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RESEARCH ARTICLE

Managing Innovation under Constraints: A Glimpse on the Brazilian Conditions for Innovation

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Abstract

To generate innovation in Brazil becomes a high level priority in the last two decades. Innovation, according to the Presidential speech, is the right way to conduce the nation towards the development of technological competitive capabilities through the high technology-based products and services. Although the nation has come a long way, Brazil has to face the challenge of overcoming obstacles in infrastructure conditions for innovation. This paper aims to describe the main conditions to manage innovation in Brazil. This work offers a quantitative analysis of the main factors that impact innovation. This is a documental research based on data collected from high reliability international sources complemented by a research field applied to a sample of technology–based firms located in São José dos Campos, Brazil. The results indicated that entrepreneurs deal with difficulties to develop managerial competences in order to manage the business growth while developing new products and services. The lack of qualified human resources to manage business in technological environment is also a matter.

Keywords: *Business management competences, Education, Innovation, Technology-based firms.*

Introduction

Located in South America, Brazil is the only Portuguese-speaking country in the South America region. As the greatest Portuguese-speaking nation in the world, Brazil occupies 47 percent of the South America territory and has about 50 percent of the South American population. In addition to these numbers, the Brazilian economy generates around 52 percent of the wealth produced in the region. As a matter of fact, South America can be properly divided into a Spanish America, a Portuguese America and Guianas; Latin America, by its turn, could be split into a Spanish America, a Portuguese America and Caribbean (Guianas included) countries.

In 2012, the Brazil was ranked as the fourth country in the Foreign Flow of Investment destination, being surpassed by the United States, which received $ 168 billion, China ($ 121 billion) and Hong Kong ($ 75 billion), according to data from Unctad [1]. Despite of this, the country, which is the seventh planet's economy, is still facing serious obstacles to their social and economic development process.

Brazil have come a long way since 1930, when the National Government opted to build an industrialized economy, but only in the last two decades innovation became a strategic issue for the Brazilian industrial worldwide competitiveness. Since then, several initiatives were promoted towards the fulfillment of a National Innovation Policies and Strategies Agenda. The main national regulatory framework has been created and described with the edition of the White Book of Science, Technology and Innovation-ST&I - by the Ministry of Science, Technology and Innovation-MCTI- [2], and the Innovation Law published in December 2, 2004. In 2011, the MCTI assisted by the Centre for Management and Strategic Studies – CGEE, in the fourth edition of the National Conference on Science, Technology and Innovation for Sustainable Development released the Blue Book of Science, Technology and Innovation.

The White Book of Science, Technology and Innovation endorsed the strategic character of

innovation for the development of the country and established the target of 2% of GDP to invest in Research and Development-R&D-to be reached in the period of 2002-2012. In addition, the White Book restructured the Financing without Return Model, involving the creation of 14 Sectorial Funds for Innovation; it also modernized the activities of the National Council for Scientific and Technological Development-CNPQ, with the launching of many innovative programs and projects, and proceeded to reform the Studies and Projects Finance Funding - FINEP, and restructured the credit area of FINEP, strengthening its core activities, such as: increasing financing volume, creating new programs to stimulate innovative projects as Inovar; Progex. The FINEP Award for Technological Innovation, besides the efforts to guarantee the perpetuation of the National Fund for Scientific and Technological Development activities.

The White Book created a permanent debate´s agenda between the scientific society and technological community, through the National Conference on Science, Technology and Innovation, having the coordination of the Center of Management and Strategic Studies-CGEE-towards to overcome innovation bottlenecks [2].

Other initiatives were launched in order to regulate innovation in Brazil, such as Informatics' Law changing and the issue of the Blue Book of Science, Technology and Innovation for Sustainable Development, during the Fourth National Conference of Science, Technology and Innovation, in 2010.

The Blue Book pointed out the key areas to underline the national innovation strategy, namely agriculture, bio-energy, information and communication technologies, health, the pre-salt, and also are quoted and recommendations are made for nuclear technology, Space and National Defense, Future-oriented Technologies and alternative energy sources. These areas are considered priorities to address finance resources regarding Research and Technological Development in the period of 2010-2020. Nevertheless, R&D in Brazil is bounded, at least, by two critical challenges towards the implementation of a high comprehensive innovation policy, which are:

- Enlarging the investments on Research and Technological Development, from 2% of the Gross Production Domestic – GPD – up to 2,5% , from 2010 up to 2020, despite the fact that the primary target has never been achieved so far;
- Applying 10% of the GPD on Education expenditure in the same period of time.

Considering that investments in R&D and Technological Higher Education are pivotal to reach innovation competitiveness, this work paper approaches mostly the constraints to provide technic and technological knowledge to sustain the innovation process, and also describes the difficulties experienced by small and medium sized technology-based firms to overcome the local frontiers towards the gathering capabilities to run business.

Theoretical Foundations

The efforts to create a technology-based industry in Brazil remain from the economic model transition in the early 1930s. But only in more recent decades the country has succeeded to establish a solid and comprehensive innovation policy, defining strategic sectors to develop and financial funding rules for each priority.

These pioneer initiatives allowed creating the infrastructural conditions to install processing industries, mostly related to the production of steel, energy, oil, gas and water and other utilities to attend new industry's needs. It was necessary but not enough condition to supplant the country's global image as one of the largest producers of primary commodities. Challenges to implement an industrial economy were established at that time.

