



Technical Report

Assessment of Integrated Indicators Solutions (IIS) as a tool for Decision Making and Monitoring and Evaluation Activities¹

by

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¹ This assessment has been prepared by Dr. Olmedo J. Varela, Ph.D. (ovarela@mailier.fsu.edu) who is currently a Senior Technical Advisor for the United Nations System and the President's Social Cabinet in the Republic of Panama. The assessment has been sponsored by UNICEF's Regional Office for Latin America and the Caribbean (TACRO). Comments and suggestions by Manuel Rojas (UNICEF-TACRO) and Alejandra Silva and Dirk Jasper (UN-ECLAC, Population Division) are greatly appreciated.

Assessment of Integrated Indicators Solutions (IIS) as a tool for Decision Making and Monitoring and Evaluation Activities²

Introduction

New information technologies (IT) are available now through various UN agencies facilitating access and interpretation of more accurate and timely data. This development is, in part, the result of a widely recognized need around the world and within the UN community to collect, inventory and facilitate access to information through information systems, in particular to indicator systems as a key tool for decision making and for monitoring and evaluation activities. Examples of such developments are **DevInfo 4.0** (UNICEF/Community System Foundation)³ and **R+SP** (UN-ECLAC-Population Division)⁴.

DevInfo and R+SP have been developed for and/or evolved to become useful tools for database design and management as well as for classification and presentation of statistical data and quantitative indicators. Both system architectures involve integration of conceptually and methodologically elaborated and classified meta-data driven statistical data and quantitative indicators, emphasizing interconnectivity and functionality of its various components. Therefore, they can be classified as Integrated Statistical Solutions (ISS) which have evolved as Integrated Indicators Solutions (IIS) within the family of decision-support systems (DSS) for decision making and monitoring and evaluation activities.

In this assessment, a summary of the integration and dissemination concepts and components built-in in DevInfo and R+SP will be discussed and a comparative analysis will be offered, assessing each IIS's *user-friendliness* regarding database design and management and access to and presentation of indicators. The comparative analysis has been organized following a basic classification of IIS users where those more interested in data visualization and presentation through user-friendly interfaces that allow generation of tables, graphs and maps, including expedite access to metadata are defined as *end-users*, while those at the other end of the IIS user spectrum, who are responsible for administering IIS, including all IIS components (database design and management and end-user interfaces design and customization) are defined as *system administrators*. Readers, however, should be aware of the fact that, within the IIS's users spectrum and in a variety of different degrees, end-users could be system administrators and vice versa.

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³ Developed by Community Systems Foundation for UNICEF. United Nations Children's Fund. Three United Nations Plaza. New York, NY 10017 USA. 2003.

⁴ Developed by Serge Poulard for UN-ECLAC-Population Division (CELADE). Santiago, Chile.

The assessment will be organized in four main sections, starting with this introduction, followed by a discussion of IIS within the context of decision making and monitoring and evaluation activities. Then a description and analysis of each IIS will be offered, including integration concepts and components, availability, user friendliness, software and hardware requirements, data and output manipulation and data analysis, migration to the Internet, editing and institutional support. Finally, a discussion is offered, with an assessment of both IIS, through a comparative analysis, including a comparative summary of R+SP's and DevInfo's main characteristics. The purpose of the assessment is not to identify "the best IIS" but to provide guidelines that will help UN agencies, Governments, organizations and individuals around the world in choosing the IIS that best fit their specific needs and resources. The assessment has been developed in consultation with the institutions responsible of the two IIS assessed.

IIS within the context of Decision Making and Monitoring and Evaluation Activities

The complexities of the decision making processes and monitoring and evaluation activities related to local, national, regional and global human development require expedited access to accurate and timely data. In the realm of statistical data, a variety of initiatives at the national and regional level such as FedStats in the United States and EuroStat in the European Union are good examples of responses to the urgent and critical need for the development of integration and harmonization policies and strategies for national and regional comparative analysis. Emerging national statistical and spatial data infrastructures and Integrated Statistical Solutions (ISS) within and across nations will strengthen such initiatives supporting global, national, regional, local and individual decision-support systems (Wallace and Sperling, 2000).

These developments have set up the foundation for advancement of statistical integration toward conceptually and methodologically elaborated meta-data driven Integrated Indicators Solutions (IIS). This step forward in statistical applications is being developed for decision making and systematic monitoring and evaluation of the well-being of nations under the broader concept of Human Sustainable Development⁵ (United Nations, 2003; United Nations 2000; UNESCO 2003).

Even though the issues related to data integration has not yet being fully addressed, even in developed countries (Wallace and Sperling, 2000 p. 23; U.S. Federal Geographic Data Committee, 1997) a strong movement toward the development of statistical and spatial data infrastructures and ISS are emerging in many underdeveloped nations including Latin America countries⁶, facilitating the design and implementation of IIS.

⁵ IIS initiatives should evolve including qualitative indicators as well. The complexities involved in decision-making processes and monitoring and evaluation activities related to sustainable human development demand integration of both types of indicators.

⁶ See for instance (Amaya, Wilmar. 1998; Directorate of Statistics and Census. 2002) for a public-private partnership in the Republic of Colombia and a Census Bureau initiative in the Republic of Panama.

