

# Case Study at National Level: ICDE, the Colombian SDI

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## Summary

This paper focuses on the needs and current situation with respect to spatial data infrastructures (SDI) at the country level from the Colombian perspective, a middle income developing economy. In terms of the Global SDI initiative, it addresses policy-oriented issues relevant to mapping authorities in emerging economies. The priorities in data production could be much better aligned within a framework aimed at generating institutional development and proper attention to users' needs by improving data access.

To this end, the paper presents the Colombian geographic authority, comments on key ICDE<sup>1</sup> issues, the national SDI, and outlines elements that are relevant for similar environments.

## Introduction

A brief background is provided, with a short description of SDI in Latin America, the existent situation of geographic data in Colombia, and an outline of the Colombian mapping agency.

### **A regional SDI for the Americas: advancing, but still in a 'feeder road'**

In relation to geodata, there is currently no integration in Latin America. The area is just starting to look seriously at the importance of having a regional spatial data infrastructure. The scenarios in which this possibility has been analysed are: The Pan-American Institute of Geography and History (PAIGH), the Directorate of South America, Spain, and Portugal Mapping Agencies (DIGSA), the UN Regional Cartographic Conference for the Americas, and the Inter-American Geospatial Data Network (IGDN)<sup>2</sup>.

At the national level, there are significant disparities: while some countries show major GIS activity, developing digital markets and evolving clearinghouse systems, for other nations, finishing national coverage at scale 1:500 000 analog/digital remains the goal. Budgets applied to mapping activities are, on average, marginal. At this point in time, in the region there is more geography than geomatics. It is small wonder that Latin America and Africa combined share less than 10% of the total world sales by any major hardware or software manufacturer.

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<sup>1</sup> Infraestructura Colombiana de Datos Espaciales-ICDE

<sup>2</sup> Santiago Borrero, IGAC. Case study in SDI Trans-national initiatives: Latin-America. 3rd GSDI Conference. Canberra, Australia.1998.

SDI business is in its embryonic phase in Latin America. Key officers in the region must still be coached as to why harmonic spatial data infrastructures joining up with local, national, regional and global levels is fundamental to maximising economic, social, and environmental benefits from geographic information. In any event, Latin America and the Caribbean nations are responding to this call at their own pace.

### **Geoinformation in Colombia: background and development trends**

Cartographers in Colombia were very comfortable with analog mapping when digital data processing in 1993 began to be used, announcing the arrival of the Information Age. The idea of users, clients and 'interference' from the outside took locals almost by surprise. Nonetheless, the country today is immersed in this technological change and the use of spatial information is expanding.

With reference to geoinformation production and data coverage, Colombia is above the average for the region<sup>3</sup>. Recent production at greatscales (1:2000) is significant and the availability of information for cadastral and other urban applications is increasing rapidly. Still, there is limited capacity to consume adequately all data produced. Specialists are in the process of redefining their own data sets in digital format, frequently in an insular manner. There is also a growing consciousness that information is important if it is accessible to most users. Thematic data and mapping production is commonly carried out in different public/private entities, resulting in enormous diversification, high costs, lack of standards, quality problems, and poor documentation<sup>4</sup>.

How this process is understood and managed will determine the character and manner in which the SDI framework will mature in Colombia. Before this happens, plenty of work needs to be done, both bottom-up and top-down. Colombians need to understand why, concerning social and economic growth, it is advisable to become globally oriented and to understand the benefits from GSDI. A history of isolation, ill-defined ideas, language barriers,<sup>5</sup> and financial challenges, have defined the local attitude.

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<sup>3</sup> In terms of standardisation of spatial data, Colombia is linked to the following initiatives: (1) The Inter-American Geospatial Data Network (IGDN), (2) PAIGH Committee for Spatial Data and Topographic products, aimed at establishing 'permanent communication towards standardisation and exchange of metadata information associated with new electronic systems while building new cartographic data bases at the national and international level'.

