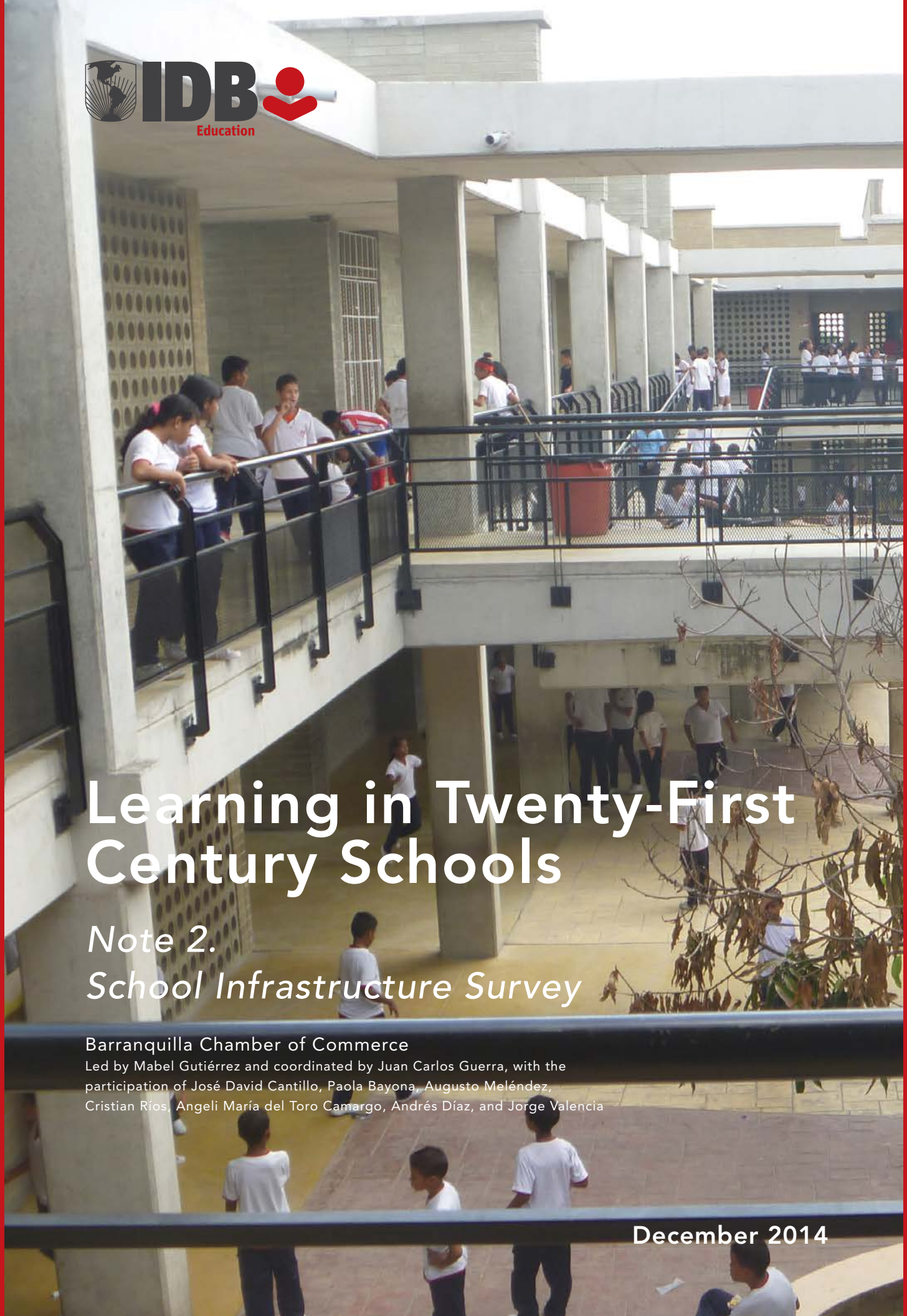

IDB Education

Learning in Twenty-First Century Schools

Note 2.
School Infrastructure Survey

Barranquilla Chamber of Commerce
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School Infrastructure Survey

Constructing a methodology for measuring the condition of school infrastructure

The process of developing a methodology for the management of education infrastructure in the countries of Latin America and the Caribbean began with an analysis and discussion of types of variables, common content, and unified criteria across this group of countries. This produced a definition of school infrastructure as well as implications for managing it in accordance with each country's legislation, plans, and policies. Based on this analysis, it was possible to determine that in each of the participating countries, there was recognition of the educational infrastructure as a key factor in improving the quality of education, and this is reflected in their national policies that explicitly present the need to build, renovate, and maintain the physical plant of the schools.