IIS initiatives face many challenges, including issues related to production, organization and documentation as well issues related to access, dissemination and interpretation of indicators. The production and/or selection, organization and documentation processes require a well defined conceptual and methodological framework that will help system administrators and its counterparts establish criteria for production and/or selection of indicators and for indicators' conceptual, methodological and evidence-based justification. Such process involves dynamic integration of data from multiple sources, time periods and geographic layers which conceptual and geographic definitions that, in many instances, change overtime.

Same as in the ISS arena (Wallace and Sperling, 2000 p. 24), IIS will benefit from metadata-driven indicators that ensure fitness for use, minimizing uncertainty through fully documented according to agreed-upon definitions and standards, maximizing data usefulness, and promoting proper usage of indicators within a dynamically integrated and conceptually founded environment. This should help prevent the frequent undesirable practice of using and interpreting indicators, within the context of measuring progress toward goals and objectives, without a definition of the concepts involved; without a rationale of the causal relationship between goals and objectives, including their conceptual, methodological and evidence-based justification; and without a methodological statement regarding the indicators' validity and reliability.

On the end-user side, the effectiveness of IIS in terms of facilitating access, presentation and interpretation of indicators depend upon the achieving of the integration challenges briefly described above, where a clear definition of potential end-users should guide the entire design process. Thus, a first step in designing IIS, consist on building end-users' profiles including identification of potential end-users' needs and resources.

One important issue to point out, before the comparative analysis begins, is that the construction, selection, and classification of indicators is a complex process that benefit but not depend exclusively of its IIS. Such process, demands institutional determination, confronting conceptual, methodological and organizational challenges and obtaining resources to support teams of many very well trained professionals for developing conceptually and methodologically founded accurate and timely indicators. The outcomes of such processes are expected to have important consequences on the lives and future of people and communities around the world. In particular, considering the use of indicators in the context of decision making and monitoring and evaluation activities related to sustainable human development. IIS are expected to respond to challenges from local, national, regional and international communities regarding its important role in supporting and facilitating such processes.

R+SP and DevInfo: two UN-IIS initiatives for decision making and monitoring and evaluation activities

In this section, a description and analysis of each IIS's integration concepts and components will be offered, including analysis of database design and database administration modules. Particular attention will be directed toward description of each IIS's capabilities for access, presentation and interpretation of accurate and timely indicators; and their user-friendliness and fulfillment of potential end-user's needs and resources. As it will be documented next, both IIS have devoted, during the last few years, great efforts to improve their capabilities in that regard, attempting to reach a broader end-user spectrum, including the general public. Applications currently used in two different UN related IIS initiatives will help illustrate on such matters. This section will describe and analyze issues related to integration concepts and components, availability, user friendliness, software and hardware requirements, data and output manipulation and data analysis, migration to the Internet, and editing and institutional support.

R+SP⁷

Redatam+SP (R+SP), was originally designed for data retrieval of *microdata*⁸, particularly from census databases. Using R+SP aggregated statistics and indicators are constructed from individual records regarding persons, households, or other information elements that can be combined into several tabulations for any geographical area defined by the user. Conforming today a family of four modules, R+SP add to its powerful and compressed microdata retrieval and processing engine, capabilities for database design and customization, managing, processing and dissemination of *aggregated statistical data and quantitative indicators*. **Redatam** is an acronym for **R**etrieval of **D**ata for small **A**reas by **M**icrocomputer. **R+SP** is the last version of the fourth generation of the software adding the letters "SP" to its name in honor of its developer Serge Poulard.



It is readily available in English, Spanish and Portuguese and it allows adding new languages to the system. R+SP has been developed to work using the Microsoft Windows operating system.

UN-ECLAC-Population and Development Division reports that versions of R+SP are used worldwide. UN-ECLAC-Population Division also reports that around 1,600 users and institutions have been registered in about 80 countries. The first generation of Redatam for DOS was released officially in 1987.

⁷ www.eclac.cl/redatam/

⁸ individual records regarding persons, households, or other information elements.

IIS's integration concepts and components

R+SP's technical documentation specifies that it uses a compressed hierarchical database which can contain the microdata itself with millions of records for persons, houses, city blocks and/or aggregated information on any geographical division of a country. These data can come from any combination of population census, agricultural census, household surveys or other sources. A database can be processed in association with external databases in common formats such as dBase. R+SP has evolved as an IIS by adding modules for designing and managing databases, including the xPlan module for making end-user applications for production, integration and presentation of indicators including migration of database interfaces to the Internet.

The *R+SP IIS* consist of a family of four modules allowing design, process, and dissemination of statistical data and indicators constructed from very large hierarchical census and other databases. These modules are:

“Process for processing data from user-selected geographical areas with programs written in the Redatam command language, or for processing with the Assistants - similar to Wizards in some commercial software- that do not require any programming skills nor any knowledge about the Redatam language. This module also includes facilities for expanding, appending, connecting, downloading and other management of existing Redatam databases.

Create for creating proprietary format *R+SP* hierarchical databases by system administrators from files in ASCII or xBase format. The file in ASCII can have layout descriptions in IMPS, ISSA, or CHILLAN formats (the internal layout description of *R+SP*).

xPlan for the construction of stand alone applications for distribution to end-users that permit them to access protected microdata to process, obtain and display in tabular, graphs or maps the indicators generated, often involving complex calculations, without any knowledge of Redatam..

Web Server, the latest member of the family, for requesting information on-line from a Redatam database on an intranet, extranet or the Internet. As in the case of the other members of the Redatam family, the *Web Server* is based on the Redatam statistical engine, which is highly efficient in an on-line environment.”