<sup>4</sup> A similar diagnosis is frequently mentioned concerning the situation observed in the developed world. Obviously, conditions and impacts differ significantly in developing societies. However, this is a situation that the poorest or emerging economies cannot afford; on other hand, there is a huge difference in terms of the size of the problem.

<sup>5</sup> In Spanish the SDI concept is not easy to understand. The meaning of some key words is still confusing. For example, 'infrastructure' usually refers to something physical, like equipment; it does not involve concepts like 'policies', as opposed to the term, 'framework'. This is the reasoning behind the request for Spanish versions of standards like the ISO metadata. Standards would then be easily understood and applied more broadly.

## **The IGAC: Responding to the need for spatial data infrastructures**

The Agustin Codazzi Institute is responsible for mapping, cadastre, agrology, geography and remote sensing activities in Colombia. The IGAC conducts geographic activities at the national and international levels, giving priority to Latin America and the Caribbean region. It was founded in 1935 as a military organisation and in 1955, evolved into a civilian entity, which is exceptional in South America. The Institute has up-to-date digital facilities and well-equipped laboratories. Since 1965, it has possessed a GIS and remote sensing training centre (CIAF), at which 4,500 students from the region have received training.

The Institute is a member of the main international geographic organisations and carries out progressive initiatives in the region, such as GSDI. In Latin America, the IGAC stands out as a key organisation for institutional development, technological change and competitiveness, focused on the promotion of territorial development.

Colombia supports the 1997 UNRCC resolution concerning the creation of an SDI Permanent Committee for the Americas. This body will provide a much needed forum for cooperation in the development of regional and global geographic information infrastructures, resembling the existing PCGIAP in Asia and the Pacific and the European Umbrella Organisation for Geographic Information (EUROGI).

The IGAC, through CIAF, is preparing a seminar on NSDI addressed to nationals and, if international cooperation makes it possible, to interested parties in Latin America and the Caribbean.

## **Origin and current evolution of the Colombian Spatial Data Infrastructure (ICDE)**

ICDE, the Colombian SDI, is in its initial stages. Although early developments began in the first quarter of 1995 and ICDE benefits greatly from observing developments in leading countries and agencies like ISO, today, it can be stated that ICDE is growing in line with GSDI objectives.

In every country, SDI reflects the local conditions and identity. For instance, NaLIS<sup>6</sup>, the Malaysian NSDI, evolved from the national digital cadastral and topographic databases. In Colombia, ICDE beginnings are linked both to the work advanced by the national oil company (ECOPETROL) in cooperation with the University of California at Santa Barbara, and to that of IGAC after the 1995 Cambridge Conference and the DIGSA meeting held in Bogota. These elements came together in 1996 when ICONTEC, a local ISO type organisation, created a national committee on standardisation of geographic information in Colombia. At that point, IGAC was appointed to be the Technical Secretariat and facilitating organisation. As a result, today, over thirty institutions, producers and users, government and private organisations, and academia, are all working together to this end.

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<sup>6</sup> Abdul Majid Mohamed. The development of NSDI in Malaysia - A Case Study. GSDI Conference. Canberra, 1998.

Biodiversity is very rich in Colombia. In 1998, as part of an initiative called the 'Environmental Alliance for Colombia', geoinformation producers agreed on the need to develop a Colombian spatial data infrastructure to build, share, and distribute geographic data nation-wide in an efficient manner. In this context, environmental information needs were to be given special attention<sup>7</sup>. This is ICDE.