In the 1950s, terrestrial transport systems have been improved to ensure appropriate distribution of manufactured goods to the consuming centers. It would also guarantee the transport of raw materials. Moreover, technological and technical schools were created aiming to offer qualified human resources to the new industries mostly foreigners. In the coming decades, some qualified students would attend the National Research and Development activities and generate the first cluster of high-tech industries related to the aerospace, aviation sector and petrochemical field. All these initiatives would also increase the attractiveness for foreign investment in the country.

The national challenge in this century is to intensify Scientific and Technological Research activities in order to generate a considerable volume of industrial products and applications, a new set of high technology-based industries and a new set of technological exportable goods and to promote national development and competitiveness. However, the last decade has further strengthened the position of Brazil as a strong exporter of primary commodities, as shown on the Table 1.

Table 1: Brazilian share in global exportation, by goods category and technological intensity (2000 up to 2009)

Category of Export Goods/ Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Basic Commodities	2,77	3,12	3,13	3,33	3,57	3,77	3,7	3,72	4,23	4,66
Intensive in Workforce and natural resources	0,9	0,94	0,93	0,96	1,06	1,05	1,06	1,01	0,89	0,78
Low technological intensity	1,18	1,09	1,18	1,27	1,55	1,55	1,37	1,26	1,43	1,15
Medium technological intensity	0,63	0,65	0,63	0,71	0,8	0,94	0,94	0,86	0,87	0,74
High technological intensity	0,52	0,53	0,47	0,4	0,43	0,5	0,51	0,51	0,54	0,49
Other	0,34	0,54	0,64	0,63	0,58	0,67	0,75	0,85	0,85	0,95

Source: De Nigri&Alvarenga [3]

Although the exports of any country is subject to global economic conditions, political interests and rules, Nassif [4] and De Nigri & Alvarenga [3] highlighted that Brazil, since 2005, has lost market share in the categories of technological content´s exportable products and increased the volume of exports in primary commodities, including raw oil.

According to the study conducted by De Nigri & Alvarenga [3], in 2005, the country exported 3.77% of all exports of primary commodities in the world; in 2009, its share rose to 4.66% of global exports of these products. This growth is partially explained by the international trade with China and India, which are experiencing an accelerated process of urbanization and, at the same time, "are not able to produce all food and all the energy we consume in this process. In this way, these countries have contributed, even before the crisis, to the increase in international commodity prices and the growth of the participation of these products in World Trade".

The country had a 0.94% share of medium technology products exported worldwide in 2006. In 2009, this participation has fallen to 0.74%. The market share of high technology products was 0.50% in 2005; was 0.49% in 2009. More recently, the crisis in Arab countries has also contributed significantly to the increase in the price of oil.

The concentration of primary commodities in the national exports is already a fact: from 2007 up to2010, the participation of primary commodities in Brazilian exports grew from 41% to 51%, after having remained at the level of 40% along the decade of 1990. The tendency of strengthening both production and international trade in merchandize of low technological content will condemn the country to a position of economic and technological dependence from developed nations, restricting its national competitiveness [4].

Jayme Jr & Resende [5] consider that "a greater integration into products with higher technological intensity is what can come to guarantee the possibility of long-term growth not constrained by balance sheet payments. That is to say, the inability to do the catching up, countries like Brazil, with a pattern of specialization in foreign trade mainly focused on commodities low-intensity goods, technology and natural resource-intensive goods and workforce-ultimately depends on favorable conditions in external demand to maintain a sustained growth free from external crises".

Jayme Jr & Resende [5] highlight three restrictive factors to the Brazilian economic growth, based on its exports specialization. Firstly, international commodities market is less dynamic than the technologically and sophisticated products. Secondly, commodities are more exposed to the major price changes than technological products because the producer's are essentially price takers. Finally, primary commodities are more vulnerable to protectionist practices, especially in developed countries such as the United States and the European countries. Thus, despite the positive business performance of Brazil since 2001, its external sector remains susceptible to swings in the global economy.

Table 2 presents an analysis of the national production concentration in comparison to the average of the countries that take part of the Organization for Economic Cooperation and Development - OECD.

Table 2: Production and trade commerce on the period 1989 - 2005

Category of Export Goods	International Trade Average - 1989-2005	
	OECD	Brasil
Primary Commodities	16,29	43,16
Intensive in Manpower and natural resources	11,97	10,22
Low technological intensity	7,23	10,45
Medium technological intensity	31,8	22,11
High technological intensity	29,14	13,67
Others	2,52	0,39

Source: Jayme Jr&Resende [5]

Just to clarify, the categories of industrialized products presented in Table 3 enhances such industries as follows, in accordance to the Stan Indicators [6]:

- High-technology industries: aircraft and spacecraft; pharmaceuticals; computing machinery; radio, TV and communications equipment; medical and optical instruments.

- Medium-high-technology industries: electrical machinery and apparatus; motor vehicles, trailers and semi-trailers; some chemicals; railroad equipment and transport equipment; machinery and equipment.
- Medium-low-technology industries: building and repairing of ships and boats; rubber and plastics products; coke, refined petroleum products and nuclear fuel; other non-metallic mineral products; basic metals and fabricated metal products.
- Low-technology industries: manufacturing, recycling, wood, pulp, paper, printing and publishing; food products, beverages and tobacco; textiles, textile products, leather.

The volume of production and export of technological products, over time, provides to a country a gradual competitiveness growth. However, to achieve high volumes of production of technological artifacts, it is essential to establish an on-going process of government investment in education, research and support to entrepreneurs. Table 3presents Brazilian R&D investments in comparison to industrial developed nations.

