

**CARTOGRAPHIC DASHBOARDS TO ENHANCE THE DATABANK OF OFFICIAL
STATISTICS IN QUEBEC (BANQUE DE DONNEES DES STATISTIQUES OFFICIELLES -
BDSO)**

BOUCHARD D.

DBx GEOMATICS inc., GATINEAU, CANADA

1. BACKGROUND & OBJECTIVES

The Institut de la statistique du Québec was established by an Act passed by the National Assembly of Québec on June 19, 1998. The Act defines the mission of the Institut as follows:

"The Institut de la statistique du Québec is the government body in charge of producing, analyzing and disseminating objective and high-quality official statistical information for Québec. This information enhances knowledge, enlightens debate and supports decision-making by the various players in Québec society."

(Source: http://www.stat.gouv.qc.ca/organisa/mission_an.htm)

This high quality official information has the advantage of being impartial. Various actors in the Quebec society benefit from this additional knowledge to enlighten discussions and support decisions. For more than 10 years now, the Institute's presence has brought great experience and expertise in producing Quebec's statistics. It also plays a major role in supporting the distribution of this valuable information.

In November 2003, the ISQ launched the on-line Databank of Official Statistics in Quebec (BDSO) in collaboration with other government departments and organizations. This database, publicly accessible on internet, includes statistics collected during the past 10 years and provides a portrait of the Quebec society. The variety of statistical themes makes it a valuable source of information, covering subjects such as municipalities, revenues, education, economy, health, sustainable development and demography. The BDSO users have full access to a wide range of data covering most of the subjects of interest about Quebec and its population.

During the fall of 2008, 5 years after the launch of the BDSO, the ISQ started to think of a way to add a fresh approach to the BDSO. The existing mapping engine did not fully meet expectations anymore. There was a need to review the user interface and the presentation of statistics. A more user-friendly, interactive and high quality visualization tool was required.

2. APPROACH AND METHODS

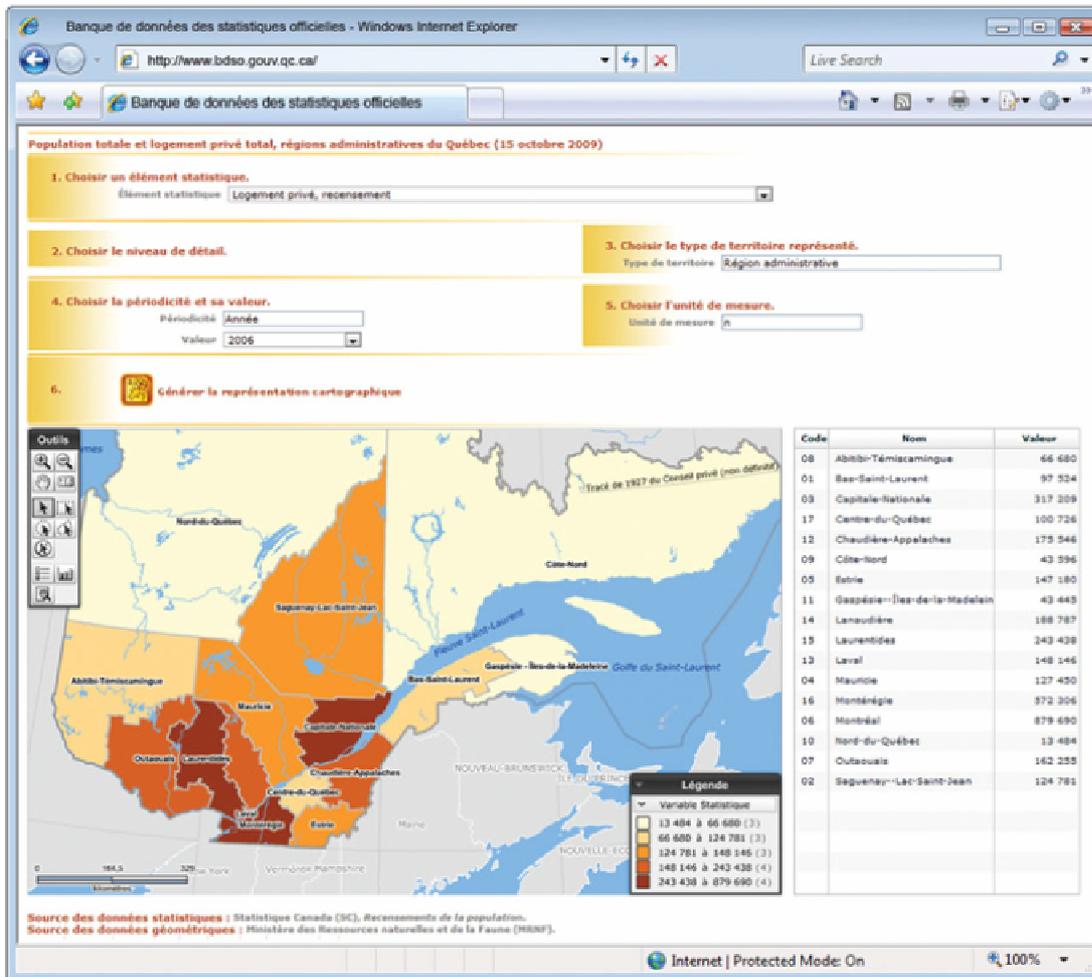


In the context of the Web 2.0, and in order to improve access to the information, a new way of presenting the information was required. The need for advanced analysis tools was also a driving factor. Using dashboard representations offers the advantage of showing information in various formats, all available at a glance. Users can easily compare data displayed within highly interactive maps, graphs and charts. Using the appropriate representation for each type of data helps the user better understand the challenges faced when dealing with health, education or economical subjects.

The ISQ decided to adopt CartoVista, a solution developed by DBx GEOMATICS. The solution offers the flexibility to personalize each representation depending on the context.

