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THE BRAZILIAN EXPERIENCE ON PRODUCT CERTIFICATION: A METROLOGY-RELATED FUNCTION WHICH PRODUCES ECONOMIC IMPACT

Updated results related to the economic impact induced by certification of industrial products are used to demonstrate that metrology and metrology-related functions are essential complementary functions of industrial technology that underpin the quality of manufactured goods and foster competitiveness and trade. In contrast with other countries' experiences, this paper shows that Brazil innovated when implementing an integrated industrial technology multiple-function system. As such, the Brazilian experience, which greatly contributed to reach its current level of industrialization, could be useful for a world-wide audience interested in the main lessons learned in the metrology and conformity assessment fields.

1. INTRODUCTION

The role of governments in metrology and metrology-related activities is to develop and maintain an adequate national infrastructure capable to provide society with the necessary means of measurements and confidence in measurement results. Access to a reliable metrology infrastructure promotes quality at the enterprise level and streamlines the technical regulation framework needed to control the regulated sector (health, safety, environment and consumer protection). In so doing, governments protect individuals and companies against possible abuse due to unreliable measurements. In this sense, the importance of a sound MSTQ[1] infrastructure goes far beyond technical and economic impacts. They, unequivocally, promote social benefits.

The paper reviews the Brazilian strategy to implement – through enhancement of its S&T structures – a national MSTQ infrastructure which has gained international recognition and greatly contributed to the country's industrialization process. Emerging from an updated and expanded version of a previous work – *economic impact induced by product certification* – recently presented in the 2006 edition of the IMEKO World Congress [1] it also discusses the role of national MSTQ technical infrastructures needed by all countries to promote industrial development and economic growth. Details of the econometric model used to assess the economic impact on the Brazilian economy that resulted from product certification (based on production time-series data of industrial products and on the effect of other macroeconomic variables) is discussed by the authors elsewhere [2].

2. MEASUREMENT RELATED ACTIVITIES: TECHNICAL INFRASTRUCTURES

In today's domestic and international trading environments all countries need a national infrastructure for conformity assessment and metrology related services to facilitate access to world markets. A well functioning infrastructure of essential services is required to ensure

[1] MTSQ (an acronym which literally stands for metrology, testing, standards and quality) is commonly used by the World Bank to generally address basic functions of industrial technology such as metrology, accreditation, conformity assessment related activities (testing and certification), standardization and quality. SMTQ, SQAM and MAS-Q are substitute denominations also used.

uniformity, reliability and recognition of measurements performed by domestic laboratories and of testing and inspections conducted by conformity assessment bodies and regulators. This regulatory framework guarantees that products which comply with standards and technical specifications, in fact, meet quality expectations of consumers and are not detrimental to health and to the environment.

Governments and industries use measurement and testing for different purposes, either for enforcement of or compliance with regulations, export/import controls, consumer protection or for quality assurance of products and services and for quality control in manufacturing. For whatever purpose, it is essential that the results of such activities are technically valid and be seen to be so. Furthermore all measurement and testing associated with trade matters are somehow conformity assessment activities; i.e. used to assess the degree to which a product or service meets customers requirements.

2.1. Applications of conformity assessment

Any government may, of course, organize its measurement-related system according to its own convenience. But in the last decades, there has been a trend to define essential attributes [3] that all conformity assessment systems must exhibit if they expect credibility outside their own borders.

Figure 1 illustrates different means of determining product's compliance with technical specifications, emphasizing that infrastructure of conformity assessment is multidimensional and may involve a variety of actors at the national and international levels (WTO, 2005 [4]).

