

## Complementary uses of Information Systems in Decision Making, Planning and Democracy: An Example in the Education Sector

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*This paper describes the ongoing implementation of web intelligence tools in public education and other policy sectors in Guatemala. In the case described, software tools first developed for use in business were adopted for planning and decision making in public institutions. Easy online access to the outputs of these tools as web documents suggested their use to foster transparency, accountability and social oversight. This paper summarizes the salient aspects of the experience so far of implementing and expanding what has been called the “Platform for Integrated Social Information.” It discusses the issues this Platform raises as a resource for improved public decision making, policy analysis and especially, as a promising but challenging tool for democracy in the education sector.*

**KEYWORDS:** *Web intelligence, business intelligence, social development, democracy, education*

### I. Introduction

Can information systems and web intelligence applications contribute to democracy? Over the last two decades the Ministry of Education (MOE) in Guatemala has invested a considerable amount of time and effort to develop its information systems and infrastructure. Overall results have been positive, and the MOE now has continuous, relatively good quality and well-maintained records going back to 1992. Even though these efforts have increasingly fallen within the purview of a well-established IT department, generally the implementation of databases and information applications have been undertaken to serve the needs of specific organizational units, using diverse software and generating data in different formats. More recently efforts have focused on implementing web intelligence tools in the MOE and other public sector institutions to bring together information from many sources. These applications were developed initially as an effort to support public sector decision-making and later to enhance planning. However, their expression as web-enabled publications and their ease of use rapidly suggested applications beyond the MOE's limits, touching upon issues of transparency, accountability and social oversight (Joia 2007).

This paper examines the “Platform for Integrated Social Information” (PISI)<sup>1</sup> that emerged from these efforts as a resource for improved public management and planning, and as a promising but challenging resource for democracy, considering that what began as an effort in increasing efficiency in data management has now expanded to touch upon critical issues of democracy and participation which will require further development. This document is based on: a) the author’s first-hand experience as the director of the project that has provided technical and financial assistance to the MOE and Ministry of Health (MOH), b) conversations with project specialists on web intelligence, MOE and donor agency counterparts in the context of the design and follow-up to the intervention,

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<sup>1</sup> Beyond the use of a business intelligence tool, we understand the PISI as a combination of software, hardware, reports and institutional arrangements that lead to the transparent availability of manipulable non-aggregated data from the social sector (currently education, health, finance and demographics) that can be accessed and analyzed through a common interface, irrespective of the institution and technology on which these data are originally based.

and c) material from an external review of the PISI and two other technology interventions conducted in 2008 in preparation of a policy brief (Trujillo 2008). It is not intended as a final analysis, but rather to provoke further reflection as the intervention continues to evolve.

## II. Three Complementary Uses of Information

### A. Information and Management Decision-Making

The most obvious need for information in the public sector is management. Managers need information to improve decision making (Cf. Kemoni & Ngulube 2008). Together with IT specialists and vendors, these “clients” are the motor in introducing information systems in public institutions, and they behave much like their private sector peers. Governments frequently adopt technologies developed for business applications.

Though information systems have existed in the Guatemalan public sector for several decades, they have mostly been stand-alone tools developed specifically or bought off-the-shelf for use in a single unit (human resources and payroll, education statistics, finance, etc.) Even in small countries public networks are large and frequently public institutions such as the MOE. These are often among the largest organizations in the country. Effective decision making in such contexts requires information from multiple levels and locations. For example, a manager in a centralized school system needs information to manage the allocation of resources between districts, but the data reflecting enrollment and retention are produced locally, not at her level.

In day-to-day work, governments have tended to adopt networking applications from the private sector (Joia 2007) as the benefits of on-line integration become apparent. As in the private sector, operational control, efficiency and quality are seen as open to improvement through “Government-to-Government” (G2G)<sup>2</sup> applications linking public data sources. For example, decisions about textbook and school material distribution logistics span multiple geographical and hierarchical levels, depending on timely combinations of information about suppliers, enrollment and geographical localization of facilities.

