Building the digital TV standard:
The Brazilian experience

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ABSTRACT

This paper analyses the implementation of the Digital Television in Brazil. This process involved the choice of the Digital TV standard to be used in the country, for which there have been three competing technologies: the Japanese standard, the American one and the European one. The Brazilian choice for the Japanese standard, associated with heavy investments to adapt it and to promote incremental innovations in this standard pose many interesting features for a heterodox analysis on technological policies. The main contribution of this paper is therefore to call attention to the strategic role of the standardization process for innovative activities, in which the governmental support is a necessary condition.

Key-words: Digital TV, standardization process, Brazilian experience.

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Introduction

Information and communications industries are sectors considered as having a supporter for processes such as the creation of qualified jobs, for yield accumulation and for the welfare of population. They also reduce circulation time of goods and money, exerting a central role in the capitalist system. The importance of the debate surrounding the advent of the Digital TV as a new paradigm is inserted in this discussion, as proposed by Dantas (2007). In his view the search for developing this new technology emerged from the capitalist crisis started in the 1970s, and represented the need of opening the path to a effective and sustainable recovery of the system.

Being considered as a new paradigm in the telecommunications sector, the Digital TV has been first fully developed in the beginning of 1990s and since then has represented the promise of a new way in making television around the world, with important effects and interactions with other fields of the telecommunications sector, as for instance the computers sector and the mobile phones sector.

The race towards consolidating this new technology and therefore of establishing its technological standard started right after with a competition among some big players: Japan, European Union and USA.

Developing countries, like Brazil, play an important role in this process. The Brazilian choice for the standard to be adopted in the country was not only surrounded by technical issues, but there has been strong political pressure as well, given the strategegid role of the diffusion process of a certain leading technology. Brazil chose for the Japanese standard and for making investments in the adaptation and improvement of this technology. This dual role of Brazil in choosing a standard and in promoting incremental innovations to further develop a regional standard must be analyzed, laying on the core of the present article.

With the aim of discussing the above questions, the article is divided into four sections. The first one presents the main theoretical aspects to be the basis of the present proposal. It is in this section that the process of technological standardization will be analyzed under a neo-schumpeterian perspective, calling attention to the effects it exerts over the dynamics of innovation. The second section is then dedicated to a brief analysis of the Digital TV as a new paradigm, emphasizing its importance for the telecommunications sector. It is also in this section that the evolution of Digital TV and the race towards establishing a standard to this new technology will be presented. The third section is then proposed with the objective of discussing the Brazilian experience in choosing the Digital TV standard and promoting the necessary advances for developing a strategy for the country, in view of the theoretical aspects inserted on section one.

The concluding remarks will be provided in section four, where some proposals are made to future policies formulation in developing countries, in which strategies related to the standardization process can not be neglected.

1. Technological Standardization and its Strategic Role in the Dynamics of Innovations

Standardization affects both innovation and technology diffusion, influences industry structure and thereby helps determine which firms benefit and which do not from technological change. Over a technology's life cycle, standardization can exert both positive and negative

effects over economic efficiency – at one side it can increase efficiency within a technology life cycle, but at another one it can prolong existing life cycles to an excessive degree by inhibiting investment in the technological innovation that creates the next cycle (Tassey, 1999). Government policies may be determinant to either reinforce its positive effects or reduce the negative ones.

The precursor of innovative dynamics, Schumpeter (1934) considered that the diffusion of a technological innovation would gradually eliminate the profits of the entrepreneur who introduced it. We defend, in extension to his argument, that this does not necessarily occur in case the entrepreneur pursues an even more ambitious strategy – of establishing a new technological standard in that particular industry, sector or even market.

The establishment and consolidation of such a standard will be translated into a powerful tool and the next technological evolutions may be dictated by the leader who introduced the standard. This is not an easy proccess, but is given by that firm or group of firms that is capable of intensively realizing opportunities, of introducing, diffusing and appropriating the gains by technical progress (Ferraz, 1989).

Aiming at comprehending the technical standardization process within the dynamics of innovation, it is important to reckon the contribution from Utterback (1994), whose central element consists on the gravitation movement around a dominant design, thus defined as: "(...) the one that wins the allegiance of the market place, the one that competitors and innovators must adhere to if they hope to command significant market following. The dominant design usually takes the form of a new product (or set of features) synthesized from individual technological innovations introduced independently in prior product variants" (p. 24).

In the proposal of Utterback (1994), the dynamics of innovation is divided into three phases: fluid, transitional and specific. The first one is the phase of experimentation, when the rate of change is fast with diffuse focus of R&D activities, whose results are highly uncertain on what concerns products, processes, and competitive leadership, among others. In the intermediary phase is when the consolidation of the dominant design and the technology standardization occur. The third phase is considered the one in which the production is dedicated to specific and standardized products, with high efficiency.

From the specific phase onwards, competition basis is altered and, as a consequence, what is denominated as firms ecology is drastically modified – similarly to the schumpeterian creative destruction process –, departing from a situation in which many firms compete among themselves to a new situation of fast exit of firms from that particular industry in which the new dominant design was established – the benefited ones are those who introduced the standard or easily got adapted to it.

According to Utterback (1994), the consolidation – or standardization – of that technology occurs as a result of the interaction among technical and commercial techniques, to whom many factors exert influence: (i) collateral assets , (ii) communication among producers and users, (iii) strategic maneuvers from individual firms in what concerns their competitors, and (iv) regulation of industry and governmental intervention.

For the purpose of the present article, it is worth to emphasize this last factor. After acceptance, the standard will exert a profound impact both on the direction and on the rate of future technical progress. The consequences for paradigmatic change must also be reckoned.

To discuss this specific matter, it is important to retake the analysis proposed by Teece (1986), concerning the existence of two stages in the evolution of a certain scientific field – the pre-paradigmatic stage, when there is no unique and generalized concept to deal with the studied phenomenon, and the paradigmatic stage, initiated when a theory surpasses the canons of scientific acceptability and marks the emergency of scientific maturity and the acceptance of standards that remain until that paradigm is superseded.

There is a trade-off in the transition from one technological paradigm to another, in what refers to the configuration of the productive structures of a country, between exploring new paradigms and 'exploiting' incremental advances in the pre-existent one, given by the diverse possible 'technological trajectories', representing the concrete way in which the technological paradigm evolves, implying change within the same paradigm.

Perez and Soete (1988) define four classes of costs that affect the entrance in a certain technological paradigm: fixed costs of investment, cost of scientific and technical knowledge required for assimilating the innovation, cost of acquisition of the necessary experience to deal with innovation and take it to the market and cost of overcoming 'locational' disadvantages, related to general infrastructure and other economic and institutional conditions. The curves that express each of these costs vary over time, resulting in the fact that the total minimum required to enter in a certain paradigm will be either high or low according to how technology evolves throughout the different phases of the product life cycle.

Transition to a new paradigm, therefore, for being complex and costly, can not be made spontaneously by private capital, demanding the support from the public sector. According to Nelson (1990, p. 60): "government agencies are an important part of the modern system. (…). Since World War II they have become the main founders of university research. In some fields, government agencies are major actors in the development of new products and processes. Where a government agency holds a strong interest in a technology, it may try to coordinate private efforts as well as fund them".

Besides, as emphasized by Bell and Pavitt (1993), it is necessary to have complementarity between public infrastructure and the efforts of firms, having the government to build a proper environment so that firms invest, since they are, in the last resort, the innovative agents.

In this context, the mechanisms for international transfer of technology are strategic to policy-makers in developing countries (Freeman and Soete, 1997). Nevertheless it is important to single out that the technology transfer exerts even more positive effects when the receiving country is capable of efficiently assimilating and operating the technology under question, adapting it to its particularities when necessary. For that it is a pre-condition some investment on R&D, even if in its less sophisticated level.

To illustrate the above arguments we now turn to discuss the paradigmatic change that is occurring in the telecommunications sector with the advent of the Digital TV, and the role of the State in this process. For that, an analysis of the Brazilian experience in the standardization process of the Digital TV in the country will be provided, as a significant example on how sound investments by the government helped to reduce the costs to enter into the new technological paradigm and to assimilate technology from abroad.