Table 3: Countries with intense activity in R&D

Position	Countries	GDP in 2011 (US$/ Million)	Expenses in ST&I/ GDP (2009)
1º	United States	15,075.675	2,77%
2º	China	7,298.147	1,00%
3º	Japan	5,866.540	1,54%
4º	German	3,607.364	2,82%
5º	France	2,778.085	2,21%
6º	Brazil	2,492.907	1,17%
7º	United Kingdom	2,431.310	1,87%
8º	Italy	2,198.732	1,27%
9º	Russia	1,850.401	1,18%
10º	Canada	1,738.954	1,92%
11º	India	1,826.811	0,88%
12º	Spain	1,479.560	1,38%
13º	Australia	1,486.914	2,24%
14º	Mexico	1,153.958	0,50%
15º	South Korea	1,116.247	3,37%
16º	Indonesia	846.450	ND
17º	Netherlands	838.112	1,84%
18º	Turkey	774.336	0,85%
19º	Switzerland	660.761	3,00%
20º	Saudi Arabia	597.086	0,30%

Source: UNESCO [7]; International Monetary Fund [8]

Inserted in the biggest 20 economies in the world, Brazilian economy reached the sixth position in the ranking due to the global economic crisis of 2008. But, under certain circumstances to establish an indicator of growth such as an economic position of a nation tends to be fallacious, as well as the level of investments in R&D can be defective as an indicator of trade power as seen in Table 4 below.

Table 4: Worldwide economic positioning versus expenditures on R&D

Country	Worldwide Economic Ranking 2011	Expenditure on R&D (% share of GDP)			
		2011	2001-2010	1991-2000	1981-1990
Israel	40	4,27%	3,62	2,98	n.a.
Finland	36	3,93%	3,52	2,54	1,42
Sweden	21	3,60%	3,73	3,23	2,58
Japan	3	3,44%	3,32	2,92	2,70
South Korea	15	3,37%	2,86	2,16	0,00
Denmark	32	3,02%	2,39	1,85	1,27
Brazil	6	1,17%	1,04	0,85	n.a.
United States	1	2,77%	2,67	2,58	2,62

Source: European Commission [9], OECD [10], Brazil [11]

In fact, many nations define a continuous growth in investment in R&D as a strategy to strengthen national capacities and competencies through the attendance of Defense, Health and other internal needs. Education is a key area to reach effectiveness on R&D investments, especially when a national education plan compromises government and industrial representatives in a long-term commitment.

The National Science Board [12] issued a newsletter highlighting what aspects would be essential to US Competitiveness through innovation, although these factors could widely be applied to any industrial country. In short, US industry and the Federal Government are the primary pillars of financial support for the US Research and Development (R&D) enterprise. The National Science Board observes with concern the indicators of stagnation, and even decline in some discipline areas, in support for US R&D, and especially basic research, by these two essential patrons and participants.

A decline in publications by industry authors in peer reviewed journals suggests a de-emphasis by US industry on expanding the foundations of basic scientific knowledge. In addition, in this century the industry share of support for basic research in universities and colleges, the primary performers of US basic research, has also been declining. Likewise, Federal Government support

for academic R&D began falling in 2005 for the first time in a quarter century, while Federal Government and industry support for their basic research has stagnated over the last several years. R&D would point out other tracks for the development action and define trends and directions for the investments in R&D and outlines the national strengths which will give support for a highly competitive economy.

According to UNESCO [7] in the last decade the investments in R&D worldwide has presented the following average share in relation to the GDP generated:

- 2.6% for North America
- 1.9% for Oceania;
- 1.6% for Europe;
- 1.6% for Asia;
- 0.6% for Latin America and the Caribbean;
- 0.4% for Africa.

With the ratio of 1.04% from 2000 up to 2010, Brazil is the most important investor in R&D considering Latin American and Caribbean. But the highest share that the country reached in the same decade was 1.16% of GDP. Projecting the target of 2.5% of GDP to 2010 to 2010 is much more than a challenge: it calls for a R&D master plan with the commitment of several levels of the Brazilian Society.

Education strategy is a key as well as strengthening technological entrepreneurship capacities. Moreover, Scientific and Technological Knowledge are essential forces to support R&D activities; it is mandatory to alignlocal public policies with a long term view of the regional economic development, and also essential to

establish educational policies in order to enable the workforce to new job demands which will impact on the type of society that will be built over time. It is essential to regulate the use of natural resources since they are assets that can define the attractiveness of a region for the development through foreign investment. In short, a very comprehensive action plan has to be created aiming to build an innovative-based economy.

Despite the efforts to create scientific knowledge, the national government has to overcome crucial constraints to transform knowledge into competitiveness. Scientific knowledge is an essential condition, but not enough to lead a country to an industrialized and competitive economy. According to World Economic Forum [13].

Many determinants drive productivity and competitiveness. Understanding the factors behind this process has occupied the minds of economists for hundreds of years, engendering theories ranging from Adam Smith's focus on specialization and the division of labor to neoclassical economists' emphasis on investment in physical capital and infrastructure, and, more recently, to interest in other mechanisms such as education and training, technological progress, macroeconomic stability, good governance, firm sophistication, and market efficiency, among others. While all of these factors are likely to be important for competitiveness and growth, they are not mutually exclusive - two or more of them can be significant at the same time, and in fact that is what has been shown in the economic literature.