As already mentioned, the aim of this paper is not to provide a technical description of ICDE, but rather to concentrate on the analysis of certain particularities used for similar situations and the promotion of global SDI. In its first stage, ICDE's expected results include a Colombian definition and realisation of the following:

- Geographic metadata standards.
- Quality standards for geographic information.
- Standards related to Basic Geographic Object cataloguing
- Standards on terminology
- Standards for cadastral land classification

Promoters of ICDE are also pursuing the following goals:

- National recognition of the geographic sector one that is strategic for development
- Increase geodata production and data-access
- Formal approval of ICDE at the highest levels of government
- Close links with other national entities that are more advanced in NSDI
- Promotion of ICDE within the local geographic community
- Incorporation of new IT to improve competitiveness
- Development of a national network of geographic information (clearinghouse system)

## **Debating the need for SDI in Colombia: a lesson to emulate?**

To accomplish SDI objectives is not an easy task in Colombia or elsewhere. As an indication, one can ask how long it is taking for those well versed in SDI to reach the point at which basic goals are achieved and performing properly and compare this to the costs and the resources involved? If these answers were available, they would be in many ways surprising and indicative of SDI possibilities for the developing world and, especially, for the poorest nations.

To consider the relevance to SDI of the disparities that exist between developed nations and lower income ones, it is indicative to consider that while in Canada there are 192 personal computers per 1 000 people, 228 internet hosts per 10 000 people and 2 322 scientists in R&D per million people, in Colombia the figures, respectively, are 23.2 and 39 (Table 1).

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<sup>7</sup> In Colombia, geoinformation is mostly produced by the Agustin Codazzi Geographic Institute (IGAC); the National Statistics Department (DANE); the Institute for Hydrology, Meteorology and Environmental Studies (IDEAM) and the Research Institute on Geosciences, Mining and Chemistry (INGEOMINAS).

**Table 1:** Communications and R&D Disparities among Middle and High income Economies\*

<b>Economy</b>	<b>1997 Population</b> <sup>1</sup>	<b>Personal Computers</b> <sup>2</sup>	<b>Internet Hosts</b> <sup>3</sup>	<b>Scientists in R&amp;D</b> <sup>4</sup>
Romania	23	5.3	2.6	1382
Colombia	38	23.8	1.8	39
Egypt	60	5.8	0.5	458
Canada	30	192.5	228.0	2322
New Zealand	4	266.1	424.3	1778
Ireland	4	145.0	90.8	1871

\* Source: World Bank. The World Development Report 1998/1999.

1 Population in millions;

2 1996 PCs per 1 000 people;

3 1997 Hosts per 10 000 people;

4 1995 Scientists and engineers per million people

As in most of Africa, a good part of Asia and Eastern Europe, in South America digital mapping data is the production priority. This is not surprising. The region is mostly covered by analog maps drawn up at small scales averaging 1:500 000, with significant levels of obsolescence. One difference observed between financially better off NMOs, where new or well-maintained data is digitally formatted, and the limited ones, is the trend to convert old analog maps into digital data.