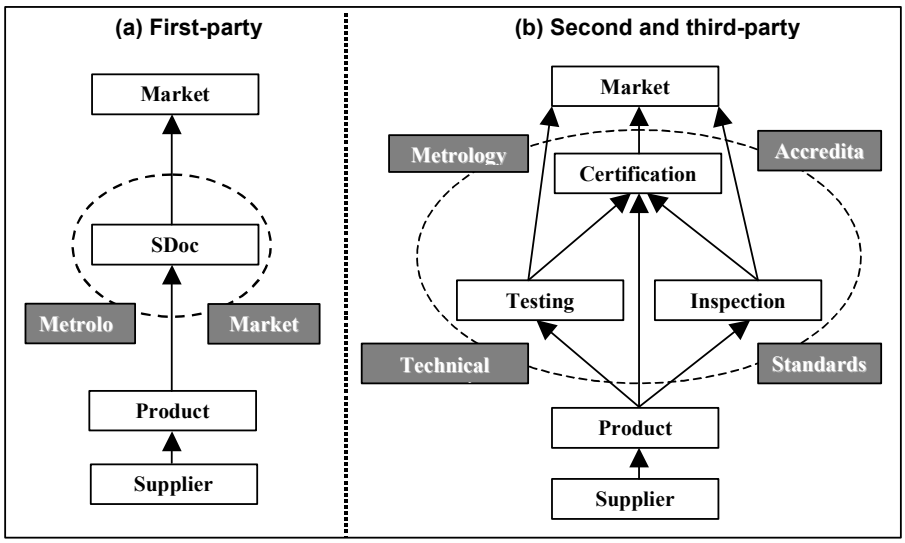

Fig. 1. Technical infrastructures for conformity assessment.

Although 'first-party assessment' substantially simplifies and speeds up the certification process as it is performed based on self declaration of conformity (SDoc), 'second and third-party assessment' make direct use of testing and/or inspection. While the first is carried out at the risk and responsibility of the manufacturer without evoking a formal accreditation scheme, the latter requires international recognition of measurement at the national level and interference of an accreditation scheme. Benefiting from these underpinning infrastructures – documentary standards, technical regulations, physical standards of measurement (metrology) and accreditation of the bodies performing the actual tasks (calibration, testing and inspection) – product certification does add value to goods and services.

2.2. Possible National System Models

There are two distinct categories of functions: provision of measurement and conformity assessment services and underpinning services (documentary standards, physical measurement standards and supervisory services). But there are three basic options for national arrangements of such services with many variations to provide: (i) all such services through one or more government departments, ministries or entities; (ii) some services through government agencies, leading the government administration to appoint (designate) private sector institutions to undertake the remainder on a non-competitive basis and (iii) some services through government agencies, encouraging private sector competition for the remainder. In all cases, these MSTQ services are provided by laboratories, inspection bodies and certification bodies.

The reality is that there is a multitude of possible combinations of the above but which always will require credibility and recognition of the system if trade barriers are to be reduced and the World Trade Organization (WTO) rules acknowledged. Where different government agencies provide different forms of recognition to private sector bodies, there is also a potential for a great deal of market confusion [3]. To the market, one form of government recognition is as good as another but if there are different standards then the risk is that the whole system will be brought into question particularly if an organisation is required to comply with different regulatory processes for different sectors of its business or operations. This can add significant costs to such a business.

3. PRODUCT CERTIFICATION: RESULTS AND DISCUSSION

Brazil has succeeded in implementing its basic infrastructure for provision of MSTQ services. Today, the system in place operates in full compliance with international standards and best practices to support and meet an increasing demand for calibration, accreditation voluntary and compulsory conformity assessment services needed to support product certification. Details of the Brazilian strategy and its major achievements are summarized in Appendix I.

In the context of this study, the authors will treat international standards and harmonized conformity assessment procedures applied to product certification. This is an effective tool that reduces asymmetry of information between trade partners – thereby encouraging business and international trade – and, that, in fact, produces a substantial economic impact.

3.1. A tool for reducing information asymmetries

It is widely accepted that information asymmetries undoubtedly affect the efficient functioning of the markets, often leading to a supply of low quality product variety. In the 1970's, Akerlof [5], Spence [6] and Stiglitz [7] set up the governing principles of modern information economics. For their relevant individual contributions to this field they were awarded the Nobel Prize for economics, in 2001. Their remarkable work drastically modified the way economists perceived the functioning of markets and explained how information asymmetries affected the rationale of social and economic institutions. Since then, other researchers [8, 9, 10] have used and extended their original ideas to confirm that information asymmetry does hinder market efficiency. In Stiglitz's own words "lack of knowledge of products of good quality in a given market may lead to their exclusion by unfair competition between producers; i.e. societal inefficiency to *asymmetric information flows"*.