National Competitiveness Capabilities

The Global Competitiveness Index 2012-2013, calculated by the World Economic Forum has pointed out the weighted average of different components of the countries worldwide competitiveness expressed through twelve pillars, which are presented in Figure 5:

Within each module there is a group of indicators that, in turn, is consisted by indexes. The results of each indicator consider the average performance of other countries. This average sets the ranking and indicates what type of economic model characterizes the country.

Having the Economic Theory as a theoretical reference, it is possible to distinguish the three different stages by some particular economical aspect. For instance, a factor driven economy is mainly characterized by the primarily low-skilled labor and intense usage of their natural resources.

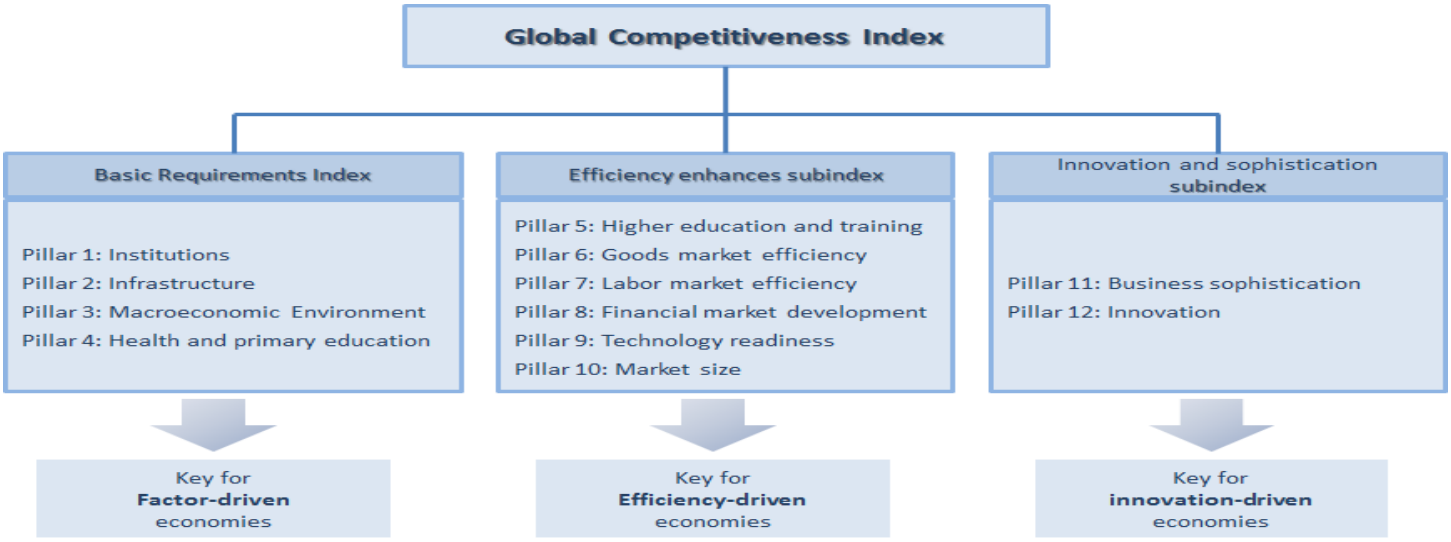

Fig. 5: The global competitiveness index framework

Source: World Economic Forum [13]

According to the World Economic Forum [13] in this stage of development, "Companies compete on the basis of price and sell basic products or commodities, with their low productivity reflected in low wages. Maintaining competitiveness at this stage of development hinges primarily on well-functioning public and private institutions (pillar 1), a well-developed infrastructure (pillar 2), a stable macroeconomic environment (pillar 3), and a healthy workforce that has received at least a basic education (pillar 4)".

As a consequence of development, countries whose economy are in stage 2, efficiency-driven, run for gathering more efficiency to the industrial processes and gradually have to increase the quality of the products. Efficiency can properly respond to the salaries growth when the related costs can´t be transferred to the product prices.

At this point, competitiveness is increasingly driven by higher education and training (pillar 5), efficient goods markets (pillar 6), well-functioning

labor markets (pillar 7), developed financial markets (pillar 8), the ability to harness the benefits of existing technologies (pillar 9), and a large domestic or foreign market (pillar 10) [13].

And finally, at stage 3, country´s economies follows the route of innovation due to the industrial learning curve, what means, the industrial competence has reached a high level as well as the wages and manpower qualification. As a consequence, along with the salaries growth, the risen of living standards will demand for new or unique products what will push companies to compete through innovation in products, services, models and process.

At this stage, companies must compete by producing new and different goods through new technologies (pillar 12) and/or the most sophisticated production processes or business models (pillar 11) [13].

According to World Economic Forum [13]

Two criteria are used to allocate countries into stages of development. The first is the level of GDP per capita at market exchange rates. This widely available measure is used as a proxy for wages, because internationally comparable data on wages are not available for all countries covered. […]. A second criterion is used to adjust for countries that are wealthy, but where prosperity is based on the extraction of resources. This is measured by the share of exports of mineral goods in total exports (goods and services), and assumes that countries that export more than 70 percent of mineral products (measured using a five-year average) are to a large extent factor driven

The calculation system used by World Economic Forum allows the identification of intermediate levels of development. Thus, according to the World Economic Forum study [13], some of the countries studied are located at the following stage of development:

- **Stage 1**: Factor-driven: 38 countries, such as Ethiopia, India, Pakistan and Zimbabwe;
- Transition from stage 1 up to 2: 17 countries, such as Algeria, Bolivia, Saud Arabia and Venezuela;
- **Stage 2**: Efficiency-driven economies: 33 countries, such as China, Colombia, Thailand and South Africa;
- Transition from stage 2 up to 3: 21 countries, such as Brazil, Chile, Mexico and Poland;
- **Stage 3:** Innovation-driven economies: 35 countries, such as Belgium, Finland, Republic of South Korea and Portugal.