### B. Information and Policy-Making

G2G applications, such as Business-to-Business (B2B)<sup>3</sup>, focus on improving services and processes. Is there more to these technologies when applied to government? Can they help policy-making? Reimers & McGinn (1997) have made strong arguments in favor of addressing policy questions through information. However, educational outcomes are not simply results of education sector actions. Poverty alleviation and conditional cash transfer policies, local public investment, migrations and health conditions and services, all affect educational outcomes in communities, families and individuals, but are not under exclusive control of the MOE. Policy decisions straddle institutions and sectors, and affect results according to how these are taken into account (Joia 2007).

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<sup>2</sup> G2G is understood as the online (electronic, Internet-mediated) mutual interaction between government organizations, departments, and authorities (See Backus 2001). Beyond the data connections between organizations, G2G may involve standards-setting, common “language” development, integrated processes and shared data management cultures (Realini 2004).

<sup>3</sup> B2B similarly can be taken in a strict sense as “... the enabling technology and the necessary infrastructure (...) to make automated supply chain integration possible (...) in a peer-to-peer pattern to trading partners...” (Bussler 2003:3), or in a more extended sense covering the exchange of messages between business partners in a market.

Policy planning where educational activities fit in with other sectors requires integrating information between education and other sectors, as well as integrating national, regional and local information. For example, the World Bank's "country at a glance" tables and charts show data from various national sources in a compact format that rapidly induces a policy discussion. Similarly, an analyst in a central office in the MOH needs to integrate data about demographics, input and teacher allocation, services production and student performance, broken down by relevant jurisdictions and sex and age groups to produce useful policy suggestions and design relevant plans.

Relating government information across institutions through G2G applications helps see the objects of policy making beyond the limits of the institutions and better relates them to the substantive issues of human development, the economy and politics, for example. Furthermore, precise data move policy making from the realm of speculation into common agreement.

### **C. Information and Democracy**

Public education is not only about services and management. It is about a citizens' right to education and the State's responsibility to guarantee this right. In this context, information is more than an input for decision making or planning. Information and Communication Technology (ICT) tools can help transparency, accountability, oversight and participation (Kemoni & Ngulube 2008). The political and cultural role of information has been recognized and is not problem-free. Morales-Gomez and Melesse (1998) warn against ICTs in participation without careful examination of their social and cultural implications. Telecommunications in the '90s expanded thanks to plummeting costs and innovation, but radically modified social relations. Arunachalam (1999) compares the significance of this to the role of movable print in facilitating the Protestant Reformation. As information systems now move from addressing specific unit's needs to integrating data and providing access the question becomes: can we harness web intelligence as a tool for democracy, or will it remain an instrument for efficiency? In this respect, the implementation in Guatemala of a Platform for Integrated Social Information which brings together data from education, health, finance and demography using web intelligence tools shows a promising start, and underscores the challenges ahead. Will information strengthen democratic practice, or increase power differences based on information between central and local government, and between institutional officers and citizens? We should think pro-actively about what information is needed for democratic participation within the education sector, and what tools and practices address that need.

## **III. Case Description: The Integrated Information Platform**

Almost two decades ago the Ministry of Education (MOE) in Guatemala began to modernize its information systems in an attempt to reduce the almost two years it took for educational statistics to be published. With initial support from the United States Agency for International Development (USAID) and later the World Bank, over the 1990s the MOE established a strong IT department and progressively expanded the application of database technologies and networking to its central headquarters and departmental directorates (the main decentralized management units in the MOE). Overall this led to the systematic storage of detailed enrollment, promotion, teacher payroll and other data over the period between 1992, when the first large-scale electronic data collection effort was conducted<sup>4</sup>, and the present.<sup>5</sup> Time to publication fell below one year and quality has steadily improved, but databases are designed, implemented and managed independently by each unit in the

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<sup>4</sup> A first enrollment census was held in 1991 but the data were never published due to unresolved data quality issues.

<sup>5</sup> Fernando Rubio, personal communication.