Thus, R+SP allows production as well as presentation of indicators where users can define any area of interest (such as city blocks) or any combination of areas, generate new indicators, obtain various types of tabulations, export outputs to other software and graphically display results. The data at different geographical levels can be combined hierarchically to generate aggregated indicators and the results shown on tables, graphs or maps or transferred to another application.

Database security and pre-programmed logical filters are available in R+SP for data protection and data integrity. It includes among others microdata confidentiality, key word protection schemes, and master keys.

Access to the IIS

The first three members of the Redatam family (Process, Create, and xPlan) are packaged together as modules of the *R+SP* software. These can be downloaded, free of charge, from the UN-ECALC, Population Division Web site <http://www.eclac.cl/celade/redatam>. The *R+WebServer* is packaged in a separate module, it operates under a Windows server and it can be also downloaded, free of charge, from the UN-ECALC, Population Division Web site.

User-friendliness

IIS's user-friendliness will be described and analyzed following the IIS's users basic classification previously described. In relation to system administrators, a summary of each IIS database administration capabilities for database design and management will be offered. Then a detailed description and analysis of database end user-interface functionality to access and visualize indicators, through system's outputs such as tables, graphs and maps, will be presented with illustrations derived from currently implemented end-user applications developed from each IIS.

System Administrator

System administrators are defined as those users, located at one end of the IIS's user spectrum, who are responsible for administering IIS, including all IIS components (database design and management and end-user interfaces design and customization). Using R+SP, system administrators are able to process data, including census microdata, and generate indicators without any programming skills nor any knowledge about the Redatam language. Modules such as *Process* include facilities for expanding, appending, connecting, downloading and other management of existing R+SP databases.

System administrator can also generate proprietary format *R+SP* hierarchical databases from files in ASCII or xBase format. The file in ASCII can have layout descriptions in IMPS, ISSA, or CHILLAN format (the internal layout description of *R+SP*). System administrators, without computer programming knowledge and using R+SP command language through the *xPlan* module, can design applications for distribution to end-users that permit them to access protected microdata to obtain indicators, often involving complex calculations, without any knowledge of R+SP's command language.

Thus, R+SP offers system administrators, within one single platform, the necessary tools to fulfill with relatively modest IT requirements, the challenges set forth by the IIS's

user spectrum. It supports system administrators with a wide range of tasks, from processing of the powerful census micro-databases to the production and presentation of indicators using census and other sources of statistical data to straightforward migration of interactive database interfaces to the Internet.

Design concepts and customization tasks are presented with detailed instructions through, R+SP's technical documentation. Technical documentation is available for system administrators to design and administer R+SP databases. The technical documentation examined (UN-ECLAC-Population and Development Division, 2002, 2004) are available at UN-ECLAC, Population Division's web site.

End-user

End-users are defined as those users, located at one end of the IIS's user spectrum, who are more interested in data visualization and presentation through user-friendly interfaces that do not require database design nor customization and that allow generation of tables, graphs and maps including expedite access to metadata. For the purpose of illustrating on one current R+SP application designed for end-users' access to indicators, the Sistema Integrado de Indicadores para el Desarrollo (SID) de la República de Panamá⁹ is presented. Description of the SID will offer detailed information about its functionality and the entire process from installing the CD to accessing and visualizing indicators through generation of tables, graphs and maps, including expedite access to metadata.

A SID's manual is available with step by step instructions on how to operate the system. For each step the manual offers an image, including windows that take the user into a friendly tour toward the system and its commands. Most options are described in the manual, including how to produce a table, map and graphic and how to access the metadata.

Installing the SID is a straightforward procedure. Once the CD is inserted in the CDROM, an automated installation follows taking approximately four steps to have it installed in the computer. Once installed, users do not need the CD to run the SID.

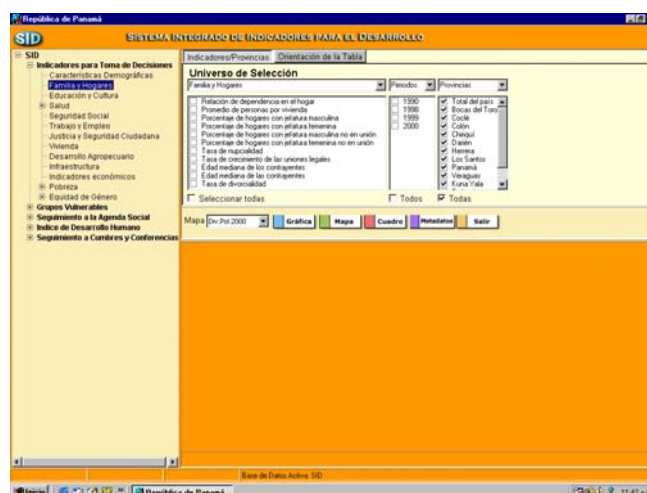
When starting the SID, a full color screen shows up with five bottoms representing options to choose from. The first button takes the user into an html environment with information about the SID, its main actors and supporting institutions, including a welcome message from Panama's President. The second button provides access through an html window to thematic PDF documents that serve as a conceptual and methodological framework for the varios themes guiding the organization of indicators within the system, including professional manuals and guides for monitoring and evaluation activities. A third button provides access to an instruction manual available in PDF format. Finally a fourth button provides access to the indicators, followed by the exit button.

