economic and commercial interests: the cutting-edge technology would just come in "packages" controlled by the country of origin, in a profitable way.

Focusing on contemporary Brazil, Troyo (2003) suggests the Brazilian claim as a source of technologies adaptable to CPDs conditions, making a technological alternative to partners of equivalent or lower socio-economic stage in various areas, including the environmental, agriculture and health sectors. He emphasizes the ability of the country to participate as an important actor in S&T cooperation, not only with developing countries, but also with industrialized ones, highlighting:

> The Foreign Ministry has the role of, through its network of overseas posts, to encourage activities that promote the transfer of knowledge, as well as activities that provide the definition of programs aimed at scientific and technological joint research with a view to innovation, be it of economic industrial value, either for relevance to the solution of social problems that the country still experiences. (Troyo, 2003, p.124).

In the opinion of this author, since the current situation is marked by the prevalence of the economic and commercial field to the detriment of the political-strategic one, the international Brazilian performance should seek strategic knowledge by way of trade or cooperation, which would result in the welfare for the Brazilian society and the appreciation of its structure of competitiveness in the world economy, increasing the space it occupies today.

Toward the question of thematic and institutional structure of S&T in Brazilian diplomacy, Troyo (2003) warns that it needs to be changed to suit the specificities of the types of cooperation. He reminds that S&T and scientific-technological cooperation are not an end in themselves, because they operate in a sector and comprise applied R&D in numerous areas. Thus, the logic of their institutions should not lose sight of the logic of the sector they want to steer.

A major complicating factor is that the field of S&T has a multitude of facets that complicate this relationship, which foreign cooperation policy must address. This is because the issue can be addressed with regard to "sensitive technologies" or dual use, or under a purely commercial optical regarding the transfer of technology, concerned buying and selling of knowledge that is susceptible to technological application and of equipments that are derived from it.

The current emphasis of Brazilian foreign policy is addressed by two axes: a) definition of "edge areas" inducing technological transformation (such as informatics, telematics, biotechnology, new materials, space technology) and pursuit of improved technologies with direct social impact (education, public health, sanitation) and b) encouraging structural changes that facilitate innovation.

Focusing on the major contemporary challenges of the Brazilian Government that could bring

benefits from international cooperation in S&T, Kreiger and Goes Filho (2005) suggest: a) to increase institutional cooperation involving the Ministry of Science and Technology (MCT) and its agencies, the Ministry of Foreign Foreign (MRE) and the Brazilian Academy of Sciences b) to avoid asymmetry between cooperating teams, seeking continued investment and c) to favor multilateral cooperation, since it is the more agile mechanism to form collaborative networks between researchers.

It should also be considered here that for a country like Brazil, attention to the scientific-technological thematic might represent a "window of opportunity" for its international projection. Moreover, the scientific and technological space (mainly of the Global Information Society), unlike other sectors in the relationship between states, is marked by an international agenda still under construction, erected, especially for international cooperation activities. It is worth remembering the revitalization that the scientific-technological cooperation has been taking place, given that countries of greater sophistication in this field identify, in some sectors, the need for non-traditional partners of reasonable equivalence, like emerging countries like Brazil, Russia, China, India and South Africa, which signals for these countries broad possibilities and opportunities.

It´s important here to emphasize that untraditional yet promising examples of international S&T cooperation have started to proliferate. One of them is the Cyclone Project-43 which foresees soon launching a Brazilian rocket in partnership with Ukraine, from the Alcantara Launch Center in Maranhão, located in the Northeast Brazilian region. Another case is the CBERS (China - Brazil Earth Resources Satellite), agreement from 1988 that involves INPE (National Space Research Institute) and the CAST (Chinese Academy of Technology Space) for building advanced satellite remote sensing, which today is found in revision phase of the electrical and environmental tests results of the Brazilian-Chinese satellite CBERS-34. Dias (2006) points out to the example of the South American Program, which supports cooperation activities in S&T in Brazil with countries of South America (PROSUL Program), aiming to contribute sustainably to the scientific and technological development of this region.

The International Space Station Program5 (ISS) is one current example of the reality of cooperation in S&T, although in this related case, Brazil is integrated with over 15 countries, under the coordination of the U.S. space agency (NASA), and despite the country be invited by the U.S. government to perform a portion of NASA task (which owns about 50% of the consortium), Brazil was defined in the mere category of collaborator, whereas the other member countries were configured as partners in a North-North cooperation relationship.