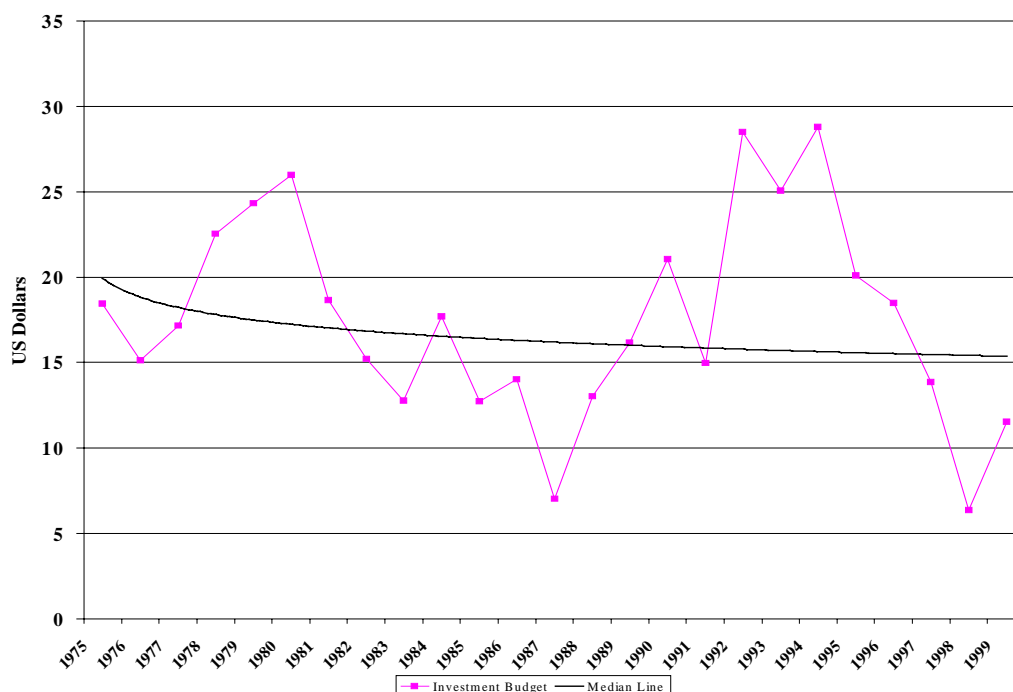
As happens in other nations, Colombia, despite the Information Technology era, has yet to formally adopt a national policy concerning the use of geoinformation and the ways in which it will be used to promote wealth and development. In addition, in a period of economic crisis, like the one currently facing the government, there are enormous problems affecting data maintenance and hardware and software updates.

Nonetheless, when considering the status of ICDE, in reference to Colombian decision-makers, it should be remembered that concepts, processes, and other key SDI elements are not yet clear or well-defined. Indeed, non-SDI specialists at decision-making levels find it hard to understand the real meaning and the ideas involved.

Economic cycles in the developing world are less predictable and more volatile in terms of time frames than elsewhere. The IGAC is facing data needs and SDI challenges at a time when its investment budget has been reduced drastically to the lowest point in 25 years (Figure 1). Under these circumstances, inevitably, the in-house debate tends to favour data production over ICDE, in spite of its relevance and benefits<sup>8</sup>.

<sup>8</sup> The median line in Figure 1 indicates that over the 25 year period shown, though there have been periods in which Colombia has accumulated wealth and gained capital, the resources dedicated to geodata production, in real terms, have constantly decreased.

**Figure 1**  
**AGUSTIN CODAZZI THE GEOGRAPHIC INSTITUTE OF COLOMBIA**  
**Investment Budget 1975 - 1999**  
 (Thousands of US 1999 Dollars)



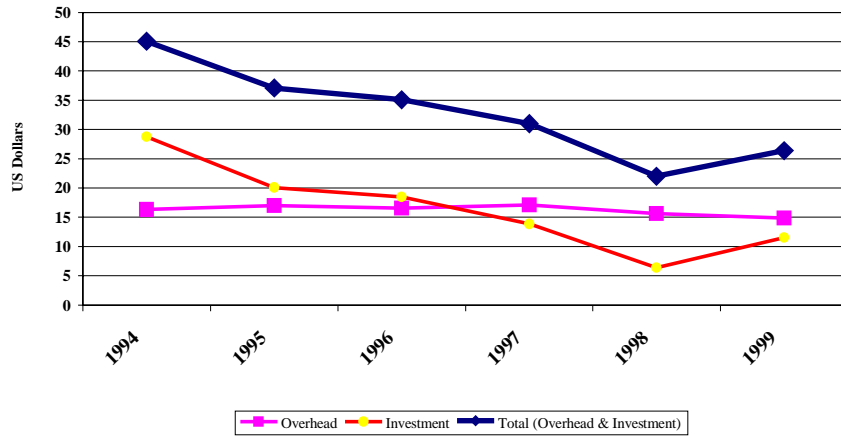
Source: IGAC

### **Confronting data obsolescence and data production slopes: The national digital data base at scale 1:100 000**

In 1994, the cartographic production line at the IGAC was modernised using the latest technology. In the following years, nonetheless, generation of basic data at the national level decreased notably. This happened first, because the IGAC focused on the production of data on large scales for cadastral purposes and urban planning, but mainly because thematic application producers introduced themselves, at a high cost, to new technology creating a substantial amount of new, yet not always structured data, thus distracting the government from the production of basic information with national coverage.