- Dashboards: the ISQ developed several dashboards on different themes. The user has access to pre-defined representations through a drop-down list. These pre-defined data representations provide a compilation of data that will help the public understand the various subjects. Each dashboard includes a map with graphics, such as histogram and comparative charts or pie charts. The high level of interaction between the different components of the dashboards makes it an effective analysis tool. For example, when selecting an area on the map, the graphs and charts are automatically updated to reflect the selection.

- Mapping representation: leveraging an Oracle Database infrastructure, the ISQ is offering a simple cartographic representation of the criteria selected by the users. They have access to a wide range of data. Through drop-down lists, they are guided to select their data of interest. The information is then available in various formats: tabular, graphic or cartographic. The CartoVista mapping engine is then being used and fully integrated with the Oracle Database.



CartoVista Mapping Engine in the Oracle Database Infrastructure

The maps are seamlessly integrated within the other user interface components thanks to the Adobe® Flex® environment, offering a very dynamic mapping interface. Simple tools and functionality are offered to the users to navigate in the application.

Here is a review of some of the solution's assets:

- A new way of representing statistics
- The choice of an advanced thematic mapping software (CartoVista), with emphasis on the graphic quality of the maps, and a high level of interactivity
- The capabilities to display maps and graphs on the same web page
- The Flex open source development environment giving full autonomy to the ISQ for producing interactive dashboards
- The easiness to access the information
- The simplicity of a CartoVista deployment that does not require a heavy server infrastructure.

The ISQ decided to base its new development on the Adobe® Flex® technology. This technology offers a modern programming language based on industry standards, with a programming model that supports the best IT practices. In a few weeks, the ISQ programmers were trained, up to speed and able to develop several interactive dashboards.

Using a vector based technology for the thematic maps ensures full flexibility and graphic quality. The ability to add new components with an open architecture was another key factor to the success of this implementation. It was mandatory to find technologies compatible with the existing infrastructure that required limited changes to the other components such as the Oracle Database.

Additionally the ease of integration of the different elements of the dashboard was also an important factor in choosing the technology.

The interactive thematic mapping definitely provided an interesting way of simplifying the information and provided a good basis for analysis. The user can display a thematic map of his choice in real time, within a user-friendly and highly interactive application.

On the cartographic side, the software is an ideal solution for any organization that is working with defined geographic boundaries that change infrequently. The ISQ boundary files fall in this category. The census data is leveraged by the normalized hierarchy of standard geographic units implemented for the dissemination of the census in the province.

CartoVista uses the same approach to define and present these hierarchies in a natural way that focuses on providing a user experience that is rich in terms of data binding, cartographic quality, theme interactivity and analysis capabilities.



CartoVista Drill-down Concept

CartoVista's maps for the ISQ application were organized as a hierarchy of maps to create effective drill-down navigation. Drill-down is a natural way to explore map data and understand links between geographies. Implementing a drill-down approach ensured that users can take full advantage of the census data while providing a basic understanding of the terms related to geography concepts and definitions.

SIMPLER WEB DEPLOYMENT

Traditional server-side mapping components require the setup of complex server environments with high performance hardware and software. In most situations, the applications deployed make extensive use of the server resources (memory, input/output, reading files on disk, etc.) to handle the delivery of the map services. When these map services become overwhelmed with large number of requests, they may become non-responsive or perform much slower because there are no more available resources on the server where the application is deployed.

In contrast, the ISQ maps are packaged in such a way to minimize the use of the server resources. In the case of a set of static XML files that contain the map thematic data, there are no server resources used other than storage. The web server simply returns the maps (a SWF file) and data (an XML file) requested to by the web browser via http.

Platform Independence

The ISQ dashboard solution is independent of the server platform. As there are no specific web server requirements, the maps can be deployed on any type of web server.

Installation simplified

The CartoVista platform independence simplifies the installation and deployment of the Institute's web mapping projects, whether it is for internal use or for a public facing web site. The software significantly reduces the burden on administrators that need to manage the web mapping project and server environment. IT administrators at ISQ can simply copy and integrate the CartoVista Flash viewer (a SWF file) in any web pages where it is needed to create an interactive map in a timely fashion. In addition, ISQ developers can use Flex to build and deploy their own dashboard projects with the same approach.

Local Standalone Deployment

The CartoVista SWF maps and its related XML data can be deployed locally on a user's computer or on any media or storage device (such as network drive, CD-Rom, or USB key). This provides useful ways for ISQ employees to share and distribute specific maps while having control of the audience as needed.