According to World Economic Forum [13], Brazil is on the border of the countries whose economic development is based on innovation. But, to reach competitiveness through innovation, Brazil has to overcome numerous constraints. However, diligently, the Government could establish the solutions around the problems estimated as the hardest to cope in conducting business in the country. Based on the World Economic Forum [13] analysis, the most problematic Brazilian factors are: tax regulations (18.7); inadequate supply of infrastructure (17.5), tax rates (17.2); inefficient government bureaucracy (11.1); restrictive labor regulations (10.1); inadequately educated workforce (7.4); corruption (6.0); access to financing (3.9); foreign currency regulations (2.1); insufficient capacity to innovate (1.8), others (3,1).

Table 6 gives a picture of countries competitiveness in each stage of economic development.

Table 6: Global competitiveness index – a sample

Stage	Country	General Score 2012 – 2013	Basic Requirements	Efficiency-driven	Innovation-driven
1	Ethiopia	3,55	3,74	3,33	2,96
1	India	4,32	4,26	4,48	3,94
1	Pakistan	3,52	3,41	3,71	3,47
1	Zimbabwe	3,34	3,46	3,22	2,94
1-2	Algeria	3,72	4,22	3,08	2,31
1-2	Bolivia	3,78	4,15	3,35	3,28
1-2	Saud Arabia	5,19	5,74	4,84	4,47
1-2	Venezuela	3,46	3,54	3,46	2,78
2	China	4,83	5,25	4,64	4,05
2	Colombia	4,18	4,4	4,13	3,58
2	Thailand	4,52	4,89	4,38	3,72
2	South Africa	4,37	4,28	4,53	3,94
2-3	Argentina	3,87	4,15	3,84	3,36
2-3	Brazil	4,4	4,49	4,52	3,97
2-3	Poland	4,46	4,66	4,69	3,66
2-3	Mexico	4,36	4,64	4,31	3,79
3	Belgium	5,21	5,52	5,09	5,21
3	Finland	5,55	6,03	5,3	5,62
3	Korea Rep.	5,12	5,66	5,00	4,96
3	Portugal	4,4	4,96	4,4	4,01

Source: World Economic Forum [13]

Although the factors were analyzed under the attractiveness perspective for foreign investment in the productive industry, under the local perspective, these problems also hinder the national entrepreneurship, especially in high-tech sectors, which are confined to a fairly limited set of industry sectors such as aerospace, petrochemical and information and communication technologies, and a few products in the optical field. On the other hand, 68 percent of the GDP, in 2011, referred to services, included those related to high technology.

A brief analysis of the detailed composition of each pillar that takes part in the Global Competitiveness Index which took into consideration 144 nations, looking back the Brazilian case it is clear how tough will be the transition from level 2 to level 3. In relation to the Brazilian score positioning, according to World Economic Forum [13].

Entering the top 50, Brazil goes up five positions to attain 48th place on the back of a relative improvement in its macroeconomic condition—despite its still-high inflation rate of nearly 7 percent and the rise in the use of ICT (54th). Overall, Brazil's fairly sophisticated business community (33rd) enjoys the benefits of one of the world's largest internal markets (7th), which allows for important economies of scale and continues to have fairly easy access to financing (40th) for its investment projects. Notwithstanding these strengths, the country also faces important challenges. Trust in politician's remains low (121st), as does government efficiency (111th) because of excessive government regulation (144th) and wasteful spending (135th). The quality of transport infrastructure (79th) remains an unaddressed long-standing challenge and the quality of education (116th) does not seem to match the increasing need for a skilled labor force. Moreover, despite increasing efforts to facilitate entrepreneurship, especially for small companies, the procedures and time to start a business remain among the highest in the sample (130th and 139th, respectively) and taxation is perceived to be too high and to have distortionary effects (144th).

The data of the World Economic Forum (2012) calls attention to the problems and the ranking obtained in each indicator helps to establish a prioritization, enabling the preparation of a plan aiming adjustment. What is fact is the difference between the process of economic development of the nation and the process of overcoming restrictive factors which would accelerate the pace of this development towards the economic growth.

The competitiveness of a nation depends on numerous factors. The strength of a nation's economy is determined mainly by the availability of natural resources, capital stock available (machinery, equipment, installations, etc.) and the level of qualification of its workforce. However, the wealth of a nation is a competence accumulation process, progress-oriented, establishing an industrial and technological learning curve. The technology establishes how the natural and constructed factors can be combined to produce goods and services.

The technology is an exogenous factor of development, being related to the simple and natural evolution of markets, which respond to the growth of savings and investments. For Schumpeterian authors, entrepreneurs are the main force for economic growth. In addition, neo Schumpeterian authors state that technological change is one of the greatest forces to promote competitiveness and social progress. Anyhow, at this point, technology, markets and entrepreneurs are the strengths do reach competitiveness and progress of a nation.

The base of the production cost reduction occurs along the improvement in the technology applied and the quality of the workforce, mainly at technical level, which is strongly related with the quality of primary and college education.