There are close links between trade, standards and the WTO as they affect our lives in ways we sometimes do not even notice, but they can have far-reaching implications for economic activity, including trade [3]. In this respect, differences in national regulation and standards may act as barriers to trade, thus hindering commercial transactions. Generally speaking, the regulatory system of any country is comprehensive and inherently complex involving long lists of products and services subject to specific legislation of conformity assessment procedures. In this sense, product certification not only maintains protection against lack of information but also reduces asymmetries and diminishes transaction costs and facilitates international trade as it ensures technical compatibility across countries. This reduces information asymmetry between manufacturers and consumers about products that have been manufactured abroad or processes that took place in another country. The potential gains resulting from adequate use of safety and product standards are unmistakably relevant. A concrete example of the economic impact induced by product certification in Brazil is discussed below (details in Appendix II) emphasizing a sensitive area of application of measurement science.

3.2. A conformity assessment activity that induces economic impact

Systematic application of harmonized standards to international trade over the last decades has helped to bring down tariffs worldwide[2]. When a product, a service or process has, or can be given, uniform certification, transactions are made much easier because economic agents know what they are buying and selling. As a result, expanding markets for goods and services provide new outlets for developing countries wishful to benefit from globalization.

Both producers and consumers may perceive certification as a procedure that restores transparency in imperfect (or faulty) markets in a situation where information is not equally shared. In the presence of information asymmetries, product certification becomes essential to protect producers who want to be assured that the products they are selling comply with specified technical standards and (specially) consumers who want to be convinced of the quality of the products they are buying. In short, products certification enhances the efficient functioning of markets and should be understood as a reference for quality.

Based on abundant theoretical and empirical evidence Nicolau et al. [11] suggest that a market reacts positively when certification is granted to a product or service. Their results strongly support that quality and product certification employed by companies substantially reduces asymmetry in the information available to firms and consumers.

The effect of product certification on the production of goods was investigated by the authors [1] by means of an econometric tool [2]. In this study, ‘product certification’ (understood as a variable of technological nature) was modelled as a dummy variable and ‘production’ and ‘monetary inflation’ were treated as time-series macroeconomic variables. Two other macroeconomic variables (dummy) were also taken into consideration to account for the exposure of the products to regional and to international markets. Based on official data, four industrial products which impact on the domestic trade balance were investigated. The criteria for selecting the products took into consideration (i) the regional trade agreements affecting the market of these products; (ii) the country macroeconomic information on market access; (iii) official production time-series data available, (iv) basic information on the product certification issued and (v) key characteristics of the national MSTQ infrastructure in place.

[2] Just to quote one example, the average tariff aliquots on industrialized products imported by OCDE countries dropped from nearly 40% (in 1950) to 1,5% (in 1988) [12].

3.3 Products studied and economic impact produced

Table 1 lists the industrial products selected and their relevant market and export attributes, ranked in the world global market. With the exception of cement (a product subject to voluntary certification) whose production nearly matches the Brazilian domestic consumption, the other three products (subject to compulsory certification) possess growing export potential. The table also specifies the standard applicable to the correspondent certification process.

Table 1. Relevant data on selected products.

Production	World Rank	Annual Brazilian Production (2005)[d]	Export	Nature of Certification and Implementation date	Applicable Standard
Cement	[a] 11º	34.5 (10^6 metric tons)	1.6 %	Voluntary, Aug 1994	[++] NBR 5736
Steel	[a] 7º	32.9 (10^6 metric tons)	39 %	Compulsory, Jan 1997	[++] NBR 7480/96
Autom. Tires	[b] 7º	52 (10^6 units)	33 %	Compulsory, May 1995	[*] GovRes.DQUAL 044
Bus coachwork[+]	[c] 2º	28,732 (units)	45 %	Compulsory, Jan 1993	[*] GovRes. INMETRO 109

[a] United Nations Statistical Bulletin (2006).
[b] ANIP (www.**anip**.com.br/ 2006).
[c] ANFAVEA (www.ufavea.com.br, 2006).
[d] Brazilian Institute of Economic and Planning (IPEA), www.ipeadata.gov.br.
[+] Bus coachwork is also known as bus shell. [++] NBR: Brazilian Standard. [*] GovRes: Government Resolution.