Consequently, surveys of school infrastructure took place in each participating country. These surveys were undertaken for various reasons, and their implementation varied depending on levels of development and the diversity of human and technical resources available for data gathering. However, this data collection had a number of common features, including the importance of taking an integrated approach to aspects such as the provision of teaching resources, the size and quality of premises, the access to basic public services, the safety of the buildings, and the quality of infrastructure and furnishings.

The main themes that emerged from the surveys in all the countries participating in the initiative fall into five main categories:

- General information about schools;
- Coverage and enrollment;
- Physical and spatial aspects of the facilities;
- Availability and quality of public services; and
- Condition of school buildings and the learning environment.

It is important to note that although data collection on school infrastructure in LAC countries shared these basic categories, each country's specific social and institutional context also played a part. This included the availability of funding for expansions or building new school infrastructure, the level of decentralization at which decisions on public investment are made, the geographical extent of each school's territory, and the density of educational institutions (among others). These aspects proved a limitation in obtaining timely, up-to-date, and reliable data on the condition of school infrastructure.

To circumvent these difficulties, it proved necessary to arrive at a consensus on a data collection

methodology through sharing knowledge on the basic and essential variables involved in issues of school infrastructure management. To this end, the countries sought to agree on a unified process for identifying, quantifying, assessing, and characterizing the condition of their school infrastructure while respecting the economic, social, and institutional specificities of each country. This methodology was developed in intensive workshops, both face-to-face and online, in which experts from the entire LAC region took part in interdisciplinary working groups. These included technical experts, professionals, and heads of education ministries, departments, or secretariats from the countries that opted to participate in this activity, namely Chile, Colombia, Guatemala, the Dominican Republic, Honduras, and Mexico, with Argentina, Costa Rica, Jamaica, and Panama joining later.

Initially, online meetings took place between representatives from each country and the project implementation team. Each meeting aimed to share information that would be useful as input when drawing up the survey instrument, using tools and strategies (questionnaires, interviews, etc.) designed specifically for these meetings. These online workshops made it possible to reach a consensus within the implementation team and acted as launch pads for the following phase of formulating criteria and reaching agreement on the basic features of the data collection as well as the specific needs of each country according to its particular situation. This phase took the form of face-to-face meetings with the Technical Team[1] of the Regional Technical Cooperation strengthened with the participation of experts and advisors who accompanied them from their country of origin.

Once the methodological, conceptual, and procedural roadmap was agreed on in the face-to-face meetings, each country's representatives approved all decisions or adjustment during the next round of online workshops led by the Executive Team. Each country was involved in all steps and decisions taken throughout the process, and approved and monitored them. This process of agreement produced a unified methodology for gathering data on the condition of school infrastructure, consisting of:

- Data collection instrument (survey manual);
- Data collection strategy; and
- Model for describing the condition of school infrastructure.

These three aspects are described below.

Data collection instrument

Developing the survey instrument involved analyzing the themes of each survey manual (or its equivalent) in each of the countries taking part in the initiative and synthesizing its contents into four main areas:

- General information and school provision;
- Surroundings and public services;
- School buildings; and
- School environment.