The most developed rural and urban areas of Colombia already have relevant amounts of cartography in digital format, ranging from 1:2000; 1:10 000 or 1:25 000 in the cities and surrounding areas and 1:100 000 and smaller, for provinces and state level areas. In this decade, at smaller scales, the amount of data produced is larger than in the previous two, and expectations are now higher. However, normal execution of these plans has been subordinated to the availability of financial resources and building up additional capacity. Budget allocations for the IGAC have suffered a down cycle since 1995 (Figure 2) and its consequences are quite negative: data maintenance is now a major difficulty, leading to an increasing situation of data obsolescence.

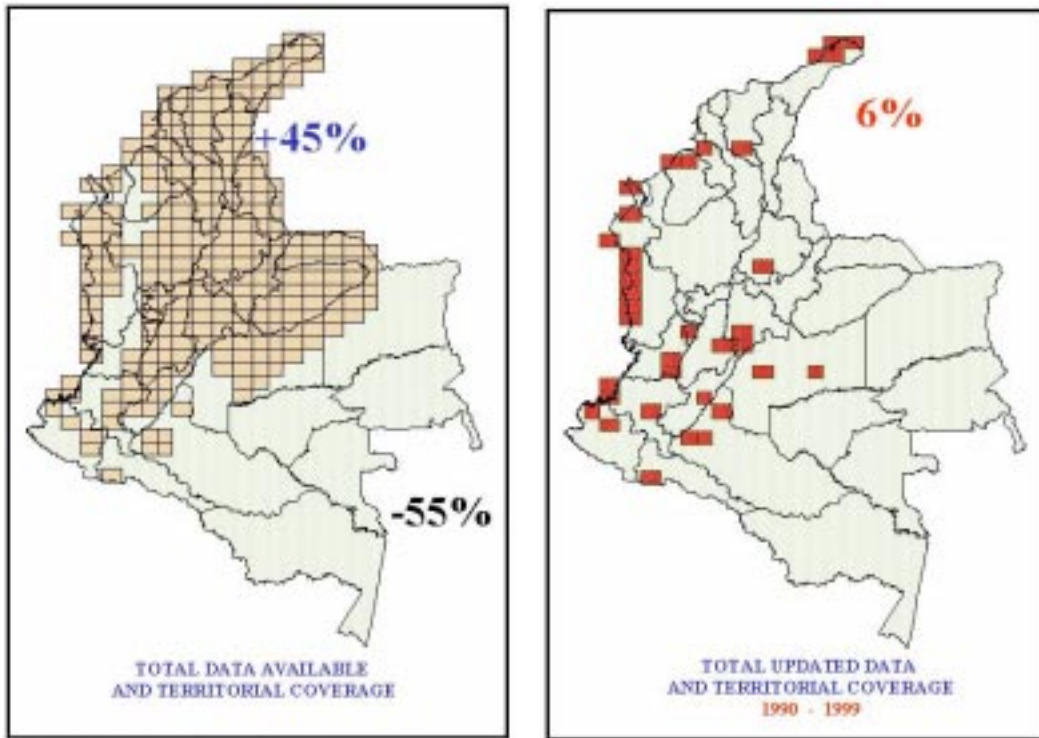
Figure 2  
 AGUSTIN CODAZZI THE GEOGRAPHIC INSTITUTE OF COLOMBIA  
 Total Budget (overhead and investment) 1994 - 1999  
 (Thousands of US 1999 Dollars)



Source: IGAC

The following is a good example: this year, the main geodata producers agreed that cartography at scale 1:100 000 should be defined for the national digital data base. At present, 55% of the national territory is covered at this scale. However, out of this percentage, only 6% is based on actual information, meaning aerial photography taken during the last decade. This signifies that at this scale, 94% of the information is outdated or non-existent. This reality clearly explains why this is currently the first priority for data production for the IGAC (Plate 1).

Plate 1: Colombian Cartography Available and Updated Data at Scale 1:100 000



Source: Agustín Codazzi Geographic Institute 1999

By 1994, annual budget allocations, though limited, were not a major constraint. Yet, the following year, this situation changed abruptly and the budget became 'the' difficulty, making production plans barely viable.

In 1995, the reality of new information markets was also a fact in Colombia. Producers and users needed different rules to take advantage of geodata sets, all of which needed a framework. The answer is directly linked to development of a national SDI. However, constant fluctuations and change are the rule, rather than the exception, in emerging societies like Colombia.

There is a kind of paradox in this situation. Although there is more georeferenced information available, data has not played a proper role in the decision-making process. Furthermore, specialised entities have been marginalised because of reduced budget allocations that affect the geodata producers and the deceptive way in which low quality data is sometimes used to formulate relevant policy. In other words, because digital data can be manipulated and presented in new and 'fancy' ways, there are policy-making scenarios that have moulded the presentation of information to impress by the form, rather than its quality.

As a result, the lesson is that data production and SDI building in emerging economies, to be successful, a minimum level of financial and institutional sustainability.

### **Embracing the SDI option**

The positive aspect of SDI is that there is almost no choice for NMA's. No matter whether large or small amounts of digital data are generated, because of the very nature of data, after a period of time, determined by local conditions, users and producers in developing nations will understand that their data must be accessible, documented, structured and reliable or, otherwise, will be practically non-existent. In terms of cartography, this is like a new brand of illiteracy. Without the infrastructure, there is isolation. Analog map production was to the old national mapping authority, the reason for production monopoly, as digital data is today to the need for data infrastructure.

In this market of many data producers and demanding users, national mapping authorities have a new role, beyond data production, as coordinators and facilitators of this process. There is a need to optimise the use of limited funds and to insure data quality and opportunities. The development of national SDI makes it possible to benefit from this new and powerful situation. It will have a significant impact on national development.

This is why when the IGAC in Colombia, in dealing with this situation, faced a choice between two priorities: data production or infrastructure development, they opted for both. Since 1994, the IGAC is directed according to a long term Action Plan, currently, the 'Strategic and Developing Plan 1999 – 2002'. When compared with the 1994 – 1998 plan, 'To know more about Colombia', the main difference is that, in addition to the basic institutional goal (to produce, analyse and make data available for various purposes), the current one gives equal priority to the design, promotion and setting up of ICDE, the Colombian SDI.

Developing nations must be aware of the need to expand their knowledge base. To achieve this goal, emerging societies must look to the information accumulated by the leading economies. This knowledge can be incorporated via international cooperation,

technology licensing, or foreign investment<sup>9</sup>. Although multilateral organisms may decide to promote data sharing, ultimately, it is data owners' right to decide 'what data to share'. However, in terms of 'how to share' data, this is also responsibility of the recipient, since the connection aspect requires or will be optimised if spatial data infrastructure conditions are available.

Policymakers everywhere make relevant decisions without complete information, yet in developing nations, due to the chronic absence of key geodata, the risks taken are even higher. Colombia and similar economies require a clearer statement and an Action Plan from the multilateral organisms dealing with global spatial data initiatives. At the highest level, not enough work is being done in emerging regions on the consequences of new space imaging technologies and applications, the role of geoinformation and the way data sets can be best organised institutionally and used to address economic, social, and environmental strategic issues more efficiently.

### **Multi/bilateral cooperation, international geographic organisations and SDI promotion**

In many aspects the GSDI initiative would move forward without support from organisations like the United Nations, The World Bank or, in the Americas, the IDB. This may be the case for standards and metadata production. In other cases, for example, 'making GSDI benefits accessible to all nations', direct involvement from these organisations seems to be essential. These organisations are and will be highly influential in developing nations and the need for an unequivocal endorsement on GSDI is basic.