Table 2 summarizes final results of the economic analysis carried out, emphasizing the impact induced by product certification on the production of the four goods investigated. Actually, data appearing in this table reflects an upgrade of a previous work [1] where the original production time-series (1993-2004) was updated to Oct 2006.

Table 2. Economic impact induced by product certification.

Product	Period under consideration (after certification was implemented)	Cumulative Production[g]	Impact induced by product certification	Production surplus (due to certification)	International Market Average Price (Nov 2005) (USD)	Overall Economic Impact for the whole period (Billion USD)
Cement	Aug 94 – Sept 06	443.3 10^6 ton	12.7%	56.3 10^6 ton	[h] 212/ton	11.94
Steel	Jan 97 – Sept 06	278.8 10^6 ton	13.8%	38.5 10^6 ton	[h] 395/ ton	15.20
Autom.Tires	May 95 – Jan 04	1.1 10^6 ton	11.0%	121. 10^3ton	[h] 1 297/ton	0.16
Buscoachwork	Jan 93 – Sept 06	481,632 u	14.1%	67 910 units	[i] 81 069/unit	5.51

[g] Brazilian Institute of Economic and Planning (IPEA), www.ipeadata.gov.br
[h] Bovespa (accessed in Nov 2006).
[i] Journal of Automotive Business.

As can be seen from Table 2, product certification clearly induces an increase in production –more than 10% for all products investigated. 'Bus coachwork' and 'steel' (subject to compulsory certification) benefited most from certification, inducing an economic impact of 14.1% (USD 5.51 billion) and 13.8% (USD 15.20 billion), respectively. Taking 2005 as a reference year and considering prices of products practiced in the international market, one may conclude that the economic impact induced by certification of 'steel' was US$ 1.19 billion/year; i.e. 0.15 % of the Brazilian GDP[3]. Similar conclusions could be drawn for the other products.

4. CONCLUSIONS

The main conclusions drawn from this work are focused on the 'exportability' of the lessons learned by the Brazilian experience. Its MSTQ system – considered an essential

[3] The Brazilian Gross Domestic Product (GDP) is estimated (in 2005) to be US$ 803.4 billion (Source: Deutsche Bank Ag.)

element to meet the tight requirements of a fast-growing world trade – played a key role in the economic development of the country.

Key strategic political decisions were taken to successfully implement the country's MSTQ system: Brazil (i) signed, with other seventeen leading nations, the Metre Convention, in 1875; (ii) adhered, in 1940, to the voluntary nature of international standards – which reduces transaction costs, fosters competitiveness and facilitates business through the trade goal *'tested once accepted everywhere'*–, even before ISO was established (1946); and (iii) created its own metrology system (Law 592, 1961), which were soon replaced by a coherent integrated MSTQ system – The Brazilian National Metrology, Standardization and Industrial Quality System (SINMETRO, Law 5966, in 1973), leading to the construction of a sound metrology laboratory infrastructure, to an internationally recognized accreditation scheme, to the implementation of a national network of independent accredited calibration and testing laboratories and to a comprehensive system for conformity assessment. This integrated model in operation today makes provision for the supply of relevant MSTQ services (testing, inspection and certification are outsourced) avoiding conflicts of interest usually present when such multi-function system also operates accreditation. In this sense, the Brazilian MSTQ system is unique.