⁹ Integrated Development Indicators System of the Republic of Panama

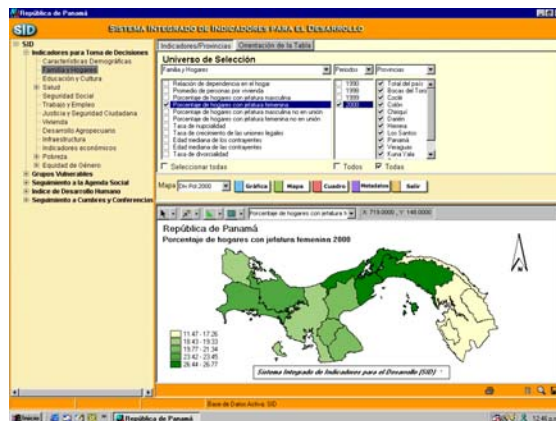
When selecting the fourth button, a road map window shows up for selecting indicators¹⁰, data parameters, and accessing its corresponding indicators, all in one-single window.



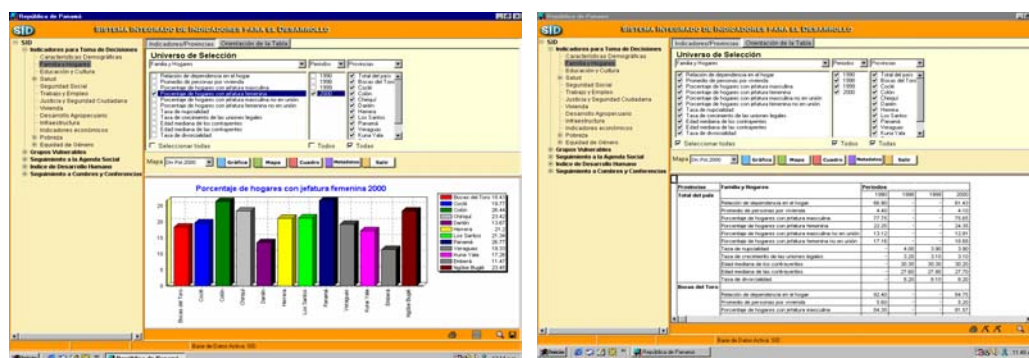
Once in this window and using only five buttons, one for each output (table, map, graph, and metadata) and one for exiting the window, the user is ready to generate indicator's outputs (tables, graphs and maps) and to access its corresponding metadata. On the window's right button corner, there are also a few icons that when clicked, allow users to zoom and print and to export the SID's outputs (statistics, maps and graphs) into popular formats such as MS Excel for statistics and jpeg and bitmap for images such as theme maps and graphs.



¹⁰ Indicators can be chosen from varios classifications set up in a tree format: sectors (For example health), subdivisions of sectors (For example, health services), goals, themes and other classifications set up by the system's administrator.



For generating an outputs users select a theme and its corresponding desired indicators, periods and geography and then click on the desired output's button. The appearance and basic characteristics of all outputs can be modified including selection of map colors and ranges (3 colors and 5 ranges), graph editing, and table's orientation. It takes approximately from 4 to 6 steps, within one window, to produce a table, graph or map.



With only two additional clicks, users can either access or visualize its corresponding metadata, or export the outputs to be used in other computer applications, including other IIS. Developers report that other cartographic coverage such as lines (i.e. example rivers) and points (i.e. health centers) can be added to the theme map for spatial analysis.

Software and Hardware requirements:

R+SP is a truly stand-alone IIS that do not depend on any other application for its functionality. Some applications such as the SID is complemented with two, also free of charge, applications which are Internet Explorer and Acrobat Reader. A Pentium computer with 32kb of Random Access Memory (RAM), 100 MB of free disk space and a CD ROM are also required for running R+SP. If dealing with census micro-databases higher free disk space is required.

Software requirements:

Operating System: Windows 9 xs, NT4.0, 2000 or XP

Internet Explorer (free)

Acrobat Reader (free)

Hardware requirements:

Pentium processor

32 RAM

100 MB free disk space (may vary depending on the size of the databases)

CD ROM.

Data and outputs manipulation and data analysis

R+SP allows production as well as presentation of indicators where users can define any area of interest (such as city blocks) or any combination of areas, generate new indicators, obtain various types of tabulations, export outputs to other software, and graphically display results. The data at different geographical levels can be combined hierarchically to generate aggregated indicators and the results shown on tables, graphs or maps or transferred to another application.

The exporting capabilities offered allow users to take data into other applications for further data manipulation and analysis. Statistical analysis is recommended to take place outside R+SP using statistical and spatial analysis packages such as SPSS, SAS and SPACESTAT.

Migration capabilities to the Internet

Since the R+SP family include a Web Server module, migration to the Internet is a relatively straightforward procedure for the system's administrators. Using an R+SP Internet version, end-users can perform the same interactive task, offered in regular R+SP modules, with some additional capabilities such as viewing tables, graphs and maps for the same or different indicators and time periods, all in one-single window using the scrolling bar.

Updating, editing and institutional support

Updating and editing involves a process where administrators use the R+SP command language to edit and update database interfaces. All generations of Redatam have been developed and maintained by UN-ECLAC Population Division. The development of *Redatam+SP* and other members of the REDATAM family received financial support from IDRC, CIDA, UNFPA, IDB and the regular budget of the United Nations.

DevInfo

Development Information (DevInfo), built on the achievement of Child Info, conforms a family of two modules and four sub modules that allow database design and customization as well as data managing, processing,



analysis and dissemination of *aggregated statistical data and quantitative indicators*.