2. Digital Television as a New Paradigm in the Telecommunications Sector

The telecommunications sector is a very strategic one, presenting an intrinsic technological content, a high potential for innovations and interaction with other sectors within a country. Due to different target markets, it is generally divided into telephony and broadcasting, even though these sub-sectors have been getting more and more interconnected nowadays. A paradigmatic change in the telecommunications sector, with the digitalization of all networks – a phenomenon that came to be known as 'digital convergence' – is the responsible for strengthening this interconnection.

Such phenomenon has reached the television industry, with its overwhelming importance since its creation in 1946. The universalization of this technology can be observed through the huge amount of houses that possess TV set: in China there are more than 300 million and almost 100 million in USA, while in Brazil the number reaches up to 40 million appliances (Brittos, 2002). Considered as a motor for development since the fordist model, it is now gaining more importance, forming a dynamic conjunct in the overall economy, mainly through its interaction with informatics and telephone industry (Caparelli et al., 2008). Television is the main media vehicle worldwide, moving more than US$ 50 million in USA, US$ 2,3 million in Brazil, representing in these countries, respectively around 36,9% and 58,7% of the total of publicizing investments (Brittos, 2002).

Briefly put, after over 50 years of analogical technology, accompanied by the gradual introduction of several incremental innovations along the years (color TV, stereo sound, remote control, SAP Closed Captions, among others) a revolutionary innovation took place with the Digital Television (Castro and Silva, 2009). With the promise of providing a six times higher definition image than the actual system, the possibilities that are now open to consumers are extraordinary, in which the advantages associated to this development can be summarized by three main features: excellent reception of sound and image; interactivity and portability (Silva, 2009).

The history of the evolution of this revolutionary technology must be traced back to the 1960s, when the cinematographic industry started introducing somewhat digital based resources to its audiovisual content. But it was from 1980s onwards that digital equipment started entering the broadcasting market in big scale, initiating the so-called 'digital era' (Almas, 2008). By this time, Japan and Europe were competing to develop an analogical High definition TV system. Meanwhile in the USA, there was a strong pressure to reassign a large amount of the TV frequency band to other services (ex. cellular phones). Since the technology for digital TV had already been developed for Nasa deep space spacecrafts, American Broadcasters asked the Federal Communications Commission (FCC) to reserve a frequency band for a future high definition television (HDTV) on a digital mode. This episode marks the beginning of the Digital TV.

After a few years of development, it was proposed to FCC an American HDTV system called Advanced Television Systems Committee (ATSC). As Europeans did not intend to lag behind, and as different requisites were necessary, in which configurability, mobility, multi-channel, were important characteristics, they developed a family of systems called Digital Video Broadcasting (DVB). The Japanese, that traditionally have a intense research in television technology, were the later to enter in this competition, so they picked the best of European system, and made some changes that turned their system slightly better, mainly adding support to portability, the Integrated Services Digital Broadcasting (ISDB).

In the whole integrated system of Digital TV, different processes must be considered: the digitalization and the compression of the signal, the transmission and the reception of the data. All over the world discussions now fall over the decision on what is the best technical standard to optimize the triple-point of compression, transmission and modulation. Technical issues are under constant evolution and since every year additional innovations are introduced in the market, countries are led to rethink their technological choices (Almas, 2008).

Countries all over the world then started discussing, as latecomers, how to introduce this innovation into their markets and which standard to adopt. As discussed in the first session, the diffusion of one certain technology in the international scenery and its adoption as a standard in one particular industry or sector may bring several advantages to the country and the domestic firms that developed the standard, mainly as a powerful instrument. The decision then was to direct efforts to choose among the three main standards – the American, the European and the Japanese.

In this context one could say that a race started among USA, EU and Japan, trying to diffuse its technology to other countries. In most countries quite a lot of indefinition remains. Argentina, for instance, even though adopted the American ASTC in 1998, more recently started, with the support from the present government, studying the European DVB technology. Both Colombia and Uruguay have decided for the European standard. Brazil was the first Latin American country to engage in this decision[3].

This is why the process that led to the Brazilian choice – quite an enduring one – is worth discussing to illustrate the arguments we defend in the present article. The Brazilian choice relied on the Japanese technological standard for Digital TV, because it is considered the most robust system for transmission, adequate to the accidental land of some cities in the country and reception by small indoor anthems, what seems to have been a very decisive argument, according to a statement by the Ministry of Communications (Revista Veja, 2005).