Benefiting from a sequence of cost sharing governmental World Bank sponsored projects[4], the country invested in the overall performance of the scientific and technological sectors by undertaking activities that promoted innovation[5] in an efficient manner. Infrastructure reform efforts and financing investments, stimulated research and development in the private sector, improved the stock of S&T human capital and supplied services to increase the efficiency of public and private investments in S&T activities. To accomplish this, Brazil:

- promoted cooperative R&D and nonroutine engineering[6] (R&D&E) activities between firms and the S&T community;
- improved the quantity, quality, and relevance of S&T research and advanced training;
- strengthened the MSTQ (metrology, standards, testing, accreditation and quality) services and IPR (intellectual property rights) administration to foster a favourable environment for investment in R&D by firms;
- stimulated reduction of the regional disparity in S&T capacity;
- rationalized public investments in S&T.

Funds were allocated to subprojects that added technical merit and social relevance criteria, to strengthening S&T capacity in the less developed regions of the country, aiming to reduce unbalanced national levels of social and technological developments.

The Brazilian MSTQ system was conceived to depend on: the private sector (primary source of demand of MSTQ services), S&T research and human capital and laboratory infrastructure. Apart from an increased capacity building (metrology laboratory infrastructure) and management capability, the Brazilian project encompassed three subcomponents:

- **technology development** which stimulated R&D&E activities in the private sector, focused, *inter alia*, on innovation by small-and medium-scale enterprises (SMEs). A strategy which streamlined access to public incentives for R&D (tax exemption programs) and produced greater productive use of scientific and technological resources (both human

[4] In all three complementary phases the PADCT Brazilian S&T Project –co-financed by The World Bank – invested about US$ 800 million, from 1985-2002. The first author of this paper was part of the World Bank Team who evaluated the PADCT Project. Results of this evaluation are available as the WB Report "Evaluative Data (2002)", Science and Technology Reform Support Project, Federative Republic of Brazil, World Bank Evaluative Report, Department of Human Development, (LA1), Washington, DC, 20433, USA.

[5] Innovation here refers to the successful implementation of creative ideas within an organization (includes research, development and routine engineering).

[6] Activities connected with new products and processes (e.g.: retooling or detailing designs and/or specification introducing Total Quality Management or ISO 9000 programs reorganizing production plants and readapting mechanisms).

and physical) by firms. Under this subcomponent, the project supported specific subprojects competitively selected and co-financed by firms.

- **science and technology research** which increased and improved the stock of high-level human capital, focused on investments on scientific research and graduate training under improved procedures and policies, including incentive mechanisms aimed at shifting scientists' and technicians' focus toward areas more relevant to the productive sector.
- **sectoral support** which improved efficiency and quality throughout the S&T system. This supported portfolio investment reforms, improved the so available monitoring and evaluation systems, and institutional protection of intellectual property rights and provision of basic MSTQ services – namely metrology, standards, conformity assessment (testing, inspection and certification) and quality. Important to notice that these activities provided important quasi-public goods (such as the strengthening of the intellectual property rights regime) required for greater private sector investment in technological innovation.

The project certainly generated a financial benefit, as it improved the efficiency of the portfolio of investments in the sector; an economic benefit, as it clearly increased private sector's investments in R&D; and an institutional benefit, as it introduced performance criteria for public institutions which today provide, on a routine basis, key MSTQ services to the S&T and R&D communities. The direct beneficiaries were: the Brazilian firms, which gained easier and express access to more relevant research and development capacity; the Brazilian society as a whole, with improved stock of human capital for S&T; the graduate students in S&T-related fields, who have received advanced training at home and abroad; and Brazilian scientists, who had access to a better R&D infrastructure and therefore the opportunity to interact with private sector and to produce world-class research.