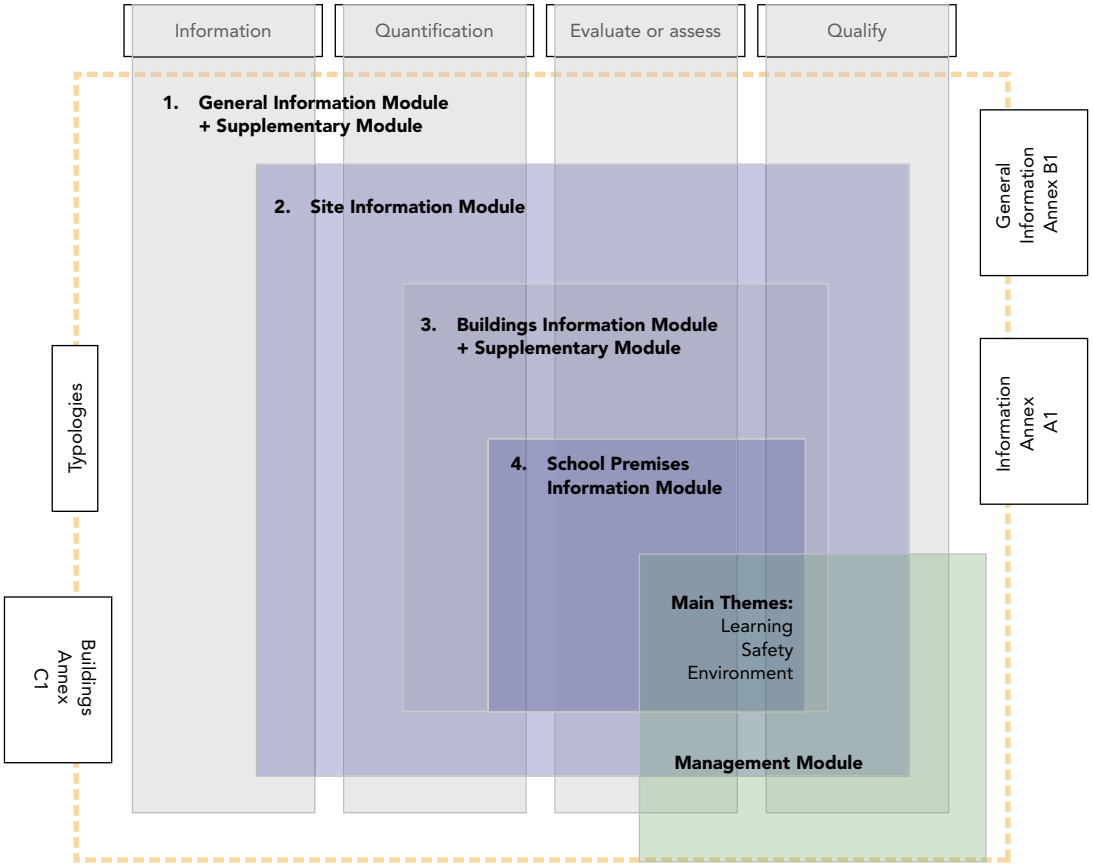
As well as identifying these categories, the survey instrument aimed to find solutions to common problems and to meet the various countries' needs for information in a way that would enable those responsible for formulating and implementing educational policies and to identify any delays or deficiencies in each country, particularly in terms of basic services. These included:

- School accessibility;
- Basic safety;
- Natural hazards and climate change;
- Practicality and comfort of school premises;
- Structural and material systems in the school buildings and spaces; and
- Availability and quality of adjoining areas as well as additional physical provision for learning activities, sports, and socializing.

Consequently, the survey instrument's content was oriented toward the need to deepen knowledge and the evaluation of internal and external school

1. The Technical Team of the Regional Technical Cooperation program consisted of one representative with expertise in the area of school infrastructure from each country.

FIGURE 1.
General survey format



environments and of their physical components. The survey instrument recorded the information in four modules:

- Basic: General information on the school's geographical position and population;
- Site: Access, enclosures, hazards, and public services;
- Buildings: Materials, access, control, and supervision; and
- Spaces: Size, comfort, materials, other physical aspects, accessibility, networks and systems, and additional spaces.

In addition to these categories, the survey instrument included supplementary variables, making it possible to include country-specific themes such ethnic groups, social vulnerability, frequency of inspection and cost of maintaining building, and detailed structural surveys by building or structure (among others). This category includes the Supplementary General Information Module (B1) that complements the information in the General Basic Information Module. The Supplementary Buildings Information Module (C1) complements the Basic Buildings Module 3 by including information on maintenance and costs per building. Figure 1 summarizes the current structure.

It is important to note that the four Basic Information modules bring together information common to all the countries, while the two Supplementary Information modules contain further and more detailed information in addition to the content of the basic General Information and Buildings modules. Furthermore, the Information Annex A1 makes it possible to standardize the processing of information from the

basic and supplementary information modules and to add items if further observations or clarifications are required during the survey process.

The consensual process made it possible to identify differences between countries when setting standards and regulations for measuring the conditions of school buildings, external spaces, and physical resources. This involved identifying various types and classifications of school environments as well as materials and features (among others). This required creating typologies that grouped together all elements of school infrastructure for each country. These typologies gave the countries the flexibility to include (or exclude) certain types of school environment, materials, or infrastructural elements. It was then possible to modify or change these without affecting the structure and main content of the basic and supplementary information modules. The typologies also included a rating of the condition of various elements and variables for the sites, school buildings, and school environments, and enabled the researchers to rate these on the basis of unified criteria.