The accumulation of production efficiency is the foundation of technical progress, which occurs when there is an increase in productivity as a result of the implementation of new techniques, methods and means to the productive process, reducing the amount of direct and indirect employment of the worker [14].

The concentration of technically-oriented activities, the manufacture of production equipment, gain efficiency and, as a result, the increase in market create ideal conditions for the emergence of technological progress, which can be explained as being

The path of the default template of normal troubleshooting activity, within a given technological paradigm sets its own concept of progress, on the basis of your choices in technology trade-offs and economic. {…} every step, seeks to solve the problems of the previous choices, which opens a new horizon. {...} Thus, a technological paradigm must have clear definitions about the direction of the technical changes to be persecuted and similarly clear

definitions concerning which should be avoided [15].

In turn, the technological development is a driving force of scientific progress, since, not only occurs in a linear and cumulative, but through deep changes of perception of the world by the scientific community as a whole, which occur from time to time: the so-called scientific revolutions [16].

In Economics the changes also occur in a revolutionary path [17-19]. Nevertheless, due to the evolutionary character and the knowledge-dependency, the essential changes are related to the peaks of technological and scientific development [20].

So, for joining a restricted group of economies based on innovation, it is necessary to establish a strong alliance between the sectors of industries such as producers of new products launch customers in the market, technological and educational institutions of basic research, as generators of new knowledge, the Government as promoter of innovations developed and the risk taking by the entrepreneur.

Anyway, the consensus among several authors leads to the belief that the economic and scientific progress are results of a cumulative process of knowledge and industrial capabilities, represented by its tangible and intangible assets which, in addition to the local factors and resources, will develop the innovative technological competences.

Considering the strength of the market as the dynamo of the economy, it is expected that a country that is on the border to be recognized as an economy driven by innovation would present strong results in export of products with technological content. But, this still is not a fact that features the Brazilian economy, as is shown in the Table 7.

Table 7: Brazilian Export Goods

Export Goods Cathegory	1995	2000	2005	2010	2012
Basic Commodities: crude oil, iron ore, copper ore, coffee beans, other	23,59	23,60	29,53	44,27	47,71
Semimanufactured goods: iron and steel, aluminum, raw sugar, other	19,87	15,26	13,72	13,81	13,26
Manufactured goods: Oxides and hydroxides of aluminium, plastic polymers, fuels and other oils.	55,06	58,10	54,73	39,74	36,74
Special Operations	1,48	3,04	2,02	2,18	2,29

Source: Brazilian Ministry of Industry Development and Foreign Trade [21]

The production and export of primary commodities growth, as seen in Brazil, tends to increase the country's role as a provider of food for the world, which gives the occupation for the immense tracts of land farming, but adds little technological value to national production. The focus on agricultural production divides the country into niches; limiting the need for technical knowledge and advanced technology to the local society, creating inequalities to the social development that are difficult to overcome such as Education.

Although the Brazilian education is reaching the goal of reducing illiteracy, the quality of the educational process has proved to be a challenge to be faced. According to the Brazilian Institute for Geography and Statistics-IBGE, in the 1950, 57.2% of the Brazilian population, over age of 5 years, was formed by people who didn't know how to read and write. In the 1960, this number dropped to 46.7 percent at the same age group. In 1970 the number of illiterate Brazilians was 38.7 percent. Ten years late illiteracy would reach 31.9 percent of Brazilian population. In the beginning of 90s, this number would drop again, reaching 25.1 percent of the Brazilian population at the age of 5 years and above.

From 2000 on, the literacy effort, with the creation of programs to reduce evasion of students of primary education, the number of illiterates was 16.7 percent, with a strong concentration of elderly illiterate people.

Following the international standards, the illiteracy data disclosure considered the age group of 15 years and above. With this, the percentage of illiterate Brazilians dropped to 13.63 percent in 2000, which amounted to 16,294,889 inhabitants. In the following decade, a further reduction would put this rate at 9.6 percent, i.e., 13,933,173

Brazilians fully illiterate citizens. The reduction of illiteracy in Brazil is positive, but, in fact, it is not optimistic. According to the IBGE's 2010 Census, just over one-third of the total number of illiterates in Brazil is formed by the elderly people. Around 60% of Brazilians illiterate people are formed by young people and working-age adult and potentially consumers [22].

Entrepreneurship as a Technological Strategy for Economic Growth

In the late 2000, State Governments have launched legal apparatus for technology-based business incubators and Science Parks aiming to regulate and stimulate the generation of new technological developments.

National Association of Entities for Promoting Innovative Enterprises-Anprotec, created in 1987, operates towards the promotion of training activities, coordination of public policies and political affairs regarding the generation and dissemination of knowledge.

Anprotec describes a business incubator as a locus of support for the development of new businesses and ideas and that, therefore, provides the necessary infrastructure and support to entrepreneurs for business management, aiming to reach enterprises competitiveness. Obviously, competitiveness is a desirable condition but that will eventually be achieved in response to the company's ability to generate innovative solutions, which determines the development of a learning curve.

In 2011, Anprotec, along with the Ministry of Science, Technology and Innovation (MCTI), held a national survey that identified the existence of 384 incubators in operation, that support 2,640 small sized firms that have generated over 16,394 job positions. These incubators have graduated 2,509 venture firms that reach about R$ 4.1 billion per year and employ 29,205 people. From this amount of graduated firms, 98 of the incubated companies are innovative: 28 innovates focusing local needs and applications; 55 attend national needs and 15 are focused on the worldwide needs [23].

The enterprises of technological basis-EBT- are highly dependent on financial support throughout their life cycle, from conception to launch, business support, in its maturity [24]. Saxenian [25] pointed out that, in the sector of products of National Defense, Government purchases accounted for about 20 percent of the revenues of the EBT´s located in Silicon Valley and Route 128, in the United States of America. Thus, the Government's financial support is critical to the survival of EBT, outlining the economic sustainability of the innovation process.

A survey carried out by Tumelero [26] based on the analysis of a sample of 92 technology-based firms selected from a population of 1025 graduated technological enterprises in Brazil reveals that, in the sample, technology-based companies that have accessed financial support from government and infrastructure support from technology-based incubators, were able to generate the first innovation in product or service launched, but they failed to maintain the innovative process. After they graduated from technological incubators, they just managed to achieve incremental changes in products and services.

Another recent research developed by Pereira et al [27] concerning to teaching innovation in higher education schools of business in Brazil, reveals that the issue "innovation" is still not a priority in business management courses and related, which creates a considerable difficulty for future managers and entrepreneurs to manage technology-based companies and also creates a gap in their managerial skills, "reducing their capacity to apply Management Theories into innovative business environments".

Finally, according to the most important supporting agency for micro and small business in Brazil [28] "the micro and small enterprises account for 99.23% of Brazil's enterprises and employ 14.8 million Brazilians with formal employment in urban centers".

Although there are obvious signs of progress in launching new businesses, the Brazilian bureaucracy is a major obstacle. The time of opening of companies has been reduced in recent decades, but even today, it is a big problem to be resolved. The time consumed for opening a business in the country may reach 119 days. In 2007, the time for opening business in Brazil was 152 days. In the World Bank´s ranking, Brazil was placed in 179positionconsidering the time taken to open a firm in a group of 183 countries. In the ranking of World Economic Forum, the country occupies the 139th position in 144 countries studied.

Briefly, the characteristics of entrepreneurship in the country has changed, indicating an effort to the sophistication in business, products and services, that is recognized in international

reports. However, maybe the biggest challenge to reach competitiveness through entrepreneurship is to overcome obstacles. They are mainly related to education bureaucracy and access to financial resources and markets.

In this theoretical review, it was possible to examine some of the main factors for evaluating the innovative capacity of a country, and the status of the economy transition from a natural resource-based exploitation model to an economy driven by knowledge. Leading the national economy to a high competitive level requires defining a gradual pace of technological development of its industrial capabilities. Factors such as basic education, technological education, and professional training are pivotal. But, in despite of the fact the outside view allows us to compare the elements of analysis among different countries, it does not clarify how technology-based entrepreneurs perceive the virtues and constraints of the national supportive programs. Thus, the theoretical review rises up the parameters to analyze the economic transition, but reveals just a few of the difficulties experienced by local innovators. So, it seems appropriate to focus this research on the local entrepreneurs' perspective.

Methodological Procedures

Due to the historic character of the national efforts to build innovative capacities in Brazil, the chosen research strategy had to be outlined by a qualitative approach. Besides, a quantitative analysis, aiming to explore different aspects of worldwide industrial competitiveness, based on the economic transition model seems to be an appropriate path to compare Brazilian efforts for innovation and competitiveness with other nations that have been struggling to build up strong economical foundations. Therefore, this present research is underlined by both quantitative and qualitative approach.

To enrich the local perspective, a field survey based on questionnaires applied to a group of small and medium sized companies, which attends high technology-based industries, was added to this study. Those participants represent 43% of the Local Production and Export Firms Arrangement, which are characterized by their association to a local business incubator, located in the region of the Paraiba River Valley, São Paulo State, Brazil, whose focus is to provide synergy between Government, Educational and Research Institutions, and Private Enterprises.

Research Findings

The following tables describe the profile of the group of companies that responded to the survey, in categories of data arranged in the form of a self-directed questionnaire.

- 77.8% of the respondent companies have more than ten years of activity. According to the criteria of Sebrae, these companies can be considered as mature firms.
- 100% of the companies are located in São José dos Campos, characterizing the developments that are typically regional.
- Mostly questionnaires respondents have accountability for business results as owner or partner (55%); managers (33%);
- The group of participants was mostly formed by service firms. Industries accounted for one third of the sample; two thirds of the participants carry out activities in the sector of specialized services.
- Branch of business activity: 100% of the firms were identified as high-technology companies. They attend: aerospace sector exclusively (55%); aerospace and health (11%); Militarily Critical Technology (11%); automotive industry (11%).
- Based on the criteria of number of employees: 55% of participants are micro and small sized firms (up to 49 employees), 33% are medium sized companies (up to 499 employees).
- Based on annual incomes, 22% of the participants declare to achieve up to US$ 0.7 million in revenues; 33% make up to US$ 6.6 million, and 22% declare to reach over US$ 6.6 million.

The profile outlined by this particular group is characterized by the predominance of the bond business relations with the aerospace supply chain. On this, we observe that, given the maturity of organizations that comprise the researched group, whose age weighted average is 17.5 years, one can infer that the operational links are already established. However, the innovation effort can be inductively associated with the search for sustainability in new sectors of the industry or in new industries, new markets, and new processes and products.

Entrepreneur's Expectations

Asking about what the expectations of the affiliated companies had in relation to the Association, 71% of responses indicated the firms were looking for guidance and counseling in business management. 28% affirmed they use the information bases for technological upgrading.

Other factors that show up at least in one answer were related to other opportunities such as: Training, Development of project sharing; shared services; sharing Research Funds, Laboratories and Product Development; Agreements with Research Centres, Government and Universities.

Regional Attractiveness

More than one factor was raised up to justify the region as a cluster of opportunities to develop enterprise´s technological skills, such as: the quality of the labour force and professional training (22%); technology or the extent of operational effectiveness (18.5%); operational efficiency (14,8%); innovation capability (14,8%); information and resources for environmental scanning to control the strategic planning (11%), investment in new business (7%); public partnerships, responsible for financing, with private, responsible for idea´s conception (7%); vertical production integration (4%).

Access to Financial Funds

56% obtained funds through national financing funds, in 10 different opportunities. The funds mostly accessed are: FINEP - Studies and Projects (40%); BNDES (National Bank for Economic and Social Development) (40%);CNPq(10%); FAPESP (10%).

Managing Strategic Partnerships

77.78% of the responses indicate that the firms use some kind of strategic partnership, and it was possible more than one response per company. From the group of companies that adopt partnerships, they are realized through the following approaches:

- Joint Ventures are the partnership approach for 25% of the respondents. 3 companies declared their strategies: one mentioned to establish joint ventures only with domestic firms; one said to deal with international companies for joint ventures, and, finally, a third company uses a partnership approach in both cases;
- Partnership with R & D centresin Universities: 25% of the approaches;
- Strategic Alliances for brokering sales: 25% of the approaches;
- Cooperative Agreements with competitor: 8.33%
- Partnership with R & D centres of companies: 8.33%
- A consortium of companies “to meet the market”: 8.33%
- Membership in APL Aerospace CECOMPI: 8.33%

Difficulties to Run the Business

This question aimed to identify the critical aspects of the enterprise management. It was given an average of 2.4 answers by each respondent firm. Results pointed out the most crucial difficulties the entrepreneurs experience so far: Finance Management (23%); Strategic Planning Implementation (18%); Products or Services Import and Export (14%); Business Management and Sales (14%); Innovation and Technology Management (10%); Business Scenario Analysis (9%); National Economy (5%); Products or Services Certification (5%); Process Implementation (5%).

Although other factors have stood out, the most critical factor is the management of financial resources. A joint effort to develop skills for managing financial and capital markets, including the search of resources for development, may prove promising for overcoming the difficulties reported by study participants.

How to Overcome Difficulties

Although a relative dispersion in the solutions presented, which is compatible with the different views of the potential for generating revenue from a service company and an industrial company, there was a larger settlement by targeting financial and tax incentive. Results indicated this dispersion:

- Public and Private Funding Access 23%
- Fiscal Incentive Granted by Local or Regional Government 23%
- New Customers Development 18%
- Professional Training and Development 14%
- Products and Services Commercialization 14%
- Managerial Consultant 9%

Two other issues also highlighted in the survey relate to training and professional qualification, indicating the perceived need of above-mentioned training in business management expertise, including expertise in the market. This question reflects the perception of support coming from the Technology Park, technological or institutional environment and entrepreneurs.

Path to Business Growth

- This analysis concludes this study. Its goal was to evaluate how the entrepreneur perceives the future vision of his/her firms, outlining the process as a referral to the internationalization of business, the contours macro political data and ambiance of this business market. It was applied a scale grade from 1 – low intensity – to

5-high intensity. From this scale a weight average (WA) has been obtained in each process.

- Association or strategic alliances with foreign companies (WA 3.89);
- Exports: Goods or Services Hi-tech (WA 3.56);
- Participation in international projects (WA 3.44);
- Direct Export (WA 3.00);
- Partners technological risk (WA 3.00);
- Research Centre (interactions) (WA 2.89)
- Participation in fairs (WA 2.78)
- Participation in joint ventures or cooperation agreements (WA 2.78)

By the position of the Weighted Average (WA), these actions reveal a potential for use as a collective strategy, which find an echo in the expectations of the group, making it a suitable platform for launching the planned actions towards the long term. Regarding the strength of the relationship in the chain and the impact caused by the big company that holds the coordination of the productive and services, the expectations were relatively low [29-30].

Conclusions

The results obtained in this research pointed out that, in the case of the local technological sector entrepreneur, even though technically qualified to attend technological requirements to develop new products, they deal with difficulties and budget constraints to properly launch new products to the market and even to reach new markets abroad. When they manage these difficulties they have to deal with another constraint which is to produce new products in large scale. Large scale production can drop operational costs, but calls for big investments. Being small, according to the results, exposes small firms to the risk of a high dependency level of the biggest companies that leads the supply chain they are inserted in.

Technological entrepreneurs claim that the biggest difficulty they face is to manage the business growth. They particularly miss marketing and finance competences. The difficulties can be explained by the fact they are directly engaged with the generation of products and services, which is time consuming. From time to time, a technology-based entrepreneur has to make a tough decision: transferring its innovation to a big company with marketing skills are already consolidated; or taking part in a supply chain; and the hardest decision, to see his/her enterprise fading away along its invention and with the whole investment made.

Other difficulties have been pointed out. In short, the circumstances like public services bureaucracy to open/close/run business is a problem. What seems to be a national natural competence – primary commodities production – reinforces the image of the country as the breadbasket of the world. High rates of taxes on industrial production and marketing are also factors that constrain the provision for creation of innovative business.

However, the country faces some of its biggest constraints in the social aspect: problems of supplying skilled labor force in the technological area is in the border of generating a so-called manpower blackout that will certainly cause such enormous difficulties to transit to a high technological content production economy.

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