Lessons learned from this phased cost-shared Brazilian S&T project:

- implementation and maintenance of a sound national MSTQ infrastructure (provision of basic services) is now understood by politicians and government officials as a major responsibility of the State, as these activities play a strategic role in the political, technical, social and economic development of any nation (including the developing countries fulfilling their potentialities) and interfere in the so-called "international wish" to establish a worldwide uniformity in measurement – a key element for removing technical barriers to trade;
- product certification – a conformity assessment activity which clearly produces economic impact– plays a key role in the standardization of production, forcing industry to comply with common protocols – and, as such, reducing asymmetries of information to bring down barriers to trade and to protect consumers against unfair competition among producers;
- financing of projects should not be implemented during a period of persistent high inflation and macroeconomic imbalance[7] as firms could earn high returns on liquid assets – and therefore have no reason to undertake risky investments in R&D.
- specific incentives targeted to firms must be in place to induce private sector cooperation and co-funding of R&D activities – private sector should be involved in defining priorities and in carrying out research (awareness and incentive programs firms are always strongly recommended to emphasize associated benefits);
- maximum autonomy should be given to principal research investigators to control research funds –fragmented funding and excessive bureaucratic control of resources create delays that impede high-quality research;
- protection of intellectual property and provision of basic MSTQ services (metrology, standards, conformity assessment and quality) are specific subfields within the S&T

[7] This is a complex issue. The Brazilian monetary inflation dropped from over 1000 % with the introduction of the economic reform initiated in 1994 to 12% when the World Bank PADCT Brazilian S&T Project finalized in 2002.

domain – they require individually designed, long-term, and programmatic funding and administrative structures.

General lessons learned from another similar project implemented in Turkey[8] may also be 'exportable'. Whenever attempted to adopt a comprehensive and integrated approach to technological development, it seems important to recognize that there are some aspects which are usually beyond the scope of the main project. In short, technological developments should be approached in an integrated matter.

Given the nature of technology development efforts and the associated risks, the Brazilian and the Turkish experiences confirmed that enhancement of the technological capabilities in industry through MSTQ investments have met those countries' industrial needs.

The projects findings and related literature on technological development stress the importance of the role of the State in consolidating a sound MSTQ infrastructure. While the project should be accompanied by institutional, financial and informational measures to remedy deficient markets, attention should not be limited to R&D and innovation but also to basic mundane needs. Whenever products and services are traded, MSTQ services play an important role as they reflect a coherent set of essential services – such as rationalization of manufacture, improvement of quality of goods and services, reduction of costs and waste. Undoubtedly, access to these basic services reduces information asymmetry and technical barriers to trade. Besides, with the reduction in tariffs, non-tariff barriers to trade are moving to the forefront as market access issues inducing regulatory requirements which have the greatest impact on trade[9]. And, in certain situations, regulatory requirements may actually prevent gains from trade liberalization. However, as stressed by Stiglitz and Charlton [13], the liberalization of economic forces as a necessary precondition to unleash productivity – and hence wealth – is not enough.

A recent informal review of past and ongoing technological development projects financed by the World Bank features the market failures due to access to unreliable information. This is particularly keen for small and medium enterprises (SMEs) whose sensitivity to asymmetry information is substantial. It suggests a more proactive approach towards awareness and information dissemination, outreach, training for owners and workers of SMEs and, whenever possible, stimulating cost sharing projects with industry. It is advisable that future projects should incorporate those lessons.

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Appendix I: The Brazilian MSTQ infrastructure: an internationally recognized system

The Law that created SINMETRO –the Brazilian National Metrology, Standardization and Industrial Quality System– was, so to speak, peculiar as it addressed an overall integrated system bringing together public and private entities involved and/or affected by all functions of industrial technology (i.e. metrology, accreditation, standards, intellectual property, technical regulation, management's technology and voluntary and compulsory conformity assessment activities). To gain political visibility, SINMETRO (the overall system) was meant to operate under a high level inter-ministerial council, the CONMETRO (*National Council for Metrology, Standardization and Industrial Quality*) which is the normative body of the system (policy maker). CONMETRO provides a high level inter-ministerial forum to centralize policy making. While this choice brings coherence and consistency to the integrated MSTQ system, the decentralization of its operation through INMETRO (the executive body) brings efficiency and effectiveness to it. For instance, under the SINMETRO umbrella, INMETRO implements scientific, legal and industrial metrology providing access to international measurement standards and ensuring measurement traceability to the *Système International d'Unité* (SI) through national *étalons*. The (today internationally recognized) Brazilian accreditation body acknowledges technical competence. Accredited laboratories yield reliable testing results. Certification bodies declare conformity assessment. This integrated model makes provision for the operation of all relevant MSTQ functions without introducing conflicts of interest usually present in this type of multi-functional system. In this sense, the Brazilian MSTQ system is exclusive. Although accreditation is housed in the metrology institute, in order to avoid conflict of interest, conformity assessment bodies (testing laboratories, certifying bodies, inspection bodies etc.) are outsourced.