Data collection strategy

Once the structure of the survey data collection instrument was agreed upon, the collaborative work of the group of experts from each country and the project implementation team focused on establishing procedural and operating guidelines for data collection. This involved defining the basic indicators that would enable national and local education authorities to make better decisions on investment and prioritize plans and programs for schools' needs for extensions, repairs, improvements, and maintenance.

Planning the implementation of the school infrastructure survey took into account the plans and policies of the local or national education authorities in the countries concerned that wished to know the condition and needs of their school premises and educational institutions. The survey instrument made it possible to identify which regions or geographical areas needed to be surveyed and to specify the scope and details of the data to be collected on-site. The data gathering process did not aim to produce complete datasets on all the country's institutions but to focus on the education authorities' specific programs. The data collection methodology involved three phases: preparation, implementation, and follow-up, as described below.

Structuring the project

In this phase, the local or national education authority took on or delegated the planning, implementation, and supervision of the project to the appropriate office or department via a project leader or director tasked with managing the institution's project team and the supplies needed to implement the project. Each country's project leader, aided by the working team, was responsible for defining a number of aspects:

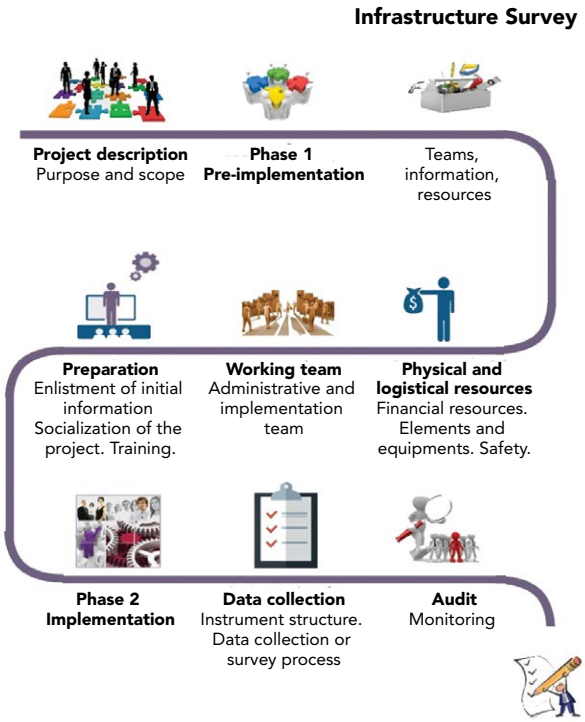
- Geographical zone or region;
- Number of institutions;
- Data to be collected;
- Timetable;
- Costs;
- Availability of resources;
- Mode of implementation or subcontracting;
- Data from previous studies;
- Scope and terms of reference;
- Minimum human and material resources needed;
- Survey specifications;
- Supplies needed for the survey;
- Contracts with the implementing body; and
- Coordination of data processing with the technical office.

Pre-implementation

This phase first included the initial management of the project, involving the allocation of financial resources and appointment of the person in charge of the project. The second phase involved preparing the physical and logistical resources needed to carry

out the project, recruiting personnel, setting out a timetable for the work, and making sure that all elements, teams, and supplies were in place to ensure the smooth implementation of the project. The third phase consisted of putting the working team together by hiring staff and contractors. In this respect, it is advisable for supervisors to have an architectural or civil engineering background with at least two years' experience of supervising and running projects, while the researchers should be final-year architecture or engineering students, junior architects or engineers, or professionals with property surveying experience. The fourth phase covered preparation before going into the field, the mapping of routes according to complexity of access, transportation, roads, and journeys timed with the help of geo-referenced plans from the educational institutions. It also encompassed the preparation of the survey teams and discussions about the project with school head teachers or principals.

FIGURE 2.
Summary of data collection phases



Implementation

The aim of the implementation phase is to carry out the process of locating, collecting, and organizing the data collected by the researchers using the survey instrument. This phase covers the basic procedures for collecting data as well as verifying and checking the physical and digital data collected.

It is important to stress that once the implementation phase is complete, updating and using the data is the responsibility of the local or national education authority, which can then access the data via the information system designed for this purpose in order to produce reports and analyze the indicators of the general condition of the school campuses featured in the survey.