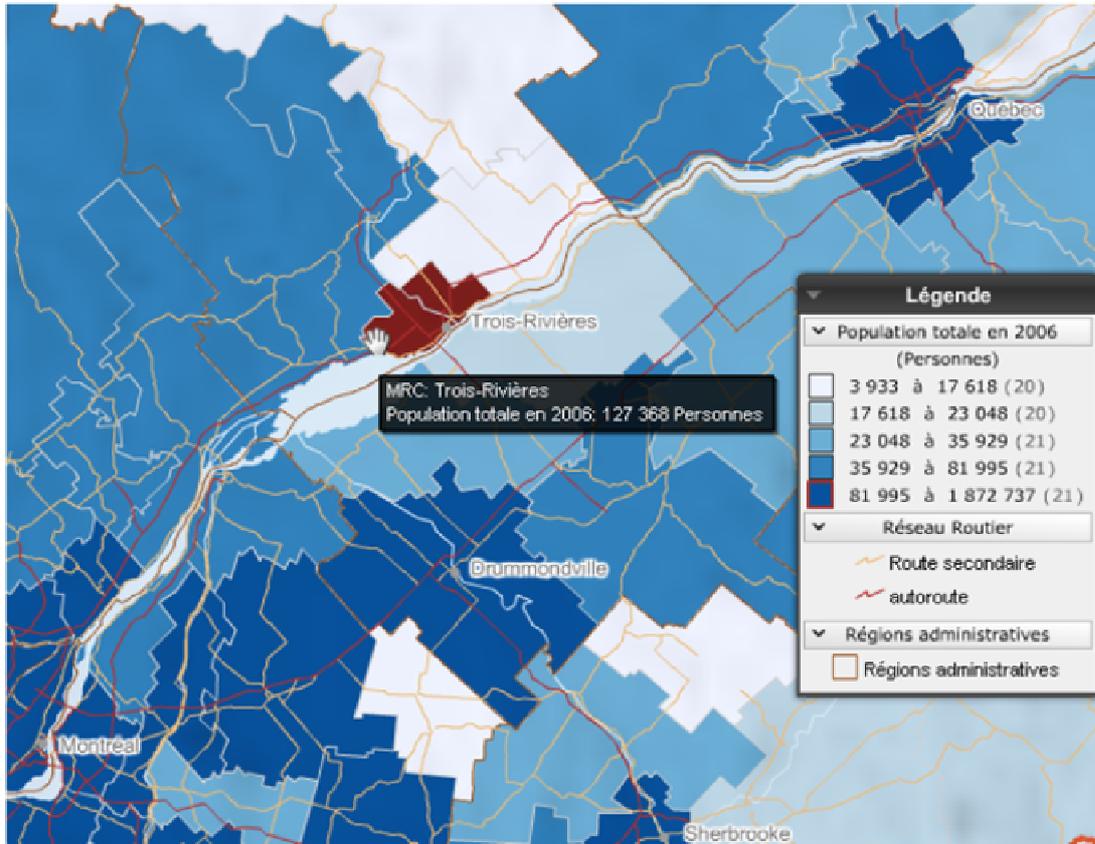
THEMATIC MAPPING CAPABILITIES

The ISQ dashboard maps feature advanced thematic mapping capabilities to display census information in innovative and meaningful ways.

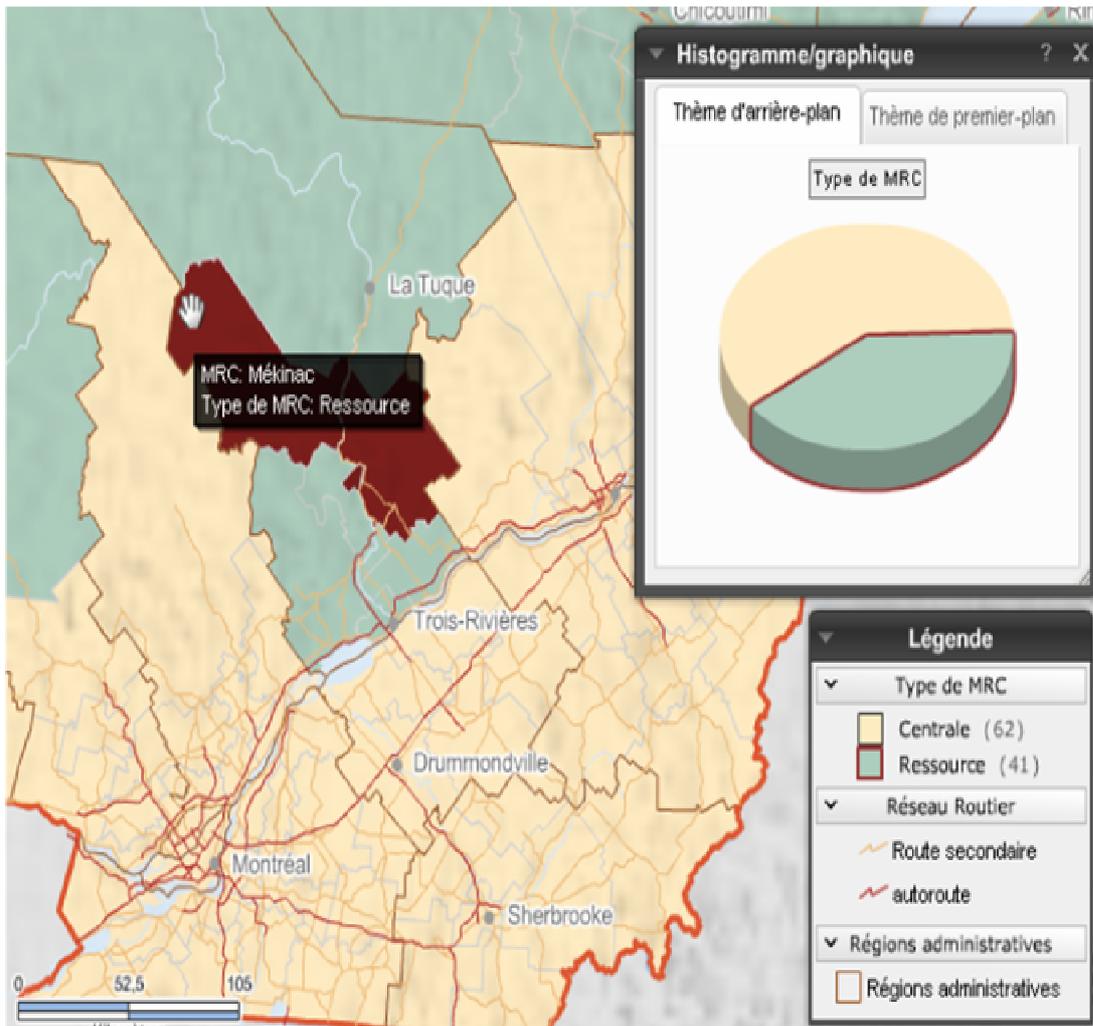
The CartoVista mapping engine includes the ability to create background and foreground themes on the fly from the attached map data, without having the need to go back to the web server.

Background Themes

Background themes are displayed on layers or region objects to show some data classification, either with ranges or discrete values.



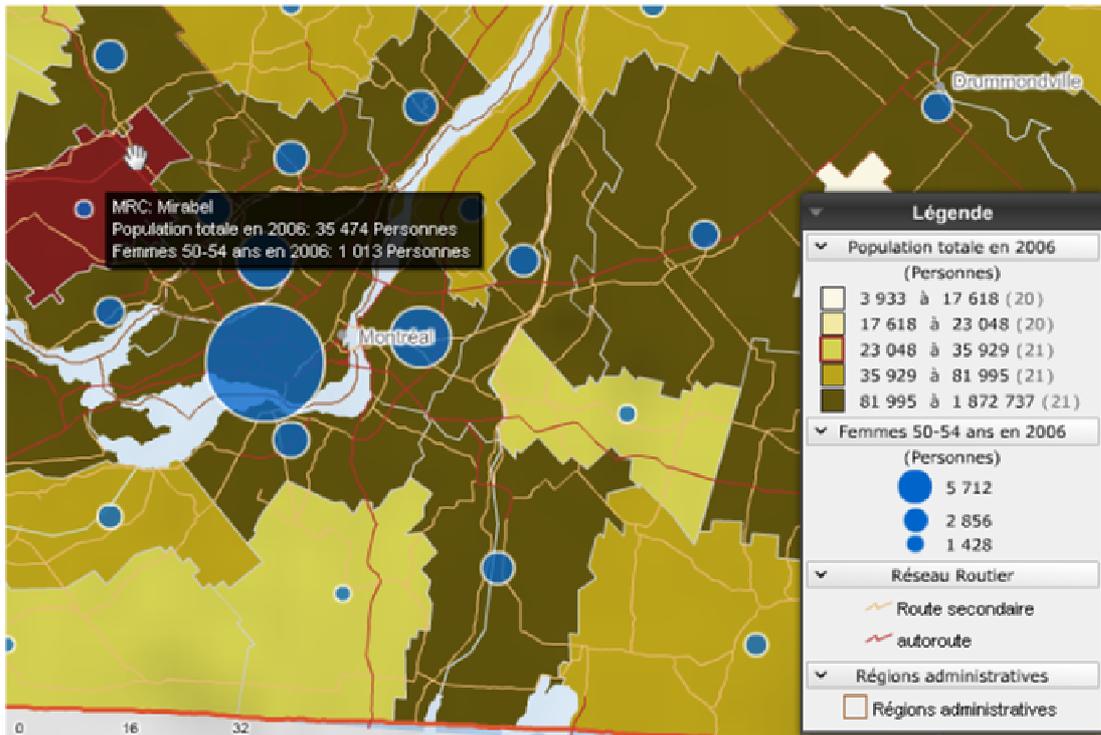
Background Theme – Range of Values



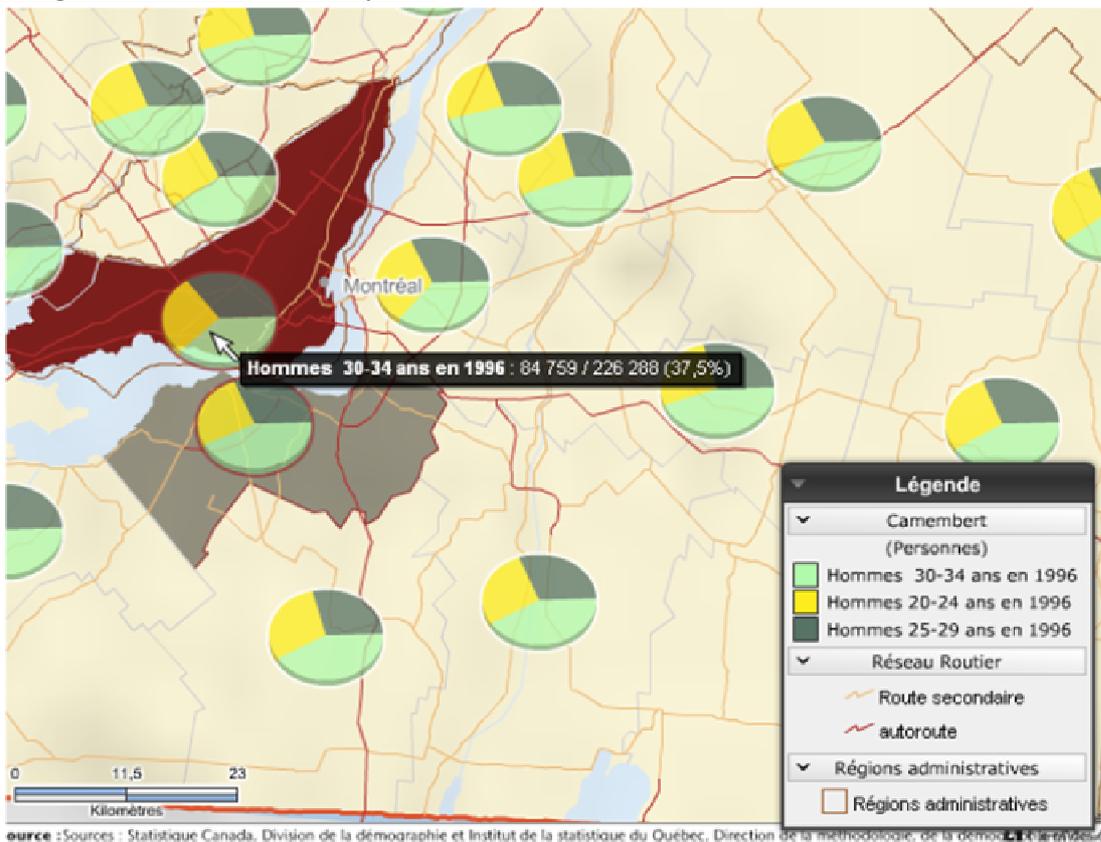
Background Theme – Individual Values

Foreground Themes

Foreground themes are displayed on top of the map to add another dimension to the background theme. Using symbols and pie charts, the user can show and easily compare numerical values in the data.