Originally designed for use within UNICEF and across the UN, in particular to facilitate programme design and implementation, DevInfo v4.0 has evolved encouraging universal use, outside the UN, with a strong commitment to support monitoring of the Millennium Development Goals (MDG).

It is readily available in English, Spanish, French and Portuguese and it allows adding new languages to the system. DevInfo has been developed to work using the Microsoft Windows operating system.

UNICEF/Community System Foundation reports that DevInfo is currently used worldwide and it has been field tested in more than 100 training sessions. UNICEF also reports that it has been endorsed by the UN Development Group's Programme Group for monitoring of the Millennium Development Goals by UN Country Teams.

IIS's integration concepts and components

The system access data from read-only databases which contains aggregated data, and it is to be integrated with Microsoft Office suite using the full capacity of MS Word, MS Excel and MS Access. The mapping capabilities incorporated using ESRI's Map Objects are to be embedded in the system displaying geographic areas to a depth of 10 geographic levels. Polygons are included to represent administrative regions and points to represent settlements and service delivery points. The system also displays lines to represent roads and rivers, but these are not linked to data.

The system is composed of two modules. A Database User Interface Module and a Database Administration Module.

Database Interface Module is considered as DevInfo main module. Its principal function is to provide users access to DevInfo databases, view the data in various formats and to generate presentations in tables, graphs and maps. When distributed the module includes quantitative data and metadata and it is expected to provide easy access to DevInfo databases through a user-friendly interface.

Database Administration Module is designed to update DevInfo databases. The module is expected to be used by administrators only. The Database Administration Module is composed of four sub-modules.

Database template: It is used by the administrator to generate database templates. The template facilitates relationships between indicators, its definitions, units and subpopulations, Area IDs and Area Names and the goals to be monitored by the indicators.

Database Entry: It is expected to be used by Data Entry Operators to enter data into DevInfo databases.

Database Multilingual Support: Expected to be provided to DevInfo administrators, this sub-module contains tools to translate the DevInfo user interface into other languages and to translate the content of databases.

Database User Interface Customization: It is used by database administrators to customize the DevInfo user interface attending user-specific requirements including images, product name, colors, organization of indicators, system tours and language support.

Database security and pre-programmed logical filters are available in DevInfo for data protection and data integrity. It includes, among others, functions to lock indicators and databases, so they cannot be modified by users and map protection through map file encryption and passwords. Technical documentation is available and it offers didactic step by step instructions on how to design and administer a DevInfo database.

Access to the IIS

DevInfo can be obtained free of a charge through UNICEF offices around the World www.unicef.org.

User-friendliness

IIS's user-friendliness will be analyzed and compared considering procedures related to database administration capabilities for database design and management as well as procedures related to database user-interface functionality to access and visualize indicators through system's outputs such as tables, graphs and maps.

System Administrator

System administrators are defined as those users, located at one end of the IIS's user spectrum, who are responsible for administering the IIS, including all IIS components (database design and management and end-user interfaces design and customization). Database design and customization processes take place in a windows-based environment where programming has been already performed by DevInfo's developer. Pre-elaborated templates facilitate such processes and the system guides system administrators through popup windows, easing the database development and customization enterprise.

The modules that conform DevInfo develop using four separated but interconnected and functional applications. Instructions are available through a DevInfo Database Administration Guide on how to use the four applications to design new databases and to edit existing ones. *Template* allows the design of a DevInfo database template structured based on a list of indicators linked to classificatory frameworks and geographic areas for which data will be entered. *Data Entry* allows structuring the way data will be stored in the database template. *Language* allows translation of user interfaces and database strings from one language to another. And *Customize* allows customization of DevInfo attending users needs, including changing the user interface's appearance.

End-user

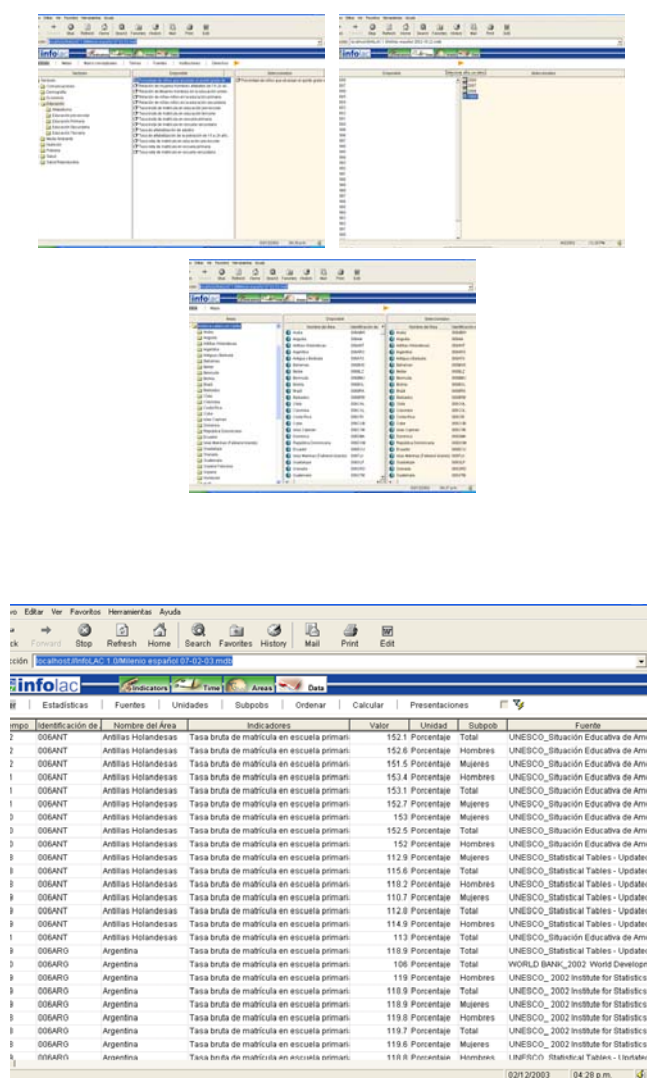
End-users are defined as those users, located at one end of the IIS's user spectrum, who are more interested in data visualization and presentation through user-friendly interfaces that do not require database design nor customization and that allow generation of tables, graphs and maps, including expedite access to metadata. An User Guide is available for DevInfo (Community Systems Foundation/UNICEF, 2004), which offers step by step instructions on how to operate the system. For each step the user's guide offers an image including windows that take the user into a friendly tour toward the system. Detailed instructions are offered in the user's guide, including how to produce a table, map and graphic, and how to access the metadata.