MOE. Data use is extensive, but staff capacity for analysis varies considerably across units and between administrations due to the significant staff turnover in the public administration.

The Guatemalan “Platform for Integrated Social Information” (PISI) initiative began in 2006, again as an MOE initiative with support from USAID, the World Bank, the Inter-American Development Bank and other donors. The USAID/Dialogue for Social Investment project ([www.proyectodialogo.org](http://www.proyectodialogo.org)) worked closely with the MOE to implement information resources to improve transparency and efficiency in management. Initial efforts were a response to the Minister of Education's concern that indicators were inconsistent according to which MOE unit published them (it should be noted that she held a degree in systems engineering). Systems were slow in addressing her requests for information, especially as any query of the data needed IT specialists' involvement, as they were the only staff familiar with the structure of the various databases. A review of technologies led to identify web intelligence tools as an answer to the problems described. A specific tool - *Business Objects*® - was selected. Its object-oriented design, which avoids the need to learn a special program language to formulate queries, and flexible reports made it easy to use for non-experts, but any software of this type would have served the purpose.<sup>6</sup> Though implementation was originally conceived as an information and communication technology (ICT) initiative to facilitate access to data, specialists leading the effort soon realized that this was better framed as a planning initiative, leading to improved access to data and information for planners and decision makers. Implementation followed roughly five steps (Alvarado & Somerville 2009).<sup>7</sup> Following on the perceived success in the adoption of this initiative in the MOE (Trujillo 2008), late in 2007 the Ministry of Health adopted the same tool with USAID support, and linked its data with the MOE's in an “Integrated Information Platform”, roughly along the lines described here.

### A. Data identification

Through conversations with managers from the various units in the MOE, key information needs and available data sources and databases were identified for integration. Working with early adopters in the planning unit and upper management, other units were incorporated as they became less reticent to sharing information. Despite early resistance, increasing volumes of data have now been incorporated into the Platform. To date, for the MOE this includes data about enrollment and promotion, teacher allocation, human resources and payroll (from 1992 to date), and infrastructure (based on a 2005 census of facilities), as well as demographic and population projection data from the last national population census (2002), and socioeconomic information from the last two national household surveys. A key element for success has been letting each unit decide what data to share. For example, while the human resources (HR) unit in the MOE has loaded all its data onto the Platform and uses it on a day-to-day basis, no data about teacher salaries are made available except within the MOE. In this way, while all analysts can benefit from the data concerning numbers and distribution of teachers, the HR unit continues to feel comfortable in this partnership.

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<sup>6</sup> In recent years a class of software tools known as “business intelligence” or “web intelligence” has taken off. These are software applications that have the ability to pull together data from multiple databases into combined interfaces and “mine” the data with great flexibility. *Business Objects*® is a commercial product available “off-the-shelf.” Other examples of commercial products are Sharepoint Server (previously ProClarity and now owned by Microsoft), Panorama ([www.panorama.com](http://www.panorama.com)) and Cognos ([www.cognos.com](http://www.cognos.com)). Free, open source options are also available. Of these, Pentaho ([www.pentaho.com](http://www.pentaho.com)) is an example.

<sup>7</sup> Sergio Somerville, as Policy and Planning specialist in the USAID/Dialogue for Social Investment project first described these five stages for the Platform in a training manual for users.

## **B. Data linking**

The second stage involved defining relations between variables and items across databases. While the first stage mostly involved IT specialists, this phase required close collaboration between IT and content specialists in defining relations. As mentioned above, previously IT staff received frequent requests from content specialists to run queries because only they knew the database structures. Now analysts could focus directly on the data. This went a long way to reduce tensions between subject-area specialists, who could focus on the analysis, and technology specialists, who could focus on the systems and infrastructure, and reduced suspicion about the project as a whole. For example, while the National Institute for Statistics codes the country's 22 departments individually, the MOE has divided the greater metropolitan department into two separate codes (rural and urban) resulting in 23 codes, which then have to be reconciled if queries are to be consistent.