Accreditation activities are always conducted to ensure transparency and independence of services subject to accreditation (i.e. the accreditation body and bodies seeking accreditation maintain no other relations than those inherent to the accreditation process). Technical regulation is operated in a completely independent and decentralized fashion, removing inherent sources of conflict originated when performed together with other MSTQ functions. This responsibility is assigned to different line Ministries and regulatory agencies, monitored by a Technical Committee under CONMETRO. Technical regulation is essentially a compulsory activity under State responsibility and controlled by a delegated governmental authority. The metrology institute only keeps the legal metrology component of technical regulation –a very specialized type of regulation applied to type approval of measuring instrument used for health, safety, environment and consumers' protection. However, to ensure that no conflict will be introduced, legal metrology is, whenever possible, based on technical recommendations issued by the International Organization of Legal Metrology (OIML). The metrology institute delegates state supervision, market surveillance and application of fines to independent Offices of Weights and Measures under state government control, enforced all over the Brazilian territory. With the implementation of the Brazilian Certification System (CONMETRO Resolution 08, 1992), testing and certification (of products, services, personnel and of quality management and environmental systems) began to be performed by independent conformity assessment bodies (testing and certifying bodies), most of which are private and accredited based on international recognized schemes. The Brazilian Association of Technical Standards (ABNT), a non-governmental and, non-profit making organization, develops, adopts and applies voluntary standards in compliance with the Code of Good Practices (Appendix 3, TBT Agreement). The National Institute for Intellectual Property (INPI), independently operated, grants patents and deals with other related matters.

International recognition of the Brazilian MSTQ system – An integrated system must be a dynamic one –a highly desirable characteristic expected to underpin any activity related

to competitiveness. New standards, sophisticated measuring techniques and conformity assessment activities, which are continuously driven by technological innovation, play a key role in the operation of the multi-functional MSTQ system. Based on practical evidences, the robustness of the MSTQ infrastructure can be measured by the following indicators:

- The Brazilian accreditation body became, in 2001, the first Latin-American signatory of the EA/MRA (Mutual Recognition Arrangement of the European Cooperation for Accreditation of Laboratories). The technical basis for the acceptance of Brazilian certificates issued by Brazilian laboratories in Europe and vice-versa was established;
- The Brazilian National Metrology Institute entered (2001) the BIPM *Mutual Recognition Arrangement for national measurement standards and for calibration and measurement certificates issued by national metrology institutes* signatories of the Metre Convention. This offers an internationally recognized protocol for establishing the degree of equivalence of its measuring system with that of other trade partner signatories.
- Fulfilling the requirements of the *International Accreditation Forum*, the Brazilian accreditation body signed its Memorandum of Understanding in 1995 and successfully entered the IAF/MRA Multi Recognition Arrangement in 1999, after peer-review approval. Similarly, international acceptance of certification of products, quality system, personnel and of inspection bodies will be recognized by all IAF signatory countries.
- In October 1999, the Brazilian Accreditation Body was pre-assessed by ILAC international experts and peer-evaluated in April 2000 to verify its laboratory accreditation function. In November 2000, the Body entered the ILAC/MRA (the Mutual Recognition of the International Laboratory Accreditation Cooperation). This agreement enabled calibration certificates and testing reports issued by calibration and testing laboratories accredited by the Brazilian Accreditation Body to be accepted by all signatory countries (today 45 accreditation bodies of 35 countries participate). Worthy to notice that only 67 out of the 147 WTO member States had their accreditation body as signatories of the ILAC MoU. Thus, the economic benefit translates into the free trade goal *'certified once and accepted everywhere'*. In short, a single certification of a product shall suffice. And as a sign of adequate performance, the accreditation body was recently (2004) re-evaluated by ILAC and had its mutual recognition status renewed for another 4 years.