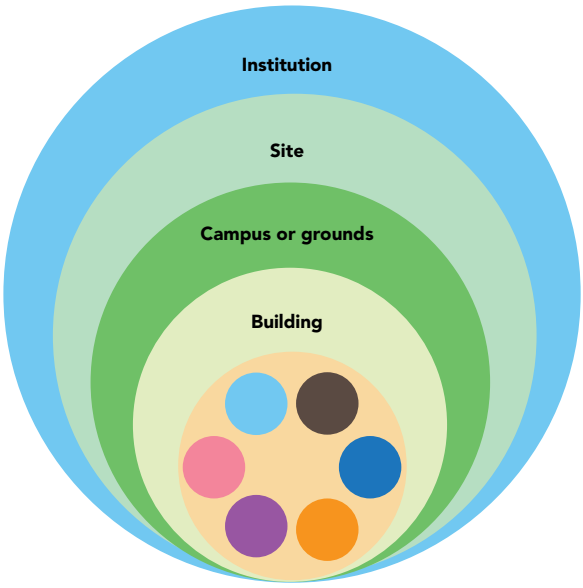
Figure 2 shows an overview of the consensually agreed stages of the data collection process.

Assessment model

The methodology for managing educational infrastructure was the result of agreement reached through participation and collaboration. The survey instrument and the data collection and processing model included a set of basic guidelines for processing and updating this information. In this way, the data analysis could serve as the basis for decision making over ascertaining, quantifying, evaluating, and characterizing the condition of infrastructure and physical resources in the region's schools. With this in mind, the working team reached a consensus on general guidelines for evaluating the condition of key aspects of school infrastructure in order to identify, prioritize, and resolve some of the problems common to all LAC countries.

These ratings included scales for the analysis of the educational institution, premises and annexes,

FIGURE 3.
Delimiting school environments



property or plot, school buildings, and the school's setting or environment (Figure 3), subdivided as follows:

- Spaces for teaching and curriculum activities; and
- Spaces for support activities such as extensions and supplementary classes, supplies and processing, and management and administration.

All of this relates to the requirements and standards of the particular educational level and school day as well as to regional political and administrative categorizations.

The main basis for structuring and analyzing the information lies in linking and aggregating the data on school premises. Figure 3 is a diagrammatic representation of how this is done.

As shown in Figure 3, school spaces are made up of distinct environments housed in buildings arranged on a campus or grounds. In other words, they are parcels of land upon which is built the physical infrastructure in which teaching and learning take place. An educational institution consisting of one or more campuses is defined as a unit providing education services and duly recognized by local or national education authorities. Finally, it is important to note that some of these educational structures contain various sites or campuses, which consist of annexes administered by a main institution.

The phases or stages in the process of gathering, processing, and analyzing the data take place as follows:

- The survey instrument for collecting data in the field gathers the information needed to analyze and evaluate the condition of the infrastructure according to common criteria for rating the condition of each component of the school infrastructure. These are ranked on a scale of 1 to 4, 1 being the lowest and 4 the highest;
- The second stage consists of entering the data into the software through inputting and data feeds and checking for data consistency. The data collected through the survey instrument, blueprints, or building plans, and photographs taken by the researchers in the course of the survey are consolidated and validated. All of these are entered into the data system;
- The third stage consists of processing and analysis. The data are evaluated and rated according to common benchmarks and standards, ensuring comparability between countries. The condition of the relevant aspects of school infrastructure are noted according to the items and questions that feature in the survey's basic and supplementary modules.

Using this rating model, education authorities in each country are able to analyze priorities and set goals as a function of the available functional and management time. Similarly, the model makes it easier to optimize, use, and improve school buildings compared to replacing the entire region's school infrastructure with new buildings in the short and medium term.

School infrastructure: From measurement to integrated management

To complement the data collection methodology, the project also needed an instrument that would enable educational administrators at various levels to:

- Obtain data organized and correlated in terms of comparable criteria;
- Prioritize school construction projects by defining a rating mechanism for various school elements and setting up a rating scheme to integrate and bring together the main findings; and
- Plan future investments according to the deficiencies identified by defining actions, projecting future scenarios, and evaluating the impact of these projections.

Based on these data, the Regional School Infrastructure Survey (CIER) aimed to provide an integrated methodology for data collection that would form an integrated information system to guide the actions of management.

Continuing the participatory methods outlined in the previous section, the working group met regularly in online sessions and approved the conceptual model underlying the technological platform. This provided input into group discussions. Finally came the challenge of agreeing on the management model and the functionalities included in the infrastructure management platform. This took place in a face-to-face meeting. As the instrument needed to be sufficiently flexible for use in each country, the working group agreed upon a dataset that could be entered into the system when installed, including parameters such as political and administrative divisions, educational level, and school day as well as standards set by local regulations.