For the purpose of illustrating on one current DevInfo application designed for end-users' access to indicators, the Indicators and Information System for Latin America and the Caribbean (Infolac) is presented. Detailed information about its functionality and the entire process, from installing the CD to accessing and visualizing indicators, through generation of tables, graphs and maps, including expedite access to metadata, is offered next.



Installing Infolac is a straightforward procedure. Once the CD is inserted in the CD ROM, an automated installation follows taking the user a few steps to have the system installed. Once installed, users do not need the CD to run Infolac.

When starting Infolac, a full color screen, within a Microsoft Internet Explorer environment, shows up with an address bar for selecting and gaining access to the specific databases. This initial screen, also called in the technical documentation as “The Homepage”, offers two sets of options. One set for accessing general information, searching data, accessing a Gallery of already made outputs and getting help. The other set of options are four buttons or icons for selecting data parameters.

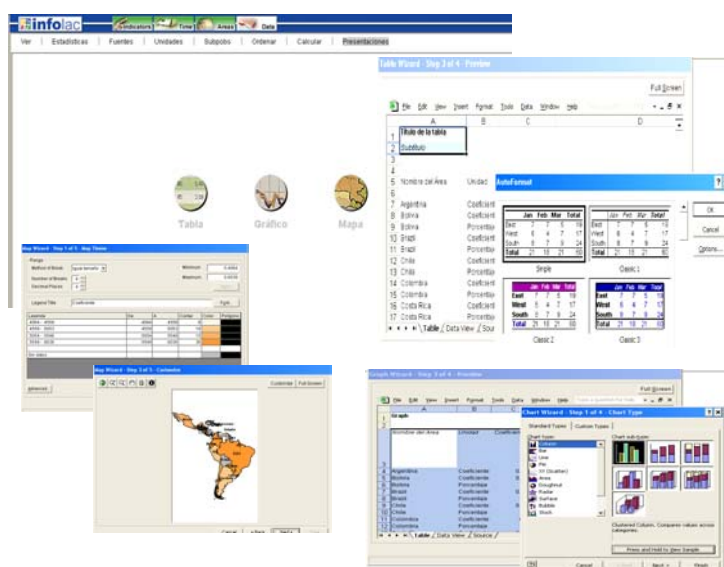


The first button (Indicators) takes users to the “Indicators” page for choosing indicators¹¹. The second button (Time) provides access to the “Time Page” where users

¹¹ Indicators can be chosen from varios classifications set up in a tree format: sectors (For example health), subdivisions of sectors (For example, health services), goals, themes, sources and institutions and other classifications set up by the system’s administrator.

can select the time period for the chosen indicators. A third button (Areas) allows users to select specific geographic areas. Finally, a fourth button open a “Data View Spreadsheet” listing the data for the chosen indicators, time periods and areas selected in the previous pages.

Once the data-selection of parameters procedure has been concluded and, previous to the production of outputs, the user view the data values for the selected parameters through a Data View with a summary of data, including area id, area name, indicators, data value, unit, subpopulation and data source. More detailed information can be obtained through the Data View such as statistics, including count, minimum, maximum and average values; units such as absolute numbers or percentages; and subpopulations such as male and female.



For generating outputs, users click on the Presentations tab located within the Data View. The data-selection of parameters procedure and the verification procedure previously described, allow users to set up the foundation for generating outputs such as tables, graphs and maps.

In addition to executing the steps involved within the data-selection of parameters procedure and the verification procedure, users can generate outputs, using the default options offered by the system with three additional steps. The appearance and basic characteristics of all outputs can be modified, including selection of map colors and ranges, graph editing, and table's orientation using MS Excel capabilities. With few additional steps, users can either access or visualize its corresponding metadata to store the outputs in the system's gallery, or to export the outputs to be used in other computer applications, including other IIS.

Software and Hardware requirements:

DevInfo v4.0 was developed based on ChildInfo v3.5 as a Microsoft Windows application and it requires the Microsoft Office Suite for its functioning. Internet Explorer, a free of charge Windows application, is also required. A second generation Pentium computer with 128kb of Random Access Memory (RAM) and other hardware characteristics are also required for running the system.

Software requirements:

Operating System: Windows 95 or higher including NT4.0, 2000 or XP
Microsoft Office 1997 or higher
Internet Explorer 5.0 or higher (free)

Hardware requirements:

Pentium II processor
128 RAM
300 MB free disk space
CD ROM

Data and outputs manipulation and data analysis

DevInfo's main module (***Database Interface Module***) has been designed to provide end-users with access to DevInfo databases through an user-friendly interface to view the data in various formats and to generate presentations in tables, graphs and maps. DevInfo's developers indicate that the system has been designed to store the results of surveys and not to carry out statistical analysis on raw data sets. The statistical analysis, suggests the developer, should be done using other software applications designed specifically for such purpose, including SPSS and SAS.

Since the data has been organized and stored using the Microsoft Office Suite, applications such as MS Excel are available within the IIS for data manipulation and analysis. Production of indicators and indexes can be performed in DevInfo using its Database Administration Module. The exporting capabilities offered allow users to take data and outputs into other applications for data manipulation, output presentation and further statistical and spatial analysis.

Migration capabilities to the Internet

DevInfo's technical documentation does not report on DevInfo's migration capabilities to the Internet. However, a function is provided to export gallery objects from MS Excel workbooks to HTML formats. This function facilitates uploading DevInfo's outputs such

as tables, graphs and maps to an Internet site allowing users to view such results via Internet.

Updating, editing and institutional support and sustainability

Updating and editing requires the use of DevInfo's Database Administration Module which allows updating, adding and reorganizing indicators that have been produced within and outside the application. DevInfo's ownership of intellectual property rights belongs to United Nations Children's Fund (UNICEF). DevInfo's technical documentation indicates that it has been selected by the United Nations to follow up the Millennium Development Goals worldwide.

Discussion

R+SP and DevInfo successfully respond to IIS's challenges of interconnectivity and functionality regarding its various components. Their characteristics also support and facilitate the complex institutional processes involved in generating and organizing conceptually and methodologically founded, accurate and timely indicators. A dynamic integration of indicators from multiple sources, time periods, and geographies is another challenge successfully accomplished by both IIS.

General Comments

R+SP, originally designed for data retrieval of microdata, particularly from census databases, has evolved to conform a family of various modules that add capabilities for database design, data processing and production and dissemination of indicators. As a truly stand-alone free of charge application, with modest software and hardware requirements and demanding few steps to generate outputs within an user-friendly environment, R+SP is a great option for *end-users* with limited software and hardware resources. System administrators with similar access to software and hardware resources and willing to perform basic command language tasks for developing end-user applications, and who prefer performing all IIS related tasks within one platform (from building and processing census micro-databases to the production and presentation of indicators to straightforward migration of interactive end-user applications to the Internet), may find in R+SP their best choice.

On the other hand, DevInfo, conformed by an administration and an interface module and various sub-modules, evolves as a database system originally designed for use within UNICEF and across the UN, in particular to facilitate programme design and implementation, more recently encouraging its use outside the UN. DevInfo is a free of charge IIS which functioning depends on having the Microsoft Office Suite installed. This intentionally incorporated prerequisite, offers greater options for performing a variety of

windows-based tasks, including manipulation of outputs such as tables, graphs and maps. Greater software and hardware requirements and more steps to generate outputs, within an user-friendly environment, make of DevInfo a great option for end-users with greater software and hardware resources. System administrators with similar access to software and hardware resources and who would rather avoid performing basic command language tasks for developing end-user applications, and who feel comfortable complementing their IIS with other applications, outside their IIS to perform all IIS related tasks, such as processing of census microdata and migration of interactive end-user applications to the Internet, may find in DevInfo their best choice.

On one end of the IIS User Spectrum: End-users

When comparing software and hardware requirements, R+SP is more likely than DevInfo, to reach a broader spectrum of end-users. It is considering its truly stand-alone software architecture and lower hardware requirements, in particular its RAM requirements (32MB of RAM for R+SP compared to 128 MB of RAM for DevInfo). The easy-to-use environment achieved by R+SP in the SID, for instance, including all-in-one-window solution for selecting data parameters and generating multiple on-the-run maps, graphs and tables, add to such assertion. R+SP's all-in-one window approach that include data parameters and output generation procedures is a well paid costly price transferred to the system's administrator to accomplish easy access and end-user friendliness.

The greater number of steps involved in producing an output in DevInfo, may saddle those end-users less patient and less curious regarding the "happenings behind the scene" in an IIS. This assertion applies, in particular, to the selection of parameters and data view procedures. These procedures, however, force end-users to become more conscious interpreters of the data available and presented through the IIS, in particular during the data view procedure, where the chosen parameters are reviewed in an ordered and very detailed fashion. The Gallery option in DevInfo constitutes an option to facilitate user's access to already made outputs by the system's administrator or by other end-users for dissemination purposes.

Even tough outputs (tables, graph and maps) within both IIS can be manipulated for customizing final outlooks, options and capabilities in terms of output manipulation within the IIS are greater in DevInfo. In R+S, end-users should conform with limited choices, in particular with the table and map outputs. DevInfo's integration with the MS Office Suite, including MS Excel allows users to customize tables and maps within one single system platform.

To solve the mapping limitation, for instance, R+PS developers could consider incorporating in its interconnectivity and functionality the Redatam+GIS planning systems, developed by UN-ECLAC-Population and Development in conjunction with the University of Waterloo (Canada). It may be hopefully done without adding too much to its modest RAM requirements, a price DevInfo is likely to be paying, in part, because of its greater mapping capabilities.