## **C. Data unification**

The third stage developed a unified presentation of the data on the Platform. A key aspect has been the integration of information using data from different units in the MOE and, more recently, between the MOE and other institutions. To date the Platform involves a broad range of integrated data, including the data described above, but also extensive data from the MOH (services provision, morbidity and mortality), the Ministry of Finance (approved, committed and spent budgets for both the MOE and MOH), specific research databases from the Presidential Secretariat for Planning and macroeconomic indicators from the Bank of Guatemala (the central bank). Unification does not involve manipulating or modifying the original source databases. Data from all sources are made directly available through a single integrated web interface. Data linking and unification has been completed for the Ministry of Education, but continues actively for the MOH and other sources.

## **D. User tool development**

The fourth stage involves developing user reports in table, graphic and “dashboard” format, as well as links to geographical information applications. This continues to date, as more users learn about the Platform. At this stage work in the previous three stages comes to fruition, as decision makers, analysts and others realize the extent of data available. In the MOE the interface is used on a daily basis by analysts and planners in central and decentralized locations, who have developed a variety of reports to address their own needs. Significantly, these reports can then be published to public folders for use by others. Though an in-depth discussion of the tool itself is not intended here, it is to be noted that these reports are not static tables and charts, but rather dynamic templates that update with the latest data each time they are consulted by users. Some examples of reports published for the education sector include:

- A tool to track results in the school registration rapid survey, conducted yearly in the second quarter by the MOE. This lets authorities and managers understand trends in registration much faster than the official registration census, which only provides results at the end of the year;
- A report tracking the proportion of teachers, by education level, who are not allocated to classrooms;
- A school report bringing together information about infrastructure, teachers, and student registration, promotion rates and performance, for each school in the country;
- A set of indices relating education to social variables such as ethnicity, gender, poverty and rurality;
- A report on conditions and progress in girls' education; and

- A report on educational expenditures by program, activity and line item for tracking in the context of the Millenium Challenge Corporation targets.

More significantly, reports are now being developed for a broader public. In education this has included a “Municipal Education Advancement Index” showing progress in registration and termination results by municipality and year, simultaneously published in hard copy, published to foster dialogue about differences among municipalities. Another application currently under development is a national indicator system that will track education input, process, output and impact indicators as these become available for policy monitoring. Similar developments have begun to occur in the MOH.

### **E. Capacity building**

The fifth and probably most challenging stage is building capacity in institutions and people. This includes training, developing manuals and establishing norms and systems for the use and maintenance of the data and information. Training has covered tool use, report preparation and statistical analysis and planning in public institutions, think tanks, NGOs, municipal governments, cooperation agencies and others. Beyond the obvious need to train people to use the tools and reports, a deliberate goal has been to establish a “critical mass” of inside and outside users and stakeholders for the platform who will support the initiative beyond the initial implementation and international funding. On the “inside”, i.e., the ministries, it has been relatively straightforward to conduct systematic training, but staff turnover is high. Users beyond the limits of the MOE, in NGOs and donor agencies and projects have tended to self-select and therefore are highly motivated and committed to training, but are less easy to reach. The project has established an agreement with a local university to deliver training directly and on-line to guarantee sustainability once the project has been completed.

These five steps, though presented sequentially, frequently overlap as additional data sources are identified: new databases are incorporated into the Platform while at the same time data continue to be linked and reports prepared for previously incorporated data. At the same time, the steps provide a guide for access and work with new units and institutions.

## **IV. Discussion**

### **A. Issues**

Implementation of the Guatemalan Platform for Integrated Social Information is a success in the eyes of those directly involved in the MOE and other government institutions, USAID and the USAID/Dialogue for Social Investment project (Trujillo 2008). Interest by other donors, municipal government officials and NGO representatives would suggest this perception is also shared by them. Heeks (2002) finds that not much more than a fifth of Information Systems initiatives are unambiguous successes. Though this initiative is now in its third full year of implementation, less than a year has so far been actively spent in the MOH, and lessons are only starