Strengths and weaknesses of Bogotá as an innovation hub: Towards the governance of the regional innovation system.

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Abstract

Bogotá is facing constraints implemented in order to strengthen its innovation capabilities and to institutionalize itself as a Regional Innovation System (RIS). Even though the city has the largest number of Higher Education Institutions (HEIs), research institutions, and technological development centres in Colombia, it is not yet positioned as an RIS. It will be necessary to do an organizational redesign in terms of the entities that comprise Bogotá and thereof its governance.

The main key players of each environment were identified based on the primary role played by the different system elements. A comparative analysis was developed over time (evolution) and space (with other countries and levels of excellence) of some successful innovation cities through a methodology called *Innovacities.* This methodology allowed for identification of the size of the backlog confronted by the city at the frontier of technological development worldwide and the most critical factors needed to generate the breakthrough innovations to achieve world-class level.

Keywords

strategic innovation
regional innovation system
Colombia

Introduction.

The main objective of this article is to present the outcome of a research financed by la Universidad del Rosario, carried out in order to identify the capabilities of Bogotá as an innovation hub, and thereof, as a contributor towards and the driving force behind the modernization of the productive sector of the Colombian economy as a producer of high-value-added technological products, through incorporating digital-enabling economies.
The research is framed in the context of the new *Plan Nacional de Desarrollo 2010–2014*/*National Development Plan of Colombia 2010–2014* (DNP, 2010), *'prosperidad para todos'*, (prosperity for everyone) in which the issue of science, technology, and innovation is considered as one of the engines of growth for the social, economic and technology development of the country (DNP, 2010). This is the first time that a Colombian ruling party has made a clear-cut proposal giving priority to a subject that in the past was almost completely ignored, or at least was not as important as expected by the academia and research community.

According to estimates of the Science and Technology Observatory of Colombia, (OCyT, 2011), the net national investment in research and development (R&D) activities is less than 0.2% of the Gross Domestic Product (GDP). The DNP 2010–2014 is seeking to reach at least 1% of the GDP in the coming four years. For this purpose, a major reform was introduced in the so-called *Ley de Regalías* (Royalties Law) that regulates mining and energy-sector exploration, and exploitation royalties by both national and international investors. According to this law, 10% of the yearly resources (around US$ 500 million) will be invested for the sole purpose of promoting and fostering scientific and technological development and innovation, mostly at regional level.

Bogotá concentrates the largest economic activity of the country, and it is expected that the city will be one of the regions that takes advantage of this new condition. However, as the findings of this investigation show, research and technological development capabilities and local endowments are still far from being world-class players. One of the key findings of the study is that the city lacks an organized innovation system, which is hindering it on the road to becoming the Colombian innovation-driver, as compared with the best practices of other cities with similar conditions in other developing regions.
Regarding such developments, it is worth asking, 'Quo Vadis Bogotá?' (Where is Bogota going?) This is because everything seems to indicate that the city is suffering from what one could call a *paradigmatic sclerosis*, which is hampering it from assuming an accelerated rhythm towards innovation as a *sine qua non* of the new knowledge-based economy.

This article has been organized as follows: first, the background and methodology of *Innovacities* are presented. Second, the main features of Bogotá in research, development and innovation are described. Third, the main outcomes resulting from the application of the methodology are analysed. Finally, the gaps and how to reduce those gaps are proposed.

1. Background

Rapid technological change represents a series of opportunities and challenges for society and for countries' production structures. Those countries which do not succeed in adapting to the transformations imposed by new technologies, especially in industry, agriculture, health, environment, energy, and education, run the fatal risk of lagging behind in terms of

development and welfare. In particular, the so-called digital and technological information separating those countries from the industrialized world is becoming greater (Pineda, 2011; Scheel and Rivera, 2013).

From an economic point of view, the key and repercussions of this process lie on the greater importance acquired by technology as a value production factor, due to the changes which have been made possible through issues such as the nature of the goods being produced, the market, and international competition. All the foregoing has been accompanied by (and has mainly been a consequence of) the increased *technological content* of goods and services derived from scientific knowledge, advanced design concepts, intelligent materials, automation, software, advanced service concepts, and medical and biological discoveries.

It is considered that innovation plays a central role in different economic processes within the *new economics of knowledge*, as pointed out by Bessant and Dodgson (1997), Edquist (1997), Gartnett, Jr (1999) and Pineda (2011). Furthermore, there is evidence at macro level that innovation is the dominant factor in international competitiveness and thereby in national economic growth and in determining world trade patterns. R&D (resulting in innovation) at micro level (within firms) is considered to be a factor which improves firms capacities to absorb and exploit all types of new knowledge, not just technological know-how, but also how to improve and maintain their competitive position (Soete, Bart and Bas, 2009).

Innovations frequently occur as a result of a linking interaction between multiple elements, rather than the effort of an isolated individual (Håkansson, 1987; Von Hippel, 1988; Lundvall, 1992; Nelson, 1993; Cooke, 2003). This conforms to a Schumpeterian view of innovation as a new mix of already existing knowledge with organizing production processes and as entering new markets in unconventional ways by improving or redesigning goods (Schumpeter, 1934).

All of this confirms not only the acknowledgment that organizations are unable to compete as isolated agents but also that a systemic approach is needed in order to shape the innovation process. Governance and proper regional conditions are the key factors regarding the interaction of different players and regional conditions in a cluster organization. A mature region produces a continuous flow of innovations, provides many mechanisms for bringing such innovations from the laboratory to the market, and has a rich network of structures facilitating and supporting such a process. The result is a constant flow of new ideas which become transformed into new high-value-added business.

The objective is to strengthen regions' R&D capacity in technology and strategic innovation so that they can attract or retain highly-qualified personnel and technologically-advanced activities in the region's production sectors. In addition, assisting other regions by fomenting innovation could result in local economy diversification and a highly valuable specialization.

Scheel (2011) and Scheel and Bretones (2011) proposed the following actions within such context:

- Strengthening regions' physical and 'smart' infrastructures for R&D related to technology and innovation;
- Supporting the creation or development of R&D in a technology and innovation capacity (agreed upon together between the Colombian State and technology-based regions) focused on a small number of research fields and for a small number of research centres (including universities);

- Sustaining the creation of regional conditions needed to support the linking of the industrial growth of the region with the impact on its natural resources and adjacent territories; and
- Prioritizing pre-competitive R&D in technology and innovation considered important for broadening the regions' economic potential. This also favours investigation having a direct relationship with natural resources endowments and the region's and adjacent regions' specific environmental conditions.

2. Methodology

Analysis of the RIS is conducted under the methodology *Innovacities* (innovation as a competitive advantage of cities-regions). The term was defined as:

> [A] geographic space with nurturing regional conditions and resources that empower citizens, entrepreneurs, policy makers, academics and bankers, with the proper relationships and capabilities, to constantly look for high-value opportunities so that they can generate, attract and share extraordinary benefits with everyone. (Scheel, 2011: 375).

This methodology was developed by Scheel, as a result of research conducted between 2007 and 2010. The study found how a selected group of cities became world-class innovative cities (Scheel, 2011). Two groups of findings were determined: first, the *city's behaviours*, which in most of the cases were disruptive performances but which empowered the cities to reach outstanding levels of competitiveness, social development, political maturity and environmental balance. The second group was *breakthrough innovations*, also known as the main drivers. They were produced, implemented and maintained by the city's stakeholders. The first group description will be developed as follows:

2.1. Innovation performances

Scheel and Bretones (2011) summarized the following outstanding behaviours, (products of the cities that have made innovative breakthroughs), and categorized the following 'disruptive performances' that those cities developed during a specific period of time.

For methodological purposes these features have been divided into two groups: the first describes those factors that characterize the regions for their social, political and eco-friendly environment; the second is related to those factors that are measured by the ability of the regions to generate significant *economic* capital. The first group is composed of six factors, which are described below:

1. To achieve high standards in **quality of life**, the following indicators were commonly identified:

- *Regional security levels*:
  - ✓ Violence and Security Index.
  - ✓ Crimes related to the use of violence per 100,000 population.
- *Confidence levels in the region*:
  - ✓ Corruption and Accountability Index.
  - ✓ Level of compliance with laws.
  - ✓ Business climate.
  - ✓ Vulnerability and Adaptation Index.
- *Inclusive society*:
  - ✓ Nutrition and Human Development Index.
  - ✓ Level of malnutrition.
  - ✓ Indicator of income inequality within a country.

- ✓ Employment and unemployment rate.
- ✓ Poverty rate.
- ✓ Commuting time.
- ✓ Nutrition and organized sports.

- *Unmet human needs*:
  - ✓ Coverage of public services (in number of Million inhabitants).
  - ✓ Percentage of urban population living in poverty.
  - ✓ Rate of education coverage.
  - ✓ Health Index.

2. Existence of **urban planning** aligned to the equitable growth and sustainable quality of life of the region, which is measured by:

- *Territorial infrastructure of the region*:
  - ✓ Transportation and recreation alternate system (space for bikes, cycle tracks, etc.).
  - ✓ Excellent urban and inter-regional transportation system and full connectivity with other population centres.
  - ✓ Territorial accessibility (airports, bus station, seaports, etc.).
  - ✓ Distribution and appropriate location of industrial areas (industrial parks).
  - ✓ Road and rails quality and dimensions, adequate and efficient.
- *Sustainable community and housing planning*:
  - ✓ Quality of urban infrastructure oriented mainly towards an inclusive and sustainable urban infrastructure.
  - ✓ Urban planning designed according to a social plan and sustainable quality of life.
  - ✓ Well-structured emergency and disaster response programs.
- *Green areas maintained and spread to all sectors of society*:
  - ✓ Hectares of green areas per 100,000 inhabitants.
  - ✓ Green areas, parks, social interaction and intramural activities excellently maintained.

3. Programs of **environmental awareness** that are achieved through:

- *Sustainable Environmental Management*:
  - ✓ Improved facilities for public health.
  - ✓ Percentage of urban population that has a collection system for solid waste.
  - ✓ Percentage of recycling urban solid waste.
  - ✓ Concentration of PM10.
  - ✓ Emission of greenhouse gas measured in metric ton per capita.
- *Environmental policy implementation*:
  - ✓ Zero Waste Programs.
  - ✓ Planning adequate and effective management of water and lands.
  - ✓ Development of suitable programs for disposal, transportation and recycling of materials and waste.
- *Programs for efficient use of energy*:
  - ✓ Per capita consumption of electricity in households.
  - ✓ Generation and management of clean energy.

4. Effective programs of **civic and social entrepreneurship**, measured in terms of:

- *State effectiveness*:
  - ✓ Control Corruption Programs and Rule of Law.

- ✓ Transparency in the management of public resources.
- ✓ Government expenditure on development of social capital.
- ✓ Percentage of effective population exercising their right to vote.

- *Social inclusion*:
  - ✓ Design and implementation of public policies that impact a large part of society.
  - ✓ Regional Care Programs.
  - ✓ Entrepreneurship for social enterprises programs.
  - ✓ Regional participation for the election of their representatives.
  - ✓ Gender, religion, ethnicity and social-class tolerance.
  - ✓ Human rights programs.

5. **Territorial assets**, which impact the economic and social development of the region by:
   - A natural feature (territorial) that generates a unique advantage over conventional indicators.
   - The level of cultural experience (diversity of attractions for international residents and travellers).
   - Using natural infrastructure (waterfalls, lakes, beaches, mountains, rainforests, etc.) to attract people from outside the region.
   - Strategic geographic location.
   - Geographical advantages (altitude, latitude and climate).
   - Advantages inherent to social centres, attractions, and more.
6. **Holistic awareness** of their leaders (with a vision and clear long-term goals), in order to:
   - Develop and monitor a long-term strategic plan.
   - Promote the existence of a powerful state vision of a holistic region (specific sectors).
   - Encourage champions (leading people recognized by society) acting as catalysts for a 'Universal Positioning'.
   - Conduct 'State Planning' with emphasis on specialist areas of great value.
   - Create a program for economic, social, political and environmental sustainability (supported by a champion).

The second group is composed of five factors as follows:

7. Brand recognition (**branding**) as a region, measured by any of the following parameters:
   - Organizations, individuals, products or events that allow a (positive) global identification of the region. There is a catalytic activity/driving/vibrant world renowned.
   - Regional attractive branding with its own attributes (talent, enterprise and infrastructure) (e.g. a regional brand with its own attribution/guarantee of origin).
   - Well-recognized and admired traditions, customs and native culture.
8. The existence of **attractiveness** features (effective attractors of talent) that can be acquired through:
   - *Attracting multinational enterprises anchors and foreign capital*:
     - ✓ Net FDI as % of GDP.
     - ✓ Developing international best practice to attract capital.
   - *The region attracting intellectual talent, scientists and business innovators*:
     - ✓ Quality of universities, research institutes and the education system.
     - ✓ Rate of tertiary education (% of EAP: economically active population).
   - *Recognized worldwide HEIs (research, entrepreneurship, knowledge)*:

- ✓ Current and specialized educational programs.
- ✓ Quality of business schools.
- ✓ Outstanding research and technological centres.
- ✓ Remarkable entrepreneurship centres.
- ✓ Efficiency in teaching foreign languages.
- ✓ High level of technical and technological training programs.

- *A good climate for doing business*:
  - ✓ Number of procedures required to start a business.
  - ✓ Costs of starting a business (% of GDP per capita).
  - ✓ Executive Services Index and Business Services Index.
  - ✓ Quality of Life Index for professional positions.
- *The region's economic sectors with high value and strong competition*:
  - ✓ Number of researchers (per 100,000 of EAP).
  - ✓ Level that basic, technological, scientific and human resources satisfy enterprises.
  - ✓ Setting and economic growth.
  - ✓ Highly Competitive Specialized Index (industrial).
- *High-quality cultural centres*:
  - ✓ Development of cultural and social activities with high impact.

9. Regions with **industrial competitiveness** (having defined one or more priority sectors) that produce large economic and social value to the region, which is measured by:

- *Clearly identified priority sectors.*
- *Processes for producing high value and differentiation*:
  - ✓ Value Added Index in manufacturing per capita.
  - ✓ Share of manufacturing exports in total exports.
  - ✓ Share of manufacturing exports with medium and high technological content.
  - ✓ Talent for production of high value.
  - ✓ Royalties.
  - ✓ List of transporting goods or production.
- *Specialized economic activity*:
  - ✓ Existence of a differentiation branding in the region.
  - ✓ Existence of competitive industrial clusters in the region.
  - ✓ Existence of venture capitals, anchor firms and industries with high added value (technology-based and knowledge).
- *Synergies between the ABIIGS[1] organizations and institutions effectively aligned to wealth creation, where the region, industry and firms are fully integrated (Cluster Development readiness)*:
  - ✓ Investment in R&D (private and government as % of GDP).
  - ✓ Existence of public policies developed to drive private investment and incentives on taxes (viable financial and economic policies).
  - ✓ Close relationship with great value between the university and industry.
  - ✓ Mobilization of resources (within and outside the region in commodities, materials, energy, etc.).
- *Evolution from a conventional industrial centre to an innovative cultural and intellectual world-class industry*:
  - ✓ Quantity and quality of innovation centres.

- ✓ Development of new cultural industries or high-impact sports industries for the region.

10. **Entrepreneurial culture**, which generates programs with a large number of spin-outs/spin-offs of great value to the region:

- Innovation Chains (clusters) {from ideas to firms}:
  - ✓ Programs that promote academic, business, industrial, social and regional innovation.
  - ✓ Entrepreneurship programs over the entire innovation chain.
- *Incubators and a business accelerators network for companies based on ecological and/or technological approaches, and the existence of a comprehensive infrastructure of entrepreneurship activities*:
  - ✓ Creation of new companies (start-ups creation) per thousand inhabitants aged 15–64.
  - ✓ Integrated network of all innovation activities of: research-development-pattenting -transfering-incubation–acceleration and clustering of Innovation Technology Parks.
  - ✓ Creation of start-ups.
- *Regional conditions related to research, development and innovation*:
  - ✓ Regional financial centres of venture capital.
  - ✓ Percentage of private investment in R&D.
  - ✓ Royalties and licences (from technological innovation) as a percentage of GDP.
  - ✓ Number of new patents registered per year.
  - ✓ Private investment in R&D.
  - ✓ Royalties and licence fees as a percentage of GDP.
  - ✓ Number of patents registered in the Global Innovation Index (GII), and its respective source (from private or public).
  - ✓ Undertaking programs for social enterprises.
  - ✓ Regional Attention Programs for entrepreneurship.

11. Development of plan for positioning for world-class **regional markets** that is achieved through enhancing the local market through global standards of performance:

- *City product per capita*.
- *Good-sized domestic market of high value and demand*:
  - ✓ Size of local market.
  - ✓ Buyer Demand Levels.
  - ✓ Local markets coordinated and well communicated through chambers or other existing organizations.
- *Generation of high-tech exports. (If possible breakdown by region.)*
- *International markets (international agreements)*:
  - ✓ Foreign Market Size Index.
  - ✓ Number of imports and exports countries +50% of the total.
- *Regional cooperation with other national and international markets (international agreements)*:
  - ✓ Trade Agreements with other regions of the world.

2.2. Enabling drivers

How did these cities make the breakthrough? This methodology is composed of a set of eight groups of factors that have empowered the cities to achieve world-class standards.

The enabling drivers have been the common detonators leading these cities to become innovative regions and therefore, achieving notable competitiveness and/or social disruptions outside of the conventional paradigms, these drivers have been grouped into the following areas:

1. **Smart Infrastructures,** based on special structures built to empower innovative strategies, such as connectivity, e-readiness and ICT infrastructures, universities, R&D centres, laboratories, etc.
2. **Associativeness, openness and holistic awareness,** based on the capacity to adopt a systemic vision and synergies to assemble interdependent clusters of industries, academies, government, entrepreneurship programs, financial institutions, etc. to move toward a sustainable holistic development.
3. **Entrepreneurial/entrepreneurship infrastructure,** leveraged by the creation of a culture for transforming knowledge and experiences into high-value business models, start-ups, spin-offs, business accelerators, etc., such as research and technology transfer centres, Financial New Venture Capital (NVC), tools/angel seed capital, etc.
4. **Technology,** measured in terms of special technological innovations designed to support the breakthrough paradigms, such as technology development infrastructure, R&D centres, transfer centres, and techno-parks.
5. **Talent,** measured in terms of specialized human resource capabilities intended to create innovative solutions to support breakthrough innovations at top university/research centres with regional specialization areas.
6. **Public policies:** special policies designed to leverage, empower and promote innovation strategies, such as state strategic plans, rule of law, effective law enforcement, and strong synergies among all industries, academe, business and local politicians.
7. **Innovation,** based on the existence of effective innovation (non-linear) chains: science education, research, technology, transfer and application of knowledge to innovation processes, innovation strategies, technology transfer, incubators (of start-ups, spin-offs), business accelerators, landing facilities and technology-based parks.
8. **Spectacular successes,** based on the existence of great events planned and executed by locals, led by high-level influencers/*visionaries/champions*/leading institutions, governmental authorities, politicians, entrepreneurs, pioneers, scientists, businessmen and foundations.

2.3. Benchmarking among some successful innovation cities through the Innovacities approach.

In order to deliver a replicable benchmark, as mentioned before, the study was based on the approach *Innovacities* (Scheel, 2011, Scheel and Rivera, 2013) which makes a deep analysis of a few world-class cities such as: Austin (US), Auckland (NZ), Metz (FR), Bangalore (IN), Barcelona (SP), Stavanger (NO) and Curitiba (BR) that have implemented 'state' disruptive strategies with which they have made a great leap to spectacular successes, and have undergone tremendous transformations, from having a low profile by world standards to becoming highly recognized cities, with vibrant dynamic activities globally positioned, not only at the economic level, but in their social and environmental behaviours. These cities have broken with conventional paradigms. They have used

innovative practices to deliver outstanding results that have positioned them on world-class arenas (Florida and Gates, 2003).

Innovacities analyses and identifies the inflection points where cities made great transformations in terms of world-class performances, and then identifies the enabling mechanisms that made transitions into a harmonious balanced regional development possible; producing large-scale changes and creating interdependent spaces in which citizens, social communities, businesses, and their local natural environments have become articulated (Scheel, 2011).

To analyse the data, to understand the terms and to establish a relationship among them, a short cross-evaluation was developed (cross-relationship analysis) of the findings in order to detect some of the key factors and star performances and their relationships for detailed study and worthwhile conclusions. With these three groups of factors (cities, drivers and performances), and after two independent rounds of data analysis, a descriptive qualitative analysis was developed (see Table 1). Keywords used: Austin (USA) – AUS; Auckland (New Zeland) – AKL; Bangalore (India) – BLR; Barcelona (Spain) – BCN; Curitiba (Brazil) – CWB; Metz (France) – ETZ; Stavanger (Norway) – SVG.

Table 1 **Cross analysis of drivers vs performance metrics**

The information inside each cell represents the way that cities use the (enabling drivers) mechanisms to achieve a determinate performance. For instance, the city of Metz (ETZ) has achieved a high performance due to competitive industries (F); programs or projects of entrepreneurship (III); applying efficient public policies (VI) and a well-supported innovation system (VII), and all of this through a well-assembled concept of Technopole which has been a spectacular success (VIII) for the last twenty years.

Summarizing, it was observed that some of the cities advanced from a steady growth during the decades, to outstanding levels of economic and social developments under sustainable standards, due to the articulation of atypical *enabling drivers*, the creation of special regional conditions and public policies, and the presence of spectacular successes. Combining these enablers the cities have produced *disruptive performances* mainly by technological innovations, new industrial policies, outstanding social orders, the decision-making of exceptional visionaries and champions who have had 'holistic development' visions, highly attractive regional poles, vibrant economies and equal social growth, and most of the cities have developed civic, sustainable decision-making processes, designed to preserve the development of future generations. Through these enabling mechanisms, these cities have broken the conventional growing paradigms applying atypical breakthrough innovations, and have now produced disrupted performances of world-class standard (Scheel and Rivera, 2013)

The number of incidences of cities using each driver to achieve a determined performance is shown in Table 3. For example, five cities employed *public policies* (VI) to achieve a better *quality of life* (B), of course with several other factors. In the final columns and rows the total incidences were added. For instance, the *enabling driver* used by most cities to achieve the determined performance is *public policies* (VI; 40 times), followed by an *associativeness and holistic awareness* (II; 37 times), and the use of infrastructures (I; 37 times). The combination of these drivers may structure the I-factor that cities use to achieve these world-class performances (Scheel 2011; Scheel and Rivera, 2013).

Table 2 **Drivers vs performance metrics (frequency of incidences)**

Public policies have 40 positive impacts out of 235, which represents 17.02% of the total. This is a logical behavior due to the fact that most of the initiatives on innovation have come from public decisions, and/or from visionaries that have public empowerment for decision-making. An interesting figure is the driver with a fewer number of impacts (17), Talent (V), which represents 7.23% of the total that deploys some contradictory signals on the R&D needed for good performance of innovation activities for industrialized countries. 50% of the drivers (I, II, IV and VI) represent 61.70% (145 out of 235) of the total number of impacts over the performance metrics (Scheel 2011; Scheel and Rivera, 2013).

According to the *Innovacities* approach, it was proceeded to obtain the information required to develop the study for the city of Bogotá. Two major groups were approached in this investigation. The first group involved enterprises, while the second group was associated with research groups, Technological Development Centres (TDCs), and the public and private non-governmental organizations that undertake Research, Development and Innovation (RD&I) activities. In total, 404 organizations received the survey through the Internet. A total of 120 answers were received: 71.2% belonged to research groups, TDCs or other entities, and 28.8% from organizations of the industrial sector.

3. Main features of Bogotá R&D and innovation issues

Findings of the research showed that Bogotá as a whole is positioned at a very inferior levels, not only regarding cities of developed regions but also in relation to cities with a similar degree of development. In a certain way, such data answers the question why Bogotá does not fulfill the minimum requirements to become incorporated into the knowledge society.

R&D in Bogotá, and by extension Colombia, concentrates more than 60% of the productive activity of the country. This trend continues to be characterized, as identified in other developing regions (Bortagaray and Scott, 2000), by:

- Generally low technological R&D intensity and complexity;
- Public sector over-representation and less private-sector presence;
- Primary emphasis on basic research and very low concentration on applied research;
- Low levels of technology transfer between public and private sectors and within the private sector itself; and
- Little involvement with international R&D in technology and innovation networks.

Bogotá as a regional innovation system should implement R&D in innovation and technology transfer by associating strategies for developing the information and knowledge society with the following main objectives:

- Creating a clear strategic framework for integrating innovation into the city's production structure;
- Creating cooperation networks among companies and between companies and the public sector (articulate a pentagon-helix concept: government, academy, industry, new venture capital investment, and entrepreneurship);
- Reinforcing the R&D activity in technology and innovation in the region; and
- Creating a strong linking between the industrial sector and the digital-enabling economies.

That implies articulating drivers as:

- ***Technology*:** an ongoing source of innovation which could become the basis for a new production structure regarding sectors having greater technological value added.
- ***Human talent*:** a highly-trained workforce at all levels, having the abilities and skills to become incorporated into new conditions regarding the knowledge economy specialization.
- ***Capital*:** access to financing from different sources and a way for investors to obtain a yield on their investment.
- ***Know-how*:** a technology transfer and knowledge structure from world-class centres of excellence, consolidating communities of practice and learning with a network of mentors, assessors, models to imitate, and service providers.

Applying the necessary measures will be guided by policies and strategies governed by operational methods and procedures in line with the foregoing philosophy and objectives. The common objective is to reinforce the competitive capacity of Bogotá, thereby guaranteeing that the policies and strategies adopted in R&D in technology and innovation become integrated within the context of ***knowledge-based cities***. Local authorities and economic operators must be aware of the necessity for:

- Reinforcing countries' ability to integrate R&D in technology and innovation into their regional economic development;
- Improving learning processes so that companies can make themselves more innovative;
- Helping companies and institutions to respond to problems regarding their adaptation to new ways of organizing work; and
- Ensuring better coordination of national sector policies to help regional development efforts. All of this is oriented to achieve an ultimate goal, a 'sustainable wealth creation for the city'.

4. Findings Innovation Drivers of Bogotá under the methodology *Innovacities*

This methodology provides a benchmarking tool that works very well for analysing the strengths and weaknesses of how the city of Bogotá could be inserted successfully into the field of knowledge-enabled economies. The main obstacle to completing the study was the difficulty of getting updated information on relevant variables. Surveys applied show the following findings:

Infrastructure

- *Connectivity, e-readiness and ICT infrastructures:*
  - ✓ Penetration of fixed broadband (13%) and capacity (1 Mbps).
  - ✓ Penetration and coverage of mobile phone (90%).
- *Technology parks:*
  - ✓ Servicio Nacional de Aprendizaje-SENA Techno Park.
- *Banking:*
  - ✓ The bank deposits represent 58% of Colombia.
  - ✓ 3.5 and 8 financial institution ATMs per ten thousand inhabitants.
- *Culture:*
  - ✓ BibloRed: 36 libraries.
  - ✓ 2 convention centres and around 50 museums.
  - ✓ Higher education (39%) and research (43%).

- ✓ Bi-annual 'Ibero-American Theater Festival'.

Openness to association and holistic awareness

- *Spaces and initiatives that promote interaction in the city:*
  - ✓ Regional Council for Competitiveness (CODECyT) and University-Enterprise-State Alliance (AUEE).
  - ✓ Programs of the Chamber of Commerce of Bogota (CCB).
  - ✓ Productive Transformation Program of the Ministry of Industry
  - ✓ 10 production chains identified in Bogota – Cundinamarca by AUEE

Entrepreneurship

- *Entrepreneurship programs:*
  - ✓ More than 50 HEIs have entrepreneurship centres or programs.
  - ✓ Entrepreneurship Fund of the SENA.
- *Programs of the Chamber of Commerce of Bogota (CCB).*
- *Other agencies and programs:*
  - ✓ Incubators.
  - ✓ Colombia Solidaria – Gestando.
  - ✓ Incubar Colombia.
  - ✓ Prana – Incubator for Cultural and Creative Industries.
- *Financing tools, venture capital and seed and angel capital:*
  - ✓ Invest in Bogota.
  - ✓ Seed Capital: Entrepreneurship Fund (SENA), Destapa Futuro, Premio Santander, Finbatec, SEED, Moot corp, Inter American Development Bank IDB Challenge and TIC Americas.
  - ✓ Angel Investor: Andes, Bavaria angels' network.
  - ✓ Venture capital: Colombia Capital, Coomeva, Progresa Capital and ECOS LAVCA Group.
- *Productive sector:*
  - ✓ The largest productive chains are related to food, construction and civil engineering; followed by chemicals and petrochemicals and health (they do not have TDCs).
  - ✓ 126,000 companies are registered in manufacturing and services activities – 17% service companies and 87% manufacturing companies.
  - ✓ 88% microenterprises, 9% small enterprises, 2% medium enterprises and 1% large enterprises. Most are focused on product transformation, followed by wholesale and retail marketing. 15% of all companies are providers of raw materials and supplies.
  - ✓ 72% belongs to construction and civil engineering, food processing and software development.

Technology

- About 104 R&D institutions or centres (40% of the national capacity).
- In 2011, the transportation service of the city was given to a consortium, known as the Integrated System for Collection, Monitoring and Information (SIRCI) to the user.
- Telecommunications Research Centre CINTEL and Tecno Parque Colombia (SENA) is the first Latin American Laboratory created for the Development of Knowledge in Advanced Networks (NGN).

Talent

- *Higher education:*

- ✓ 119 (56%) higher education institutions; 75 (30.61%) universities and colleges; 19 (38.66%) technological institutions and 18 (46.15%) technical institutions (SNIES, 2012a).
- ✓ HEIs offer 28.3% of the national undergraduate and graduate programs.
- ✓ At undergraduate level, 47% of programs are related to management science and economics and accounting; 24 % are offered in electronics and systems and related telematics (SNIES, 2012b).
- ✓ At graduate level, 70% of programs are offered in management science, economics and accounting, human science and social and political science; 10% in health sciences and 15% in engineering.

- *Research capabilities:*
  - ✓ The majority of the national research group located in the highest categories given by Colciencias A1 and A (82 out of 341) are focused mainly in the management, human, social and health sciences.
  - ✓ Research capacity is oriented to basic research rather than applied research.
- *Development capacity:*
  - ✓ Most of the TDCs (13) recognized by Colciencias represent 43% of the national centres.
  - ✓ Research in TDCs is oriented to productive sectors, such as metalworking, transportation, information and telecommunication technologies, textiles, biotechnology, logistics, shoemakers, and forestry, among others.

Public policies

- *Regional Competitiveness Plan 2010–2019.*
- *Plan for Science, Technology and Innovation Bogota DC 2007–2019.*
- *Agenda for Science, Technology and Innovation for Bogota and Cundinamarca.*
- *Local social policy programs.*

Innovation strategies

- *World-class companies with a presence in Colombia that promote local innovation.*
- *In May of 2011, the IBM Innovation Centre was established.*
- *Innovation support:*
  - ✓ DaVinci Program (promote the creation of spin-offs from research results).
  - ✓ Innovation Business Round organized every year.

Spectacular successes

- *FIFA U-20 World Cup in 2011.*
- *World Book Capital City 2007 (UNESCO).*
- *Golden Lion Architectural for Best City 2006.*
- *Cities for Peace 2002 (UNESCO).*

5. How to evaluate the innovation performance of Bogotá

After observing some of the features that Bogotá has against the best practices that emblematic cities have implemented the most important gaps were established and analysed. This analysis also helps Bogotá, in order to achieve priority objectives to generate necessary conditions to become an innovative city. The main innovation enabling drivers were benchmarked in spite of the poor information that could be collected. The following gaps were found:

Table 3 **Gaps between Bogota and the best practices**

Drivers	Gaps
Infrastructure	▪ 15 square meters/person of green space, below the global Best Practices (BP). ▪ Position 62 below the global BP of roads quality. ▪ Position 72 below the global BP in terms of infrastructure and physical connectivity. ▪ Not adequate electric transportation corridor in the urban surface according to the Index ICUR, 2010. ▪ A disadvantage of 5.7 percentage points on the global BP related to the levels of malnutrition. ▪ High level of unemployment compared with other major capitals of South America. ▪ High levels of poverty compared with BP in urban areas. ▪ High rate of violence compared with other capital cities. ▪ 8.2 points below BP in Branding in Latin America.
Openness to association and holistic awareness	▪ The *Land Use Planning* has been partially approved. It shows low vision of environmental sustainability compared with global BP. ▪ 84.1 points below the global BP in the field of environmental sustainability. ▪ 39 positions below the global BP level in terms of clustering. ▪ Recycled 350.216 kg/year. Bogotá is ranked as one of the cities with the least capacity for waste recycling in the world. ▪ Emits 53.1 (Particle Matter – PM), lower than 10 μ. Monthly Average PM10 (μg / m^3). Placing it 33.1 percentage points over the reference value recommended by OMS. ▪ 46.3 points below the global BP of square meters of green area per person. ▪ One major weakness with 75.7 percentage points of global BP levels of corruption compared with other cities. ▪ Electoral abstention for the 2011 elections was 52.6% of the total population eligible to vote. ▪ 78 positions below the global BP on transparency in the management of public organizations and corruption control.
Entrepreneurship	▪ 46.9 points below global BP in business services. ▪ 41.2 points below global BP in executive services. ▪ 91.7 points below global BP regarding the creation of new businesses. ▪ 2.5 points below global BP relating to access to venture capital. ▪ Colombia is located 99 positions below the global BP regarding the efficiency of the market for goods and services.
Technology	▪ Bogotá had 13.85 broadband connections per 100,000 people (2011). ▪ Colombian Research Centres are located in the positions 975 and 2.284 (Ranking of Web of World Research Centres).
Talent	▪ Higher education dropout rate close to 48%.

Drivers	Gaps
	▪ Low rate of staff engaged in R&D (only 0.23 researchers per thousand inhabitants). ▪ Business schools are located 400 positions below the global BP (Best Web Ranking of World Universities). ▪ Colombia is 58 positions below the best results in the PISA Test for 2009.
Public policies	▪ 33.7 points below the continental BP in expenditure for social capital development
Innovation strategies	▪ 1.7 points below the global BP within collaborative university-industry R&D. ▪ 98.1 points below the global BP in terms of patents registered per year. ▪ 87.8 points below the global BP in terms of royalties from patented inventions. ▪ 3.1 points below the global BP in private investment for R&D. ▪ Colombia is located 72 positions below the global BP in terms of exports of high added value according to The Global Information Technology Report GITR – World Economic Forum. ▪ Bogota has 79% of Foreign Direct Investment FDI in Colombia.
Spectacular successes	▪ 'Rock al Parque' is the best festival in the region. The city is also known as a Rumba City with the best discos and DJs.

6. What should Bogotá do to reduce the gaps?

Bogotá has the largest number of higher education and research institutions, and technological development centers in Colombia (Malaver, Maussa and Vargas, 2005). However, Bogotá is not yet positioned as an RIS. An organizational redesign will be necessary in terms of the entities that comprise it.

Bogotá should implement different activities on R&D, technology, innovation, entrepreneurship and technology-transfer-associated strategies for developing a knowledge and information society, as well as a strong digital-enabling economy designed to support sustainable wealth creation, such as:

- Create a clear strategic framework for integrating innovation chains into the city's production structure.
- Establish cooperation networks among companies and between companies and the public sector.
- Reinforce R&D activities and programs in technology and innovation in the region.
- Identify and empower champions such as mayors, businessmen, academics, athletes and artists, who can be emblematic and catalyst figures for the world positioning of the city.
- Develop long-term plans for the creation of competitiveness poles for development and technology clusters as an engine of social development and wealth creation.
- Mainly, and above all the other factors, Bogotá must generate a transparent and balanced (among all stakeholders) Rule of Law, to attract and maintain talent, capital, technological partners, and all kind of stakeholders who can help the re-positioning of the city as a world-class player.

- Finally, regarding the governance of RIS, according to Scheel (2011), the following seven aspects should be considered important for redesigning the RIS in Bogotá:
  - ✓ Include strategies to facilitate deeper relationships to help overcome rigid barriers that exist today between research and technological development and the productive sector. This is to encourage greater and deeper relationship between universities and businesses in R&D.
  - ✓ Provide a broad portfolio of knowledge-transfer services (mostly e-services) to meet specific needs across different types of companies, either as users or generators of technology.
  - ✓ Apply marketing asset initiatives based on technological innovation and scientific management to be aimed at specific target groups of productive enterprises.
  - ✓ Develop long-term relationships with industrial clusters that are much more satisfying than individual projects and technology transfer isolated in exploiting the potential of regional collaboration in the RIS.
  - ✓ Provide advice on making direct technical-assistance programs for the restructuring and modernization of enterprises by defining policies and strategies of innovation, even similar to those adopted by industrialized countries in the European Union.
  - ✓ Strengthen institutions and infrastructure services that are necessary to support such industries. A main activity of the RIS will be to foster entrepreneurial skills in technological innovation and scientific management.
  - ✓ Establish special measures to support mutual inter-company relationships, which also include subcontracting programs between large and small companies. In addition, it is important to develop other schemes for strengthening business alliances with the participation of entities RIS interface.
  - ✓ To be able to implement these activities, the city must assemble an RIS, which will provide the proper governance for Bogotá to become an innovative city with an institutional framework which would provide empowerment to local capacities and enhance the ABIIGS (Academy, Bank, Infrastructure and innovation, related and complementary Industries, Government and Society) synergies, as well as the interactions among all stakeholders, the efficiency of regional resource allocation management, and the governance and articulation of all stakeholders. Thus, Bogotá would be able to achieve what other developed regions have accomplished: an innovative city, where development will be based on high value added knowledge, high competitiveness standards, the capability to be positioned as a world-class player with recognized specialization and branding, and attractor of foreign investment, high-value talent and anchor firms. In general a well-tuned RIS will provide the city with a mechanism capable to articulate the three sub-systems: the city will have a *high economic impact*, due to: High economic value-added growth, with well-recognized branding.
  - ✓ High recognized differentiation as well as a well-articulated specialization.
  - ✓ High-value jobs.
  - ✓ High impact on the tax structure (regional GDP).
  - ✓ Effective innovation clusters, with highly competitive firms.
  - ✓ A large body of start-ups with high-value business models.

- *As well as a minimal environmental impact:*
  - ✓ Able to minimize the environmental cycle (Life Cycle Assessment).
  - ✓ Free of garbage or able to transform all residues.
  - ✓ Possessing an improved environmental impact and a high energetic eco-Efficient Index.
- *Creating great social benefit for all citizens:*
  - ✓ High Life Quality Index.
  - ✓ High Global Progress Index.
  - ✓ Social inclusiveness mechanisms.
  - ✓ Equally shared social capital.
- *Providing a high-level talent organization with:*
  - ✓ High-quality tertiary education.
  - ✓ High-value technology-based niches.
  - ✓ Scientific and technological infrastructure of high quality and differentiation.
- *Finally, a highly innovative city will have a great impact on the government performance*:
  - ✓ With a strong platform on an inclusive e-government.
  - ✓ A regional holistic vision with all-inclusive stakeholders.
  - ✓ A well-structured urban plan as an attractive pole of regional firms, linked to key ABIIGS stakeholders.
  - ✓ A visionary policy with a robust and inclusive rule of law.

7. Conclusion

The purpose of this study was to develop a proposal for transforming Bogotá into one of the most competitive cities of Latin America (according to world-class indicators), to enable the city to attract Foreign Direct Investment (FDI), specialized talent, and high-value and specialized services, and to become a city with high quality of life and a sustainable environment.

In order to achieve world-class standards, the city must develop a well-tuned **regional innovation system** strategy which will provide:

- A balanced and effective **governance** among all stakeholders that enhances the strengths, and it transforms obstructing hurdles, in sound drivers for economic growth and social development in a sustainable and long-term way;
- The ability to **insert** research centres and universities in the region within the innovation chain in a harmonious, effective and sustainable way;
- A proven ability to **incubate** new start-ups and accelerate technology-based businesses;
- Flexible tools for **financing** new venture capital;
- A more effective and valuable **Resource Allocation Management** (RAM) system, in and outside the region;
- A mechanism that dynamically and **synchronized** inserts key resources where and when they are required;
- A high-value-added **specialized** niche differentiated for the region and for each stakeholder;
- An efficient mechanism for knowledge management and information systems necessary to support **intelligence**, surveillance and trends, as well as a support

system for decision-making (DSS: Decision Support Systems) for proper governance of a attractive and well recognized pole; and

- An efficient mechanism for **value** creation distributed equitably and to come in cycles of increasing returns of win-win value for all participants.

Finally, the RIS of the city must be perfectly aligned to the Science, Technology and Innovation Plan, as well as to the inclusive and sustainable wealth-creation strategy of the region. Based on this, the city will have all the requirements to be a world-class, well-recognized innovative city. A well-designed RIS is defined by Carlsson and Stankiewicz (1991) as a set of networks of public, private and academic sectors that interact in a specific territory, taking advantage of a particular infrastructure for the purposes of adapting, generating and/or disseminating technological innovation, social and systemic processes. Adapting this definition to Bogotá's RIS, one may consider that the city is a geographical network, in which different stakeholders are concentrated in order to cooperate permanently with each other; their interaction and mobility is essential to developing their activities towards a common goal: the creation and sharing of sustainable wealth for the region.

The purpose of implementing the RIS for Bogotá will be to call, coordinate and govern all stakeholders necessary and sufficient to position the city in the ranking of best cities in the world. In addition, Bogotá will be recognized for its high industrial competitiveness; human capital; R&D technology for enterprises; sustainable development; and its excellent quality of life. Therefore, the **governance** of the innovation chain must be associated with key policies and strategies within the RIS itself. Governance practices should be applied to two environments: those activities that must govern from within the RIS, and those dedicated to governing the activities outside the RIS; but both focused on the structure of the chain mentioned above.

Some of the typical features of RIS governance have three levels: the strategic level of local think-tank leaders; the tactical level (i.e. the management tank); and the operational level (i.e. the resource management tank). This seems to be the intention with the launching of a new undertaking organization known as CONNECT Bogotá-Region, which keeping the proportions and scope has some similarities to the Connect branch in San Diego. The ground is fertile for this purpose, but still the results are yet to be made a reality in the middle and long term. In this context, the RIS of Bogotá is still a long way from being positioned according to minimum standards of global best practices, and certainly the one associated to its governance is of paramount importance. This is the main mean adopted by other regions and cities: it is not to dictate what should be done, but rather to direct the scarce resources available to actual and feasible technological innovation projects.

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Note

[1] ABIIGS: *Academy, banking system, industrial infrastructure, innovation, research and development systems, governance policies and social capital drivers.*