The instrument's technical structure features a typical three-tier multilevel architecture (database, business logic, and interface) that is also adaptable in terms of technological options for database searches and operating systems.

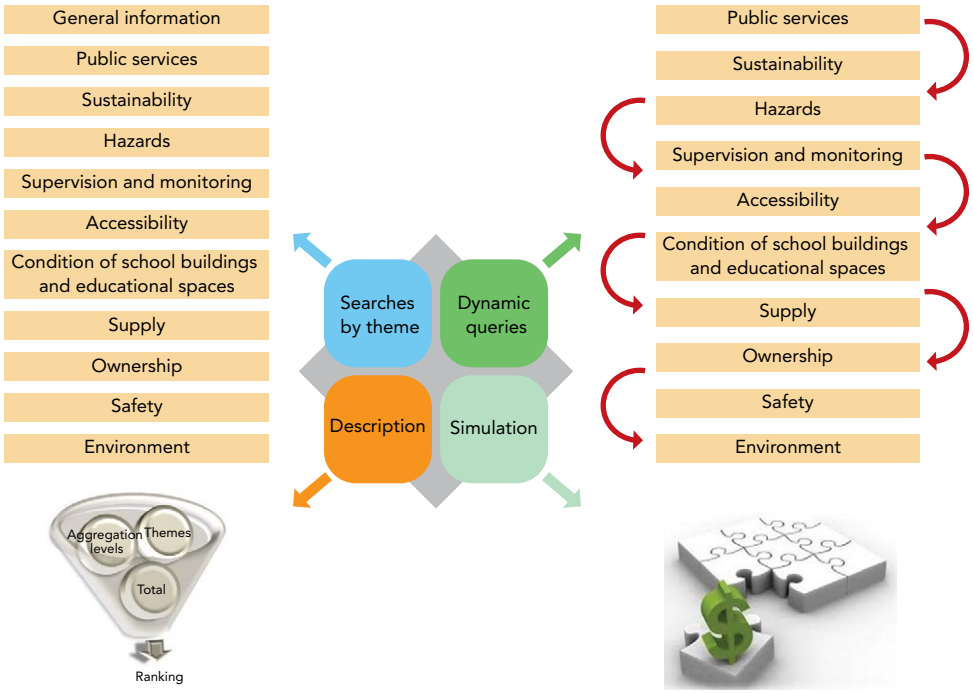
Thus, there was agreement over the instrument's aim and scope, and this should help with decision making relating to school infrastructure through the use of a reliable application for prioritizing school building projects and for planning future investment in order to fill any gaps identified. The instrument makes it possible to:

- Consolidate information on school infrastructure in territorial units corresponding to educational authorities;
- Manage information to facilitate decision making in the education system;
- Maintain a database of school infrastructure; and
- Combine data or variables collected via the survey instrument, relate them to standards and other baseline values, and aggregate them by geographical area.

The CIER information system seeks to facilitate decision making on school infrastructure management by organizing, comparing, and correlating the information obtained through this data collection methodology. This management aid allows for four types of search: theme, dynamic query, rating, and simulation. These models make it possible to process data with a view to resolving the management issues identified by each country. Ten management themes incorporated within the CIER information system modules relate to these issues, namely:

- Services: Data on the provision and quality of water, electricity, gas, mains drainage, rainwater collection, garbage collection, telephone, and internet provision and systems;
- Sustainability: Data on caring for the natural environment;
- Hazards: Natural and human-made hazards and conditions capable of affecting educational premises;

FIGURE 4.
Operation of CIER information system



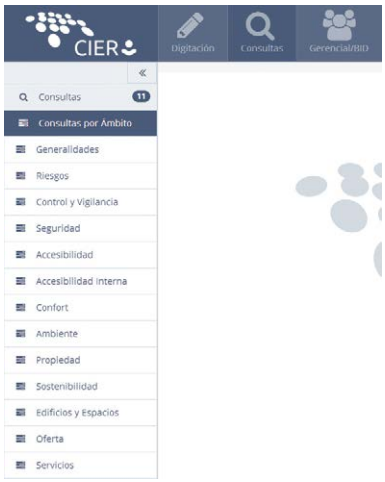
- Control and monitoring: Conditions of vulnerability in terms of relationships between perimeter fencing of schools and public law enforcement;
- Accessibility: Types of access to properties and their condition;
- Condition of buildings and campuses: Condition and characteristics of materials used in construction;
- Supply: Current capacity of properties and campuses compared to number of students;
- Ownership: Data on ownership and legal title to school properties;
- Safety: Structural safety of school buildings and availability of fire detection and protection systems;
- Environment: Information on functional units and compliance with local standards; and
- Internal accessibility: Emergency evacuation routes and signage.