Foreground theme: Graduated Symbol



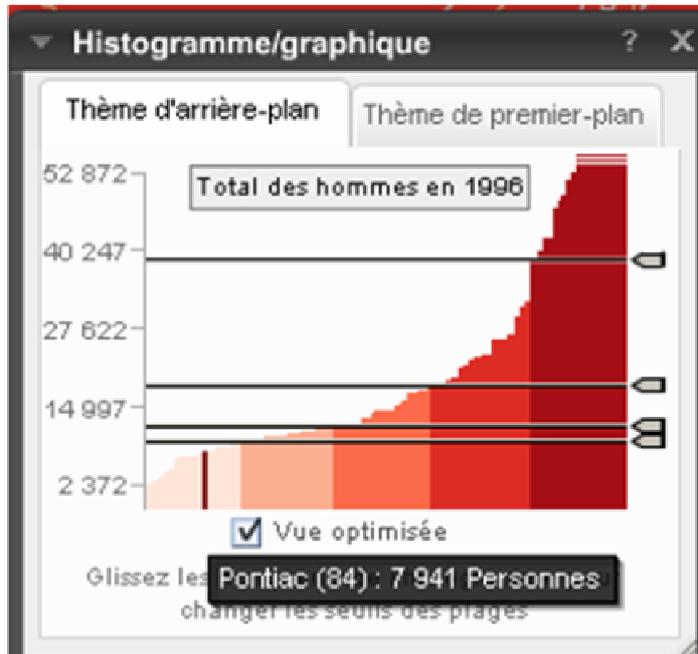
Foreground theme: Pie Chart

Modifying the Thematic Parameters Client-Side

In the application, the map thematics are fully customizable and can be changed on the fly for a much better statistical mapping experience.

All parameters of the thematic analysis are available via simple and effective dialogs. The user can change the analysis parameter and see the change on the map right away.

When displaying a range of values theme for example, the built-in histogram/graph window can be used to get a graphic representation of an indicator's data distribution, inflection points and thresholds. This is a very easy way to understand the minimum and maximum values in the data as well as providing the capabilities to change the range thresholds visually.



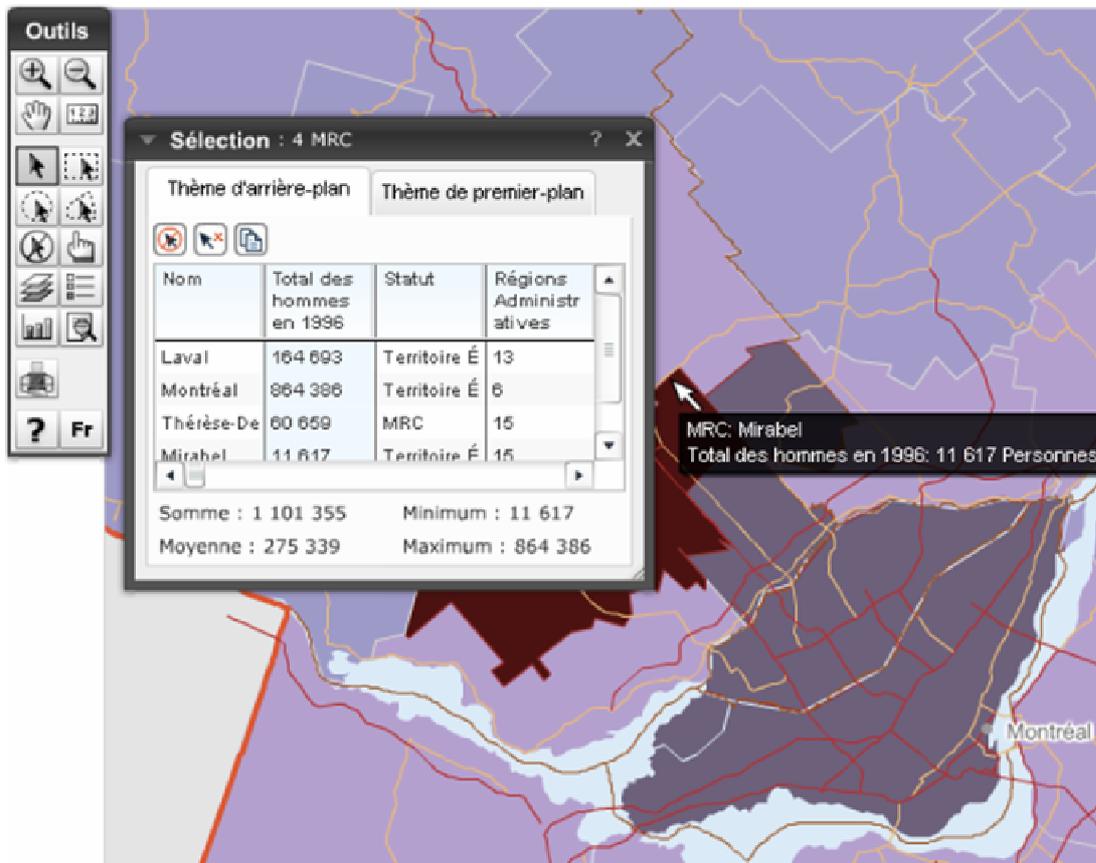
Histogram/Graph Window

Advanced Data Selection Tools and Effective Data Display

CartoVista's advanced geographic selection tools are used to get detailed statistics about any geographic area in the map. The following selection methods are supported, with the possibility of using the SHIFT/CTRL key to select multiple geographic units.

- Direct selection
- Rectangular selection
- Circular selection
- Polygonal selection

Selected records are displayed in the selection window with dynamic capabilities such as the ability to reorder the data by any field.



Selection Window

Once the data is displayed in the selection window, the user can use the toolbar to copy and paste the data (into a spreadsheet for example).