Appendix II: The Brazilian Experience in Certification

The National Metrology Institute on Metrology, Standardization and Industrial Quality (INMETRO) was designated as the Brazilian *Enquiry Point* meeting requirements imposed by the WTO/TBT Agreement. In Brazil, INMETRO is known as the "Focal Point for Technical Barriers to trade", a vital source of information for entrepreneurs who wish to be aware of technical requirements needed to discipline trade and to avoid unnecessary obstacles to export.

Similarly to the model used in industrialized countries, in Brazil, technical regulation is decentralized through different line Ministries and regulators. In order to overcome barriers, INMETRO offers a manual on Technical Barriers to trade (*What are technical barriers and what to do to overcome them*), a guide to help exporters. As a result of a three-way partnership with the National Industrial Confederation (CNI) and the National Services of Industrial Apprenticeship (SENAI), supported by the Ministry of Development, Industry and Foreign Trade, the manual offers exporters a broad view of what technical barriers are all about. It explains the INMETRO´s role acting as a Focal (*Enquiry*) Point for technical barriers to trade, listing all the international agreements currently valid, plus the available tools for those who wish to overcome the obstacles faced on their exportations.

Functioning as the Focal Point for Technical Barriers to trade for Brazil, INMETRO – responsible for the technical regulation on Metrology and Conformity Assessment –

maintains an updated electronic technical regulation data base. Through a specific link in its web page, INMETRO makes available the full text of 578 legal acts, government resolutions and technical regulations already issued and updated lists of the Brazilian products subject to compulsory certification, therefore controlled by technical regulation. INMETRO today operates 80 conformity assessment programs (70 are of compulsory nature and 10 of voluntary nature). As of November 2006, 198 products are subject to voluntary certification and 90 new products are in process of certification under 52 ongoing projects. The mark of conformity of INMETRO gained recognition within the country and is today widely used in Brazil: 14,100 products exhibit it in the regulated sector and 1,104 in the voluntary domain, involving products manufactured by 4396 firms operating in Brazil. Accredited by the Brazilian Accreditation System (INMETRO), certification is outsourced: (i) 55 certifying bodies operated product certification; 34 operates quality management system (ISO 9001); 20 operate environmental management (ISO 14000); 2 operate planted forest management; 1 operate management of corporate social responsibility and 1 operates HACCP (Hazard Analysis and Critical Control Point). Under the voluntary nature of certification, about 10 quality management system certifying bodies operate independently in Brazil. The complete list of products subject to voluntary certification is also advertised as a strategy to ascend these products to new markets. The information (available in Portuguese) can be accessed through http://www.inmetro.gov.br/rtac/consulta.asp.

While technical papers on the virtues of ISO 9001 ([14, 15]) abound in the literature, frequently regarded as the stepping stone to achieving total quality in the entire organization, management quality system certification remains a controversial issue [16]. Without going into the merits of the subject, official data (Table 3) suggest that certification did contribute to the consolidation of an infrastructure for industrial quality in Brazil.

Table 3. Evolution of ISO 9001 management quality system certification in Brazil.

'Year'	Enterprises Certified	Total Certificates	Total Enterprises	Accumulated Certificates
1981	1	1	1	1
2000	1974	2 343	6 259	7 929
2001	1781	2 069	8 040	9 998
2002	2257	2 582	10 297	12 580
2003	3536	4 285	13 833	16 865
2004	2934	3 316	16 767	20 181
2005	2026	2 260	18 793	22 441
2006	2300	2 542	21 093	24 983[+]

[+]As a reminder, ISO 9001:2004 was replaced by ISO 9001:2000. Brazil allowed 3 years for firms to upgrade their certification. Although in 2006 the total number of ISO 9001 Certificates issued in Brazil added to 24 983, today, 7 280 firms hold 8231 certifications considered valid.
(Source: ABNT CB:25, http://www.abntcb25.com.br/cert9000.html).