Figure 4 shows how the CIER information system works.

The "themes" heading is used extensively in the CIER module both in the form of searches by theme and in interactive searches. Searches by theme (Figure 5) make it easier to visualize data from the survey instrument on various aspects of school infrastructure, its condition, and baseline indicators, which enable evaluation according to a standard or benchmark. Searches make it possible to display data for each property featured in the CIER as well as various levels of aggregation by political or administrative division in each country.

Interactive searches enabling simultaneous searches for different themes make it possible to call up information that allows the user to identify any deficiencies in a property's infrastructure and to select variables from other themes in order to prioritize various types of intervention. For example, it is possible

FIGURE 5.
Search by theme



to search for properties vulnerable to natural hazards, to find out details of ownership, or to combine these with structural condition. The system thus makes it possible to select themes for cross-referencing. Figure 6 shows the search window:

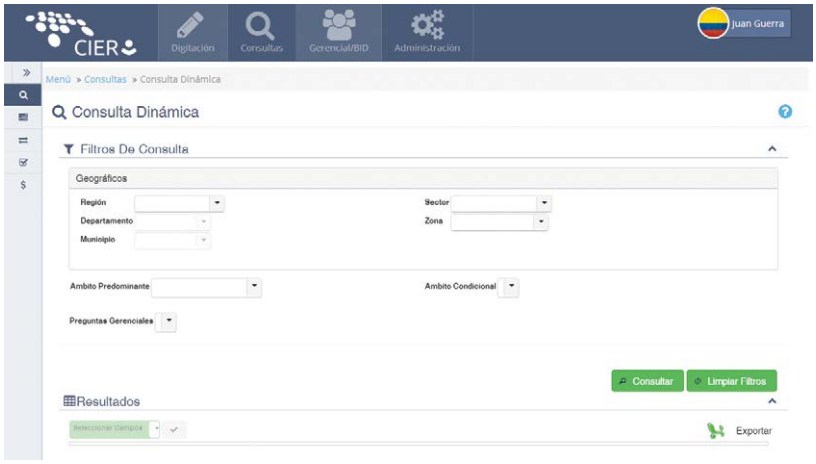
Search by rating also makes it possible to generate a ranking by defining a model that ascribes a rating to each property and all levels of aggregation, with themes relating to infrastructure and its components weighted according to specific criteria. This makes it possible to compare properties in terms of the general condition of their infrastructure, using either individual or aggregated searches. Comparisons between the infrastructural condition of properties according to specific criteria are also possible, enabling the prioritizing of investment in order to direct resources where they are most needed based on detailed knowledge of the condition of the infrastructure and its existing capacity.

Finally, the simulation module creates scenarios based on a number of assumptions (measures), enabling cost-benefit analyses of outcomes and the creation of projections. This makes it possible to estimate the cost of extending the infrastructure to meet the country's priority needs for functional units in terms of existing school capacity. This module also generates cost/benefit scenarios for remedying infrastructural deficiencies according to current norms and standards and projections of construction costs for new campuses, taking into account selection criteria and building capacity (Figure 7).

This module provides data on which to base decisions over which interventions to prioritize. It makes projections of the costs of such interventions, identifies the areas requiring investment, ranks properties according to the condition of their infrastructure, and determines whether they conform to parameterized standards in accordance with each country's norms. It can also rank the condition of specific elements of the infrastructure.