The Brazilian decision, nevertheless was not strict to the fully adoption of the Japanese standard, but instead used it as a basis to make further technological developments, and to introduce the necessary innovations to adapt it to the particularities of the country and developing a standard of its own. This whole process lays on the main core of the next session.

3. Brazilian Experience in the Standardization Process of the Digital TV

In Brazil, the telecommunications sector is a very strategic one. Some data confirm its importance in the economy of the country: in 2006, the telecommunications sector was responsible for 6,2% of the Gross Domestic Product (GDP) showing a 7,1% of growth when compared to the previous year, when it employed around 311,5 thousand people. In this same year, TV operators experienced a revenue of around R$ 19 bilhões (Lenhari and Quadros, 2007).

The investments for the building-up of this sector can be traced back to the 1960s, when the military government decided to make sound investments on certain strategic sectors considered fundamental to the country's infrastructure, among which the telecommunications sector. In this context, between 1965 and 1972, we can observe the creation of Embratel, of the Ministry of Communications and of the Telebras System. The investments of this system favored

[3] Available at <http://www.teleco.com.br/tvdigital.asp>.

the mass communication and allowed the implementation of a sophisticated telecommunications infrastructure what strongly contributed for the integration of a big country like Brazil (Caparelli, 1998). In the present, in any part of the Brazilian territory, more than 5 million satellite dishes can receive a free open signal from the main broadcasters in C band.

The open television consolidated itself as a tool for disseminating culture and entertainment among population and, as stated by the Broadcast Decree 52795 from 1963, represents a strategic tool for national integration, for language preservation, culture, education, and public information. The country is among both the 10 greatest television markets and those 10 countries that show biggest publicizing investments (Brittos, 2002). In the Brazil, the terrestrial open TV broadcast is a very successful model, in contrast with many developed countries. For instance, in USA, over 80% of the houses have paid cable TV, in Germany around 93,2% and in Brazil only 10% (Brittos, 2002). So the importance of terrestrial broadcast is enormous, not only due to commercial aspects, but also to political and strategic ones.

With the responsibility of keeping these features, television industry in Brazil has always shown a need of promoting a compatible technology with the television set of consumers, at the same time that it fostered the innovative capabilities (Castro and Silva, 2009). In the beginning of the 70's, for instance, when the decision about introducing color system was made, as the American NTSC system (the first developed) was considered unsatisfactory and the German system PAL would not be compatible with our black and white system, the option was to develop a especial system for the Brazilian market, as a mix of the two existing systems.

The first governmental initiative towards the implementation of the Digital TV in Brazil occurred in 1991, under the scope of a specific Commission (COM-TV) created by the Ministry of Communications. In 1994, a specific technical group for studying the Digital TV was formed, being firstly composed of the Television Engineering Society (SET in Portuguese) and of the Brazilian Association of Radio and Television Broadcasting Stations (Abert in Portuguese), and later on Mackenzie University joined this initiative. COM-TV was extinct in 1998 and the implementation process of the Digital TV was from then on under the conduction of the then recently-created National Agency of Telecommunications (Anatel, in Portuguese) (Bolaño, s/d).

The Group Abert/SET/Mackenzie then initiated field studies and tests to evaluate each of the three existing Digital TV standards (American, European and Japanese). In 1999, Anatel hired the Research and Development Center for Telecommunications (CPqD) to validate the methodology of the tests that had been conducted[4].

The conclusions from the study went on the direction of showing that the European (DVB-T) and the Japanese (ISDB-T) presented better results than the ASTC as both technologies had better performance in highly populated areas, with stronger signals and with low interference from near channels. Besides, ISDB-T's better performance was also related to other features: the reception of signals by internal anthems; higher rates of immunity to noise; flexibility with regards to technological applications, such as broadcasting of sounds and images and either mobile or portable reception; it privileges the installation of new channels in the territory (a very important argument, since in Brazil the analogical signal would still have to the kept for at least ten years) (Bolaño, s/d).

[4] It is worth to emphasize that the methodology utilized was quite successful and served as a basis for the later development, by the International Telecommunications Union (ITU), of specific standards to conduct field tests for TV signal reception.