On the other hand, in the institutional focus, deserves recognition the performance of EMBRAPA - the Brazilian Agricultural Research Corporation, and it has been seen as a remarkable example of mobilization toward S&T international cooperation. Founded in 1973, it weaves a web of fruitful external relations conducting cooperation with many institutions and countries, which has contributed to the high level of scientific and technological development of Brazil in this sector. An ongoing doctoral research of the author examines the international cooperation in S&T in Embrapa Semi-Arid branch since its deployment, focusing on several dimensions of this cooperation, which includes the political and strategic, as well as those related to S&T and innovation produced by joint efforts, skills and experience of the actors involved in these processes. The unit of analysis of this study is the Embrapa Semiarid, whose position is strategic within the region of Tropical Brazilian semiarid, given that it is located in its center. Some of the most recent data collected shows a marked degree of innovation through these experiences. Among the many partners on the list of the cooperating Embrapa Semiarid partners are Japan, USA, Germany, France, UK, Netherlands, Argentina and Uruguay, and lately Sri Lanka, through its Department of Agriculture (DOA), and Australia by Commonwealth Scientific and Industrial Research Organization (CSIRO). Cooperation with CSIRO has mainly focused on the application of advanced techniques in molecular cane sugar, genetic improvements and on animal health area, in addition to the use of the modeling program developed by CSIRO that allows the evaluation of different production systems.

IX. Concluding Remarks

Knowing that international cooperation can become an important element of the strategy of an autonomous technological development of a country and given the issues faced discussed herein, it´s imperative that a deep reflection be taken about the foreign policy that should be designed and implemented addressing the scientific and technological cooperation in the countries. It´s evident that the scientific and technological dynamics will increasingly influence the ways of the world economy and its movements will be reflected in all international aspects, which engenders an essential tangency of the scientific-technological thematic across all the interface of the external action.

[2] Placement in the program <http://www.alcantaracyclones-pace.com/> site. Accessed on 17th Sep 2013.
[3] News from the National Institute for Space Research (INPE). <http://www.cbers.inp-e.br/>. Accessed on September 17th, 2013.
[4] News broadcast by NASA in <http://www.nasa.gov/mission_pages/station/main/index.html>. Accessed on September 17th, 2013.

Thus, in this backdrop and considering the reflections developed here, notwithstanding the risks and challenges to be faced, it is clear that for the scientific-technological fields there are large "avenues" for international cooperation that are yet to be covered. However, to maximize the potential of this journey, initiatives must be taken with the goal of creating a well oriented development towards the priorities of the majority and of future generations, respecting the cultural heritage of people in their process of emancipation and technological literacy, as suggested by Bazzo et al. (2003).

Therefore, an interaction is imposed between international cooperation and programs of national scientific and technological development, as well as the democratic structuration of an international S&T cooperation policy, based on a well-articulated strategy with allied partners that become concrete in effective and sustainable actions. This statement conforms not only the reflections from authors, but also the evidences brought out in the Brazilian Science, Technology and Innovation Conferences, all of them emphasizing the vital importance of international cooperation for the advancement of scientific nations. The 4th.Conference occurred in 2010 and highlighted 14 recommendations for the advancement of the Brazilian science: among them, five addressed directly the international cooperation, and all the others were tangent to it.

A striking example of the current determination of the Brazilian State for fostering international cooperation in S&T is the conditioning that the Education Ministry does today, through its body focused on the post-graduate education, the Coordination of Improvement of High Level Education (CAPES). It requires the presence of international cooperation for improving evaluations of graduate, Masters and PhD programs.

Thus, given that international cooperation plays a profound role for institutional development of science, as many examples show, international cooperation in S&T should be seen as a critical instrument in fostering autochthonous knowledge generation, and be encouraged as a policy by nation-states. Ratifying Baiardi and Ribeiro (2012), the benefits of this cooperation can be large, reaching the federal and sub-federal levels, insofar as this promotes research leading to dynamic supply chains. Furthermore, inducing production of regional scientific and technological knowledge, international cooperation in S&T intensifies the supply of innovations, which triggers the possibilities of the regional economy to internalize temporary monopolistic advantages, including intra-national trade.

For instances where countries have low public budgets and such fragility in their graduate and post-graduate education systems and also in their national research system, as the vast majority of African countries, urgent action for public policies should be taken to seek for support from the international cooperation in order to preserve and enhance its scientific capabilities. Without that, such objectives in those countries would become too difficult or even unattainable at first.

International cooperation in S&T can still support and create centers of excellence on which could support national research systems. It is worth remembering that the transfer of technology to promote sustainable development is one of the central issues for the design and appropriation of "green technologies" claimed by the planet. The importance of technology to a new techno-industrial-environment paradigm requires the full utilization of accumulated knowledge, including those arising from the latest technological advances, for which the international cooperation in S&T must have a fundamental role. It is not difficult to see that this kind of cooperation is the instrument that may lead the process of global governance for environmental sustainability of the planet. The challenges to implement it, given the difficulties inherent in a multidisciplinary and multicultural process are undoubtedly extensive. Notwithstanding the form " anarchic " international system, not a holder of central authority, an auspicious future can be seen through the promotion of beneficial forms of international cooperation, if governments seek a better coordinated way, with support from researchers and academics in this process, corroborating Axelrod and Kehoane (1985).

Finally, considering that international cooperation is an instrument of foreign policy of a country, and that cooperation in S&T is one of its modalities, it´s essential that governments align and coordinate policies that are transversal to this broad theme. Only then it will be possible to enhance this cooperation in order to make it reflect the reality of society, its desires and needs, in harmony with its historic-cultural process, since, as Baiardi and Ribeiro (2012) suggested, no state and modern society today can prescind international cooperation in science and technology.

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