On the other end of the IIS User Spectrum: System Administrators

Being able to process the valuable census microdata with high level of efficiency, including very modest hardware requirements, constitute a plus for R+SP. Censuses can be considered as a primary source for producing demographic, socioeconomic and quality of life indicators, covering a broad range of geographic levels. Increasing efforts and accomplishments regarding enhancement of methods for ecological inference (Benoit and King, 1996) power up censuses, to its already widespread and valuable use. Covering a broader range of IIS tasks, from building and processing of the powerful census micro-databases to the production and presentation of indicators, using different sources of statistical data, to straightforward migration to the Internet, makes of R+SP a good choice for system administrators willing to perform basic command language tasks and who would prefer to perform all IIS related tasks within one platform.

Comparative Summary of R+SP's and DevInfo's Characteristics *		
	R+SP	DevInfo
General Characteristics		
Availability of technical documentation	☒	☒
Availability of user's guide	☒	☒
Available free of charge	☒	☒ (a)
Hardware requirements		
Processor	Pentium	Pentium II
MBs of RAM (Random Access Memory)	32	128
MBs of free disk space	100	300
End-user interface characteristics		
Few steps in setting up the system	☒	☒
Straightforward access to metadata within the IIS	☒	☒
Level of friendliness in generating outputs	Higher	Lower
Capabilities for improving outputs' outlook within the IIS	Less	More
Statistical analysis tools	Less	More
Data manipulation capabilities	Less	More
Basic mapping capabilities	Less	More
Exporting data and outputs to other IT applications	☒	☒
Database administration characteristics		
Building and processing census micro-databases	☒	☒
No command language required for designing an end-user interface	☒	☒
Multilingual support	☒	☒
Database Interface Customization	☒	☒
Database templates design	☒	☒
Data entry templates design	☒	☒
Migration of end-user application to the Internet within the IIS	☒	☒
(a) Requires the Microsoft Office Suite.		
* This comparative summary should not be interpreted without reading of the corresponding comparative analysis		

Using DevInfo database design and customization processes take place in a windows-based environment where programming has been already performed by DevInfo's developer. Pre-elaborated templates facilitate such processes and the system guides system administrators through popup windows easing the database development and customization enterprise. In addition, DevInfo includes templates with pre-elaborated formulas for indicators and index construction. Thus, system administrators less familiar with and reluctant to performing command driven tasks for developing IIS applications, even if the command language is very simple, may find in DevInfo a good choice.

Exporting data to be used for data manipulation and analysis in other applications, including other IIS, is a straightforward procedure in R+SP as well as in DevInfo. This shared capacity suggest favorable conditions for exchanging data resources and indicators between both IIS. System administrators using either IIS could agreed upon templates for sharing of statistical data and develop other coordination efforts for enhancing interconnectivity and functionality between both IIS.

While DevInfo do not report on a module within the DevInfo's family for migration of the database interface module to the Internet, a Web Server module within the R+SP family makes migration of the integration effort to the Internet, a beneficial dissemination enterprise. With the R+SP Internet version, end-users can perform the same interactive task offered in the database interface module version, with some additional capabilities such as viewing multiple tables, graphs and maps for the same or different indicators and time periods in one-single html window.

The Galley option in DevInfo for the storing and presentation of the system's outputs constitutes an option to disseminate indicator's outputs in the Internet. A function is provided to export gallery objects from MS Excel workbooks to HTML formats. This function facilitates uploading DevInfo's outputs such as tables, graphs and maps to an Internet site allowing users to view such results via Internet.

IT challenges for shaping the IIS's user spectrum through participatory processes

System administrators have been defined as those users, located at one end of the IIS's user spectrum, who are responsible for administering the IIS, including all IIS components (database design and management and end-user interfaces design and customization). End-users have been defined as those users, located at the other end of the IIS's user spectrum, who are more interested in data visualization and presentation through user-friendly interfaces that allow generation of tables, graphs and maps including expedite access to metadata.

Readers, however, should be aware of the fact that, within the IIS's users spectrum and in a variety of different degrees, there could be end-users who are system administrators and vice versa. Readers should be also aware of the fact that promoting end-users' involvement in some system administration tasks may be beneficial. In particular, those end-users who are more directly related to decision making processes, policy design, strategic planning and monitoring and evaluation activities.

Reports from IT initiatives at the community and national levels reveal that data manipulation and active participation of IT users in the institutional, conceptual and technical processes related to the development of user-driven Integrated Geo-statistical Solutions (IGS) and IIS, can play an important role in enhancing IIS's sustainability (Varela, 1996, 1998, 2002). Participatory processes may empower and promote users' ownership of IT through users involvement in the development of the conceptual, methodological and strategic considerations incorporated in the entire IIS building process.

Depending on end-users' and system administrators' profiles, researchers, analysts, UN and governmental officials and other interested parties, including the general public will benefit from being able to choose the IIS that best fit their needs and resources. Getting involved in the IIS design and implementation processes may add to such benefits.

Build on informed IIS choices is a difficult but worthy task. It involves the development criteria for the assessment and selection processes, where defining IIS's users needs and determining availability of resources to develop or access IIS is crucial. It is my hope that this assessment will help people and organizations, through participatory processes, take better and more informed IIS decisions and that emerging forces from shared experiences and new IIS developments, including interconnectivity and functionality within and across IIS, will enrich and shape the technological, institutional and social dynamics taking place within and around the IIS user spectrum.

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