As for the UN system, the situation was studied during the 1997 UNRCC for The Americas, later concluding with a proposal for the creation of a UN Permanent Geographic Information Commission and the need to re-engineer the Regional Cartographic Conferences, drawn up by the 1998 Special Working Group meeting in Mexico. The main issue still remains and that is, how the UN will move from actual recognition of GSDI relevance to a practical level of involvement in spatial data infrastructure promotion within the next decade. For instance, UN sponsorship of SDI key activities following an agenda, which is non-existent today, appear vital to facilitate regional participation and access of developing countries to already available data.

With respect to the World Bank there has recently been progress. The World Development Report of 1998/99 focuses the Bank's attention on the information revolution and signals three main areas of activity: (1) developing nations must include policies to narrow the knowledge gap, (2) all parties must work together to strengthen the institutions needed to address information problems and (3) knowledge is at the core of any development effort. This statement, coming from the Bank, is an open invitation to GSDI authorities, since the approach is still essentially, a very conceptual one.

On the other hand, the role of bilateral cooperation and that of international geographic organisations should also focus its agenda on the need to support this 'information for all' scheme, by promoting SDI activities in the emerging regions. This includes spatial data production, delivery mechanisms and metadata standards<sup>10</sup>.

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<sup>9</sup> The World Bank. 'Knowledge for Development' report. 1999.

<sup>10</sup> Colombia recently signed an Action Plan with the US to initiate cooperation resulting in data sharing, standards, protocols, and methodology training consistent with the GSDI objectives.

One important way of understanding the many benefits derived from GSDI is, obviously, by practising it. At this stage of development, SDI is also an educational process ('working locally but acting globally'). In terms of the various elements involved in SDI, with respect to the developing nations, there is currently more training than education.

Clearly, vendors move quickly and, before costly in-depth studies on SDI are produced or resources are specialised, hardware and software is being obtained as the solution to 'everything', and the training received is by and large, the one included in the commercial deal, which is more mechanical than conceptual. All of this translates into significant problems regarding data production and quality, which are 'solved' via hardware and software upgrading.

This cycle is not efficient. The matter should be highly relevant when considering technical assistance as part of bilateral cooperation agreements or when defining the agenda for the different education commissions, that act as part of the international geographic organisations. Many cases studies are showing the existence of in the developing world of a tremendous gap between technological tools available and poor levels of use, due to some extent, to low availability of specialised resources and the quality of technical assistance.

### **Conclusion: moving data production and ICDE, to promote social, economic, and environmental development in Colombia**

The World Bank, in its latest development report, sums up this situation when it states that 'developing country governments, bilateral donors, multilateral institutions, nongovernmental organisations and the private sector must work together to strengthen the institutions needed to address information problems'. Otherwise, there is a higher risk: information capacity in globalisation is raising the danger that 'the poorest countries and communities will fall behind more rapidly than ever before'<sup>11</sup>.

SDI application in the developing world will take time. However, the outlook will be notably different if, by the next Cambridge Conference, lessons are learned, new technologies incorporated and SDI promoters obtain support from world leaders to spread its benefits to all nations in need. As for Colombia, the solution involves an adequate combination of many key elements: budget, capacity-building, cooperation, technology, policy, people, sustainability and support for SDI development. Information is the entranceway to unlimited possibilities for development and democracy. In Colombia, peace negotiations with old guerrilla movements are at the core of the current national development plan.

The geoinformation strategy presented in this paper relies on specific and realistic goals that can be attained following an institutional plan, many of them by the year 2001, when Colombia will host the GSDI 5, the Global Map summit, and the General Assembly of the Pan-American Institute for Geography (PAIGH).

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<sup>11</sup> The World Bank. 1999 World Development Report.