In 2001 the Federal Government publicized two reports to inform and to gain comments from the interested parties of the laboratory tests, technical and trading aspects of the digital TV[5]. The regulamentation of the Fund for the Technological Development of Telecommunication (FUNTTEL)[6] was also initiated by this period, with the aim of fostering technological innovations, the capacity building of human resources, job creation and the competitivenesss of the Brazilian telecommunications industry.

With the evolution of the subject in the country, the Brazilian System Digital Television (SBTVD) was instituted in 2003 by Decree 4901. To reach its objectives, a call for presentation of research projects around the SBTVD was launched in 2004, under the evaluation of the Brazilian Research and Projects Financing Agency (FINEP) and under the coordination of CPqD. From this initiative, 22 proposals were approved, involving around 1500 researchers from several universities, and the amount of R$ 65 million (Filho, 2007).

In parallel, various meeting with the most diverse entities involved in the theme were promoted by the Brazilian government. The activities of each of the above mentioned proposals were evaluated and the decision on each standard to adopt was postponed several times, in order to try to make the best choice. The Brazilian strategy ranged from the initiative of developing a standard of his own, passing through the choice for one of the three established standards, or even deciding for a different standard, as the Chinese one, still in its beginning.

The country soon realized it would not be able to develop his own new standard, and the debate around the theme was quite intense, with most different pressure groups, surrounded by political interests. The three leading groups – USA, EU and Japan – were also making huge pressure so that Brazil, that enjoys a very substantial market for television, chose their respective standards.

USA defended the adoption of ASTC as a unique standard for Americas. In October 2003, the Overseas Private Investment Corporation (OPIC) announced the creation of a special funding in the amount of up US$ 150 million in case Brazil chose for the ASTC technology. Just one day after this announcement, the European also offered some financing to Brazil with the same aim (Bolaño, s/d).

Nevertheless, in face of the various advantages presented by the ISDB-T and other negotiation involving the implementation of a factory for producing semi-conductors, the waiver of royalties, the adoption of the compression standard MPEG4 and the allowance to develop a Brazilian middleware were fundamental features for choosing the Japanese standard (Filho, 2007).

In June 2006 the Brazilian government publicized the Decree 5820, which established the guidelines for the transition from analogical to digital television. The choice was for the Japanese system (ISDB or ITU-R Rec. BT 1306 system C) as much as for the incorporation of technological innovations approved by the Development Committee. The Decree also marks the formal establishment of the Forum of SBTVD, in which many different agents were mobilized to participate in the technological choices of the Brazilian standard, including private firms, governmental bodies, consumers associations, academic and research entities. One specific

[5] Public Consultation 291/01, which publicized the "Report on the Analysis of Laboratory and Field Tests for Digital Television Systems" and the "Integrating Report of Technical and Trading Aspects of Digital Television", by CPqD.
[6] Created by Law 10.052/2000, FUNTELL is regulated by Decrees 3.737/2001 and 4.149/2002. Available at <http://pt.wikipedia.org/wiki/FUNTTEL>.

technical model was set to coordinate R&D activities, a special branch of the Brazilian system, since the main aim was to develop a technology adapted to the country's needs.

The organization of programs and services of the SBTVD were supposed to guarantee a system that possesses a kind of a 'future protection', with no legacies and focused on flexibility to select the adequate parameters to allow the provision of each service. It is the correct selection of parameters that will guarantee longevity of receptors, meeting the Brazilian socio-economic profile, the high exigencies of consumers. It was, in brief, designed to accommodate different configurations and business models, at the same time that it would make it possible to reach an expansion to future services (Prado et al, 2009).

The first activity involved in the specification of receptors consisted on the identification of sceneries, the description of cases of usage and then: the compilation of existent requirements, the analysis of such requirements; negotiation, specification and classification. This is how the Brazilian model appeared (Silva, 2009).

From then on Brazil and Japan formed a Conjunct Working Group (GTC) at a ministerial level to move on in the technical cooperation for Digital TV. Among their activities was the development and harmonization of documentary standards in order to facilitate the consolidation and diffusion of the technology.

The consolidation of such a technical basis is believed to allow the strengthening and expansion of the software market and of interactive content in Brazil, a market of high technological content and high value added (Castro and Silva, 2009).