Controlling Map Layers and Labeling

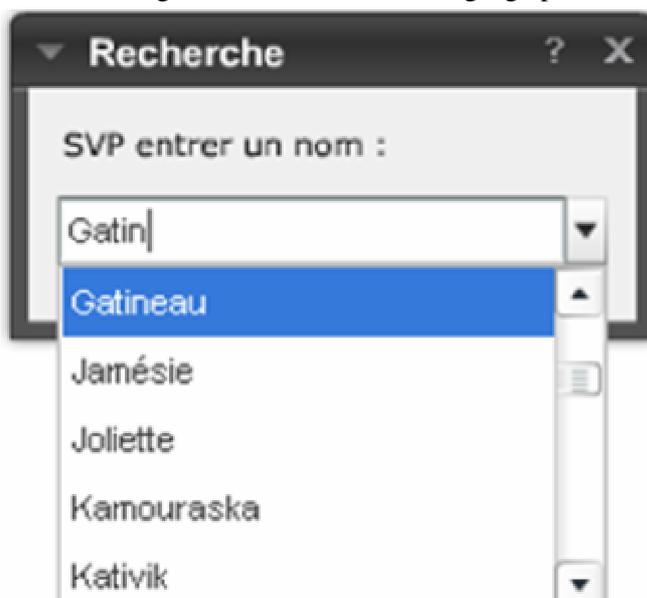
The software offers advanced functionality for controlling the display, opacity and labeling of each layer in a map through the layer control dialog.



Layer Control Tab

Searching

The find dialog can be used to search for geographic units by name.



Searching Function (Find)

RESPONSIVE USER INTERFACE

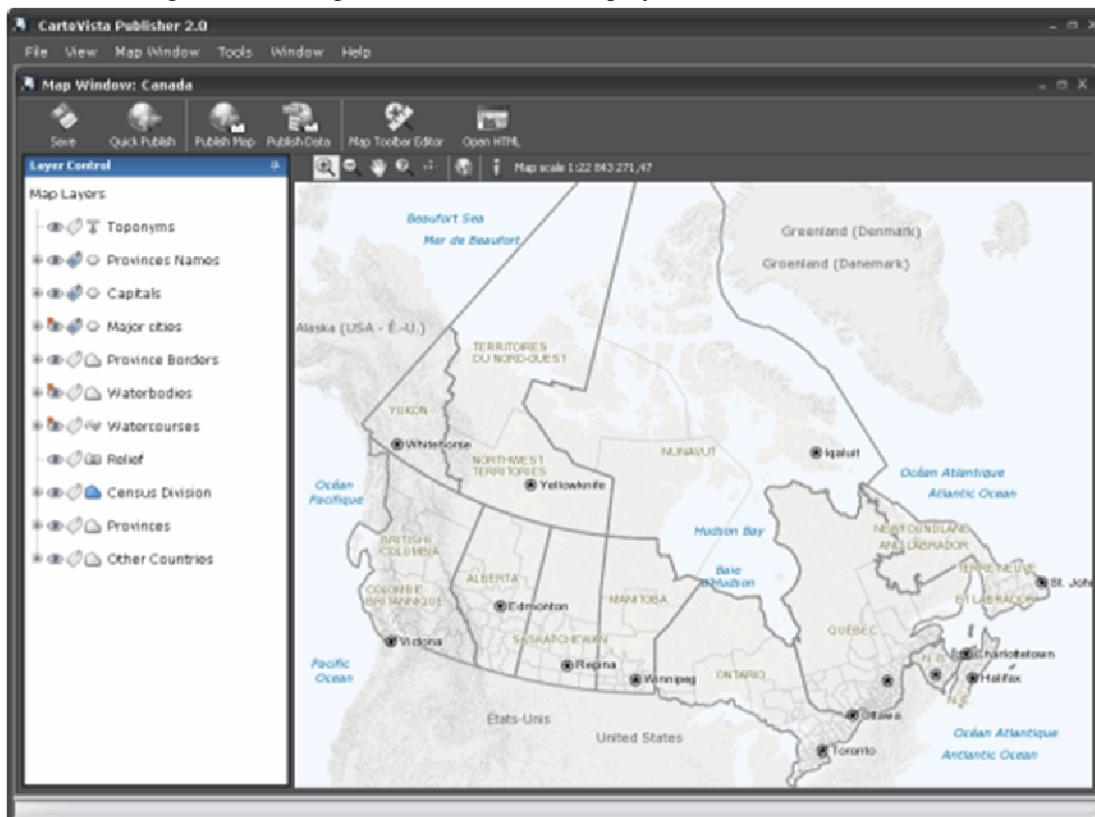
Working with an interactive vector format like Flash has the advantage of creating a fast and responsive user interface. As soon as maps and thematic data are downloaded, there is no need to return to the web server for more information. The user can zoom-in on the map, display or change a theme without making systematic requests to the web server. When you navigate in a map, the map scale and related controls are updated to display proper distances.



Loading Bar

SIMPLE INPUT / HIGH-QUALITY CARTOGRAPHIC OUTPUTS

The ISQ GIS professionals are using the CartoVista Publisher to setup the maps in their application. The CartoVista Publisher is a desktop application that reads conventional GIS data (ESRI Shape, MapInfo Table, etc.) to publish the map to Adobe Flash for display in the CartoVista viewer.