It is important to emphasize that each stage of development of the structure described here, which is the CIER's basic operation, involved the definition of a set of indicators for each theme or measurement variable. This required constant feedback between the project implementation team and the interdisciplinary group of experts. This also meant that the technical

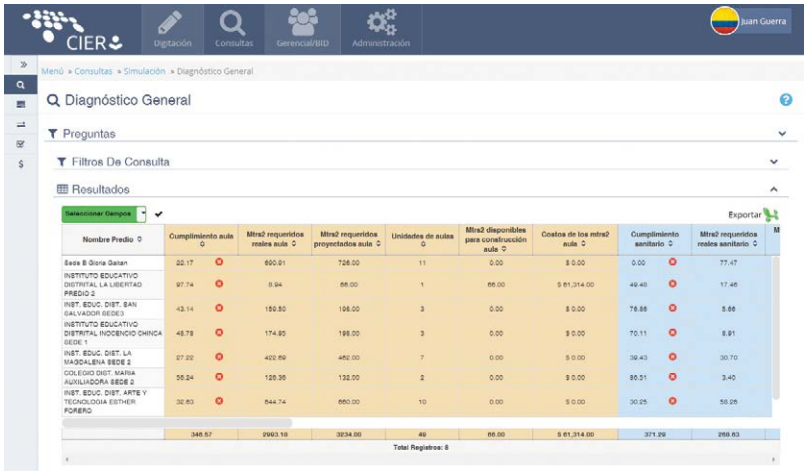
FIGURE 6.
Dynamic queries



characteristics of the design and function of each instrument were agreed upon and approved by each country.

In developing the project, it was necessary to test the system and the data collection methodology in the field by means of pilot studies. Thus, field studies were conducted in order to implement all stages of the methodology, as described below.

FIGURE 7.
Simulation model



CIER pilot study

The CIER pilot study aimed to find out if any adjustments to the survey instrument, the data collection methodology, or the information system were necessary by actually using the instruments designed.

The pilot study took the form of visits to 40 selected educational institutions in the city of Barranquilla, Colombia. Two teams of researchers conducted these visits, each team consisting of two final-year civil engineering students, a supervisor, and a professionally qualified civil engineer, who were equipped with all the materials and instruments necessary for conducting the data collection in accordance with the methodology. The working team's task was to conduct the survey in the educational institutions previously designated by the director and supervisor, in three stages:

- Stage 1: Filling out the general and administrative questionnaire by the head teacher (or equivalent) of the educational institution;
- Stage 2: Obtaining general information on-site and identifying the school buildings and premises within the institution; and
- Stage 3: Recording planimetric information on each school site.

During each of these three stages, there was detailed observation of the activity of the working group with the aim of ensuring correct use of the survey instrument and adherence to the methodological guidelines. Once this process was complete, the pilot study resulted in methodological adjustments to CIER procedures.

Firstly, it was necessary to ensure that those responsible for administering the questionnaire were fully conversant with the technical concepts involved in entering the information so that some revision and editing to the survey manual could take place. In the revised edition, there was greater emphasis on using unified criteria, simpler language, and definitions describing technical aspects such as enclosures or perimeter fences, access to school premises, the physical condition of evacuation routes, and the use of school spaces.

Secondly, field testing made it possible to adjust procedures for planning school visits, particularly in the case of the interview concerning general information. The pilot study showed that school personnel sometimes had no information on the identification of plots and buildings or the consumption and cost of public services (among others). There were also difficulties in carrying out measurements on some school campuses because of restrictions due to opening hours or security as well as difficulties in gaining physical access to some institutions.

This situation led to further thinking on adjustments to the CIER methodology in terms of familiarizing head teachers and school principals with the project as well as setting up more and better channels of communication between the various actors involved in the pre-implementation and implementation phases of the project.

Conclusions

The CIER system is a valuable instrument for confronting the challenge of improving the quality of education in LAC countries. It helps remedy the lack of adequate, freely available, aggregated, and complete data that would enable the monitoring and evaluating of conditions of and changes in school infrastructure. A lack of information and a dearth of reliable statistics have historically been an issue in the sector despite the fact that these are crucial to guiding public educational policy.

Despite these benefits, we should not only consider the technical aspects of implementation but also be aware that applying it requires political will on the part of the authorities. Hence, making a methodology such as CIER available is not a definitive solution to the problems of school infrastructure given that cultural, social, and economic conditions also count for a great deal in the area of education. In this respect, integrating the CIER system into public policies in LAC countries involves a continuous process of dialogue and construction.

Even with these constraints, the CIER system has proved to be an instrument with the potential to have a positive impact on improving the quality of education in LAC countries provided there is the political will. Over and above this potential, the experience of collaborative work between the countries of the region for their mutual development has been a notable success.

Developing the CIER system was successful in bringing together and creating links between the various actors within the education system and the management of school infrastructure in LAC countries. Its constant concern for creating a space for interdisciplinary discussion over improving the quality of classroom processes is a good model of collaborative work, building consensus around issues of social and economic development in Latin American and Caribbean countries.

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