Though based on Japanese standards, the Brazilian system heavily relied on the introduction of innovations. Among them, we could mention the usage of the codifiers H264/AVC and H264/AAC[7], to video and audio, respectively, as well as the adaptation to local conditions. We must also single out the development of an innovative standard for modulation by the University PUC-Rj and the greatest innovation of the Brazilian system which refers to the development, by two Brazilian universities (PUC-RJ and UFPB), of a middleware, baptized as GINGA[8] (Silva, 2009).

The standardization process of the Brazilian technology for digital TV is under way, following a steady timetable. The elaboration of the standards is carried through by the Technical Committee of the SBTVD Forum, distributed along eight working groups involving around 150 people and representing more than 40 entities. Moreover, a Commission for Special Studies on Digital TV was formed within the scope of the Brazilian Association of Technical Standards (ABNT), who was then responsible for coordinating this standardization process[9]. Within 14

[7] To illustrate the importance of these tools, the H.264 standard was projected to compress vídeo, being able to supply a high quality vídeo utilizing a substantially low rate of bits, without increasing the complexity of implementation in a way that could make it non-practical or too costly. Maintained under a constant rate of technological updating, it is estimated that through this technology one can obtain between 40 and 70% of more compression than the previous utilized technology (Prado et al., 2009).

[8] The name Ginga "remete" to a national expression in the country, that represents a typical characteristic of the movement and attitude of Brazilian people, related to the way they walk, speak, dance and relate to several aspects of their lives. Ginga means flexibility and adaptation, also inherent to the Brazilian middleware (more information on <http://www.ginga.org.br>). The middleware is still under a specification process (Silva, 2009).

[9] It is worth to mention that the issue gained so much importance in Brazil that ABNT created one special webpage for the Digital TV standardization process and nowadays the Standards that have been developed are the only ones

months of existence, the Commission held 35 meeting, resulting until the present moment in the publication not only in Portuguese but also in English and Spanish of most of the 13 technical standards (Castro and Silva, 2009).

Since the beginning of the studies about video and audio standards, until their definition, decisive efforts had to be made, as it involved most heterogeneous stakeholders, with conflicting interests. One of the main challenges is the constant need for negotiations and harmonization of interests and the pressure exerted by a tight timetable to the development of products that would be capable of allowing for the launching of the Digital TV (Silva, 2009).

The relevance of the international market has been taken into account by the SBTVD Forum and the Brazilian system was recently nominated as ISDTV (International System for Digital TV), so it would be configured as an international system, not restricted to the Brazilian reality. Later on, the system also came to be known as ISDB-Tb, in other words, the Brazilian system based on the Japanese ISDB (Almas, 2008). The country has been recently engaging into strong diplomatic and technical efforts to encourage other South American countries to adopt the ISDB-Tb international.

This is how, following the Japanese strategy, whose standard was developed based on the European and hevily relying on the introduction of innovations, Brazil adopted a similar strategy, basing itself on the Japanese standard at the same time of introducing other innovations as well. Moreover, the option for an international standard facilitates the trade of products, programs and interactive services, increasing the volume of high technology international trade (Silva, 2009).

Though a latecomer, Brazil took advantage of previous technological progresses and utilized the mechanisms for technology transfer in the best manner, since it also invested on R&D to better assimilate the technology that was being transferred, and to adapt it to the country's particular features. The Brazilian decision, in this context, was for the adoption of a hibrid Japanese-Brazilian system, utilizing the basic structure of the Japanese system and implementing important innovations. The adherence to international standards has been kept, many times showing more robustness than the Japanese one (Almas, 2008).

Governmental support also includes the necessary investments to foster the fully implementation of the SBTVD, through the specific funding program Protvd, managed by the National Bank for Social and Economic Development (BNDES), aiming at helping the investments to be made by the main operators in this technological transition. The first funding initiative approved in the end of 2007 under the scope of the Protvd received a total of R$ 9,2 million for modernizing the analogical transmissors of the one of the greatest operators in the country (SBT) (Brittos and Bolaño, 2007).

The Digital TV was made available in Brazil in the end of 2007. This transition is supposed to happen in a gradual manner, initially within 10 years, allowing the whole population to have enough time to get adapted to the new technology (Castro and Silva, 2008).

It is foreseen that much investment is supposed to be made in this transition. According to data from CPqD, television operators will probably invest around R$ 5,5 billion in equipments during the first five years of the transition. It is also estimated that up to 2016 50 million set-top boxes be sold, generating around R$ 125 billion. It is then proposed that the whole market will

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that may be obtained for free, as in general all others are sold by ABNT (for more information see <http://www.abnt.org.br/tvdigital/TVDIGITAL.html>).

face huge investments brought by the new scenery of technological innovations originating from the digital media (Rondelli, 2007).

According to data publicized by the SBTVD Forum, within one year around 40 million consumers had access to the new technology, considered somewhat a low penetration ratio. One reason for that was the high price of the set-top boxes, the equipment that promotes the reception of the digital signal by an analogical TV set[10]. The Brazilian government is studying the implementation of a strategy to reduce the costs of the set-top boxes from around R$ 700,00 to R$ 200,00.

Other public investments have shown to be necessary to support the standardization process of the Brazilian technology, therefore guaranteeing its consolidation: investments in the strategic field of metrology[11] applied to telecommunications and to the Digital TV more specifically. In the absence of a sound metrological basis, the compatibility among the technologies and its various aspects (reception, codification, transmission) may be compromised. Aware of this need, the Brazilian government, through the National Institute of Metrology, Standardizationa and Industrial Quality (Inmetro), has engaged into the development of a strategy to advance in metrology applied to the sector. In this context, the Division of Telecommunications Metrology (Ditel) was created in 2006, working in the standardization process, conformity assessment, and given traceability for radio-frequency quantities[12].

4. Concluding Remarks

As we could observe along the discussion conducted at the present paper, the analysis on the standardization process of the Digital TV, shows an emblematic case in which Brazil, even though remains at an inferior level of development and entered the new paradigm as a latecomer, put efforts that allowed the country to gain more benefits from the mechanism of technology transfer. Through the conduction of sound investments on R&D the country managed to be able to receive the technology from the donating leader – Japan – but not only adapting it to its particularities but also introducing innovations, thus contributing to the evolution of the new paradigm.

Brazilian government emphasized the need of overcoming those four classes of costs as defined by Perez and Soete (1988) as obstacles to a succesful entrance into a new paradigm, trying to reduce fixed costs of investment, the costs of scientific and technical knowledge required for assimilating the innovation, the costs of acquisition of the necessary experience to deal with innovation and take it to the market and the cost of overcoming 'locational' disadvantages, related to general infrastructure and other economic and institutional conditions.

Moreover, a synergy among various agents of the Telecommunications System of Innovation was fostered, and both research and decisions counted on the participation of most varied entities: governmental bodies, industry, associations, academic institutes, R&D institutes.

[10] Available at <http://www.teleco.com.br/tvdigital.asp>.
[11] Metrology: pertains all theoretical and practical aspects related to measurement, whatever the uncertainty, in any field of science or technology (JCGM, 2008).
[12] For more information on the strategic role of metrology for the standardization process, see Souza and Hasenclever (2008).

This is how Brazil developed a strategy of utilizing an existing technology as a basis – the Japanese – and moved forward to improve it and develop a new standard, compatible to international trends. Brazil is now taking similar steps as those taken by the three leading groups (Japan, USA and EU) and is promoting the adoption of its standard by other partner countries, in order to create scale and market to the Brazilian equipments, with a strong support from financing organizations, as the BNDES for instance.

The example illustrated at the present paper calls the attention for the need of understanding the technological standardization process under an evolutionary perspective, as this should not be set apart from nor from governmental or innovative policies. The case of the Digital TV standard shows how strategic a choice for one or another technological standard can be. The Brazilian experience presents some contributions for those countries that are still in the process of deciding which one to adopt, as the need on making some investments on R&D can not be neglected if one wants to better adapt the technology to their domestic needs, especially when it is related to such a strategic sector.

Our findings allows us to conclude that the activities involved in the standardization process play a strategic role in the dynamics of innovation and as such sould be included in the formulation of industrial, technological and pro-innovation policies, specially in developing countries where the issue is still a recent one.

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