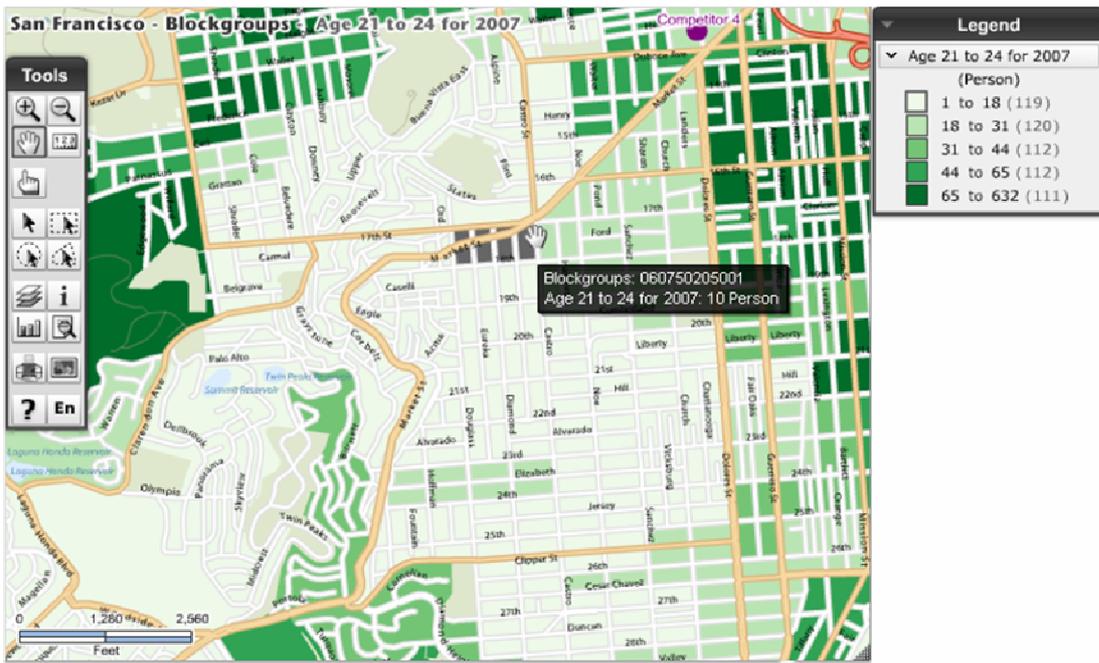
CartoVista Publisher Interface

The Publisher includes effective tools to set the map layer styles and options to control:

- The visibility and zoom layering (scale-dependency) of map layers
- The styles of map features (based on classes or not)
- Labeling options (position, duplicates, etc.)
- Advanced styling options such as the opacity and blending mode of layers
- The setup of interactive layers (unique identifiers) for thematics and hyperlinks

Map Feature Generalization

As part of the publishing process, vector layers (polygons and polylines) are optimized in terms of size by a map generalization procedure. The map features are projected on a virtual Cartesian plane that is



Sample High Quality Map of San Francisco Block Groups with High Quality Map Labeling

Raster Images

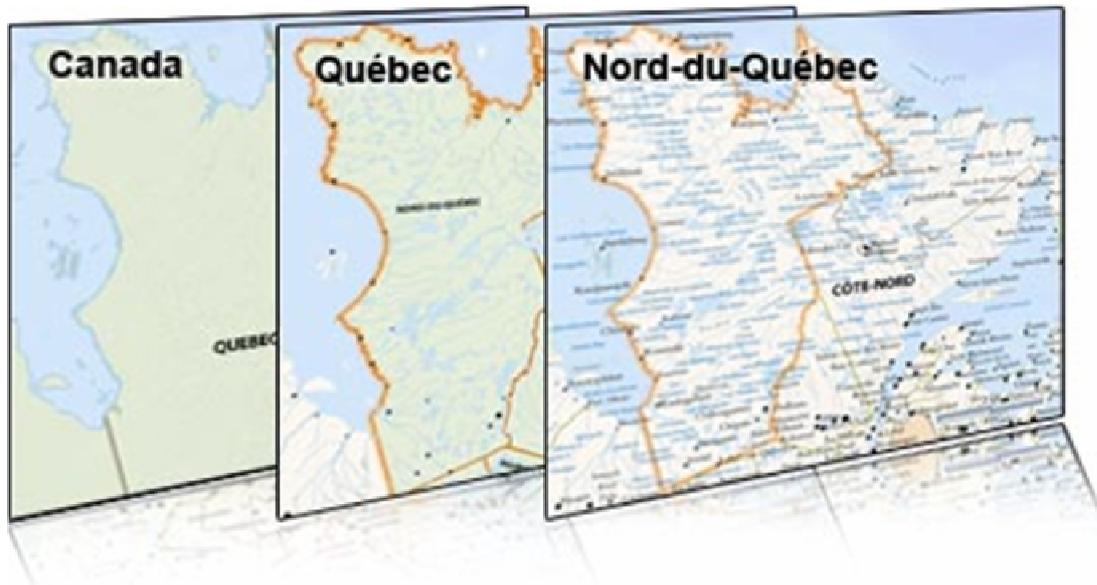
The solution includes the possibility to insert raster images as a map layer. This is very useful to add contextual layers such as satellite imagery or relief to create a greater visual impact and richer cartographic experience.



Sample High Quality Map of La Guajira Colombia with Raster Imagery (Satellite)

Zoom Layering

With CartoVista, the ISQ project can leverage the concept of scale dependency or zoom layering to only display certain layers at specific scales. Zoom layering is very useful to simplify maps and not overwhelm the user with too many details. This feature is of particular importance when generating thematic maps that focus on statistical measures applied on a specific geographic layer.

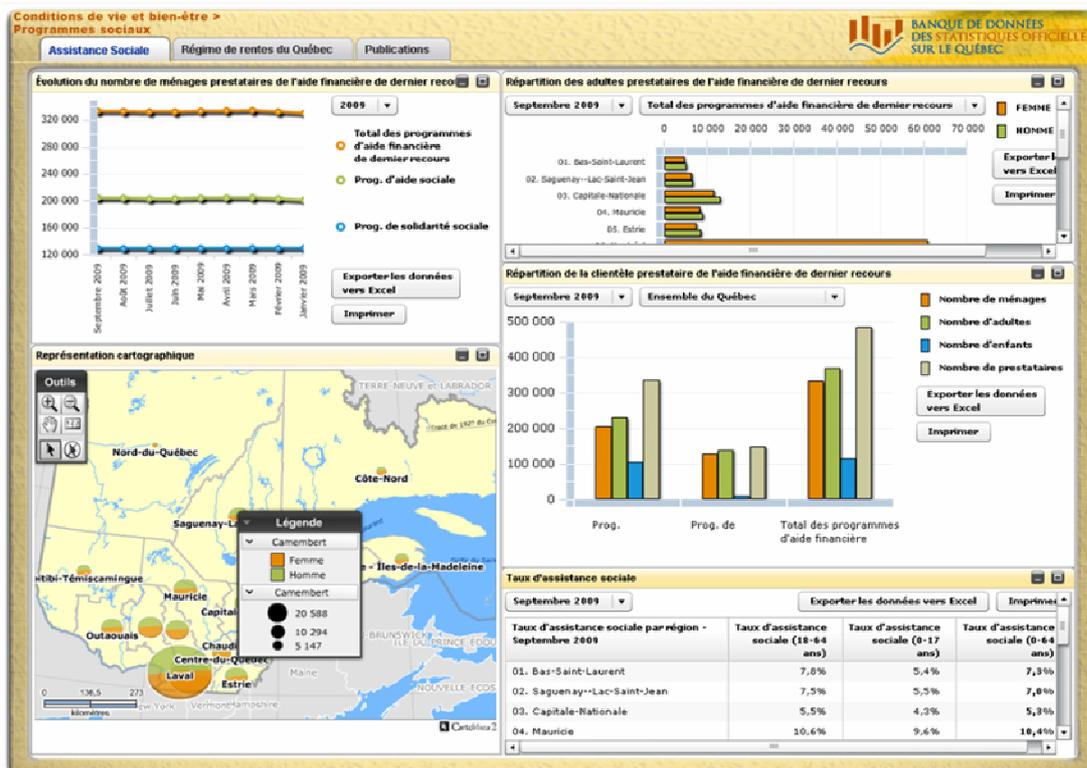


Zoom Layering Concept

LEVERAGING ADOBE® FLASH®/FLEX® TECHNOLOGY FOR MAPPING

All that is required to view the ISQ dashboard application is the Adobe Flash Player version 9.0 or later. The Adobe Flash Player is compact, fast and deployed already on more than 98% of the computers today. The application foundation is a solid vector graphics technology that is proven and globally accepted in the industry.

DEVELOPING RICH INTERNET APPLICATIONS - ISQ CARTOGRAPHIC DASHBOARDS



ISQ Sample Dashboard Application Developed with Adobe® Flex®

The dashboard applications in this project were developed with the Adobe® Flex® technology. Essentially, Adobe® Flex® is a free, open source framework for building highly interactive, expressive web applications that deploy consistently on all major browsers, desktops, and operating systems. Rich Internet Applications (RIAs) created with Flex® can run in the browser using Adobe® Flash® Player software or on the desktop using Adobe AIR™, the cross-operating system runtime. This enables Flex® applications

to run consistently across all major browsers and on the desktop. And using AIR™, Flex® applications can now access local data and system resources on the desktop.

As such, Adobe® Flex® provides a modern, standards-based language and programming model that supports common design patterns. MXML, a declarative XML-based language, is used to describe user interface (UI) layout and behaviors, and ActionScript™ 3, a powerful object-oriented programming language, is used to create client logic.

In the context of this project, the information technology staff at the institute was introduced to Adobe® Flex® with minimal training and was fully operational within only a few weeks. The learning curve was very low, mostly because of the fact that Adobe® Flex® includes a rich component library with more than 100 proven, extensible UI components for creating rich Internet applications (RIAs).

In terms of mapping inside the dashboard application, the CartoVista Software Development Kit (SDK) was used. The CartoVista map component includes more than 150 thematic mapping functions. This extensive set of functionality helped developing the project high quality statistical maps in a timely manner. The SDK also features all of the proper hooks to control the interactivity (selections, drill-down, etc.) between the application maps, charts and data tables. The structure of a simple MXML application with the CartoVista component is described below and is showing how scripting can be setup.

3. RESULTS

Implementing the complete CartoVista solution has brought the ISQ the capabilities and knowledge to launch dashboards and create other mapping applications. DBx GEOMATICS solution is offering new tools to the ISQ to support their new approach. The ISQ now has the infrastructure in place to deliver high quality thematic mapping and develop customized applications that fully enhance the distribution of its statistics. The ease of integrating the CartoVista mapping solution was a significant part of the success in improving the quality of their overall offering. It has also provided a great measure of autonomy to the ISQ staff. GIS professionals can create high quality cartographic outputs that can be perfectly integrated in dashboards and applications developed by the institute IT staff, as required.

Finally, this interactive and user-friendly application increased the analytical capabilities of the interface for the public. Through thematic mapping, the user gains a better understanding of the subjects of interest about the Quebec society. The use of the CartoVista spatial component is definitely an asset in the publication of those statistics.

These dashboard type of applications add to decision-making processes, allowing thematic maps and additional graphs to be included in reports or to be used during interactive presentations.

4. CONCLUSION AND FUTURE PLANS

The CartoVista solution, developed by DBx GEOMATICS, is an innovative technology offering a wide range of capabilities to enhance the distribution of statistics for the ISQ. The added value of this new integrated statistical system supports the legacy of publishing statistics in Quebec. The BDSO definitely offers a one-stop shop guarantying information consistency while offering a large range of tools and functionalities.

Integrating a vector mapping solution has brought some innovation to the ISQ to better serve its customers, both internally and externally.

In conclusion, the visualization of the Quebec strategic data through maps and graphics is a great improvement for the official statistics of the province.

KEYWORDS:

Rich Internet Applications, Thematic mapping, Cartographic Dashboards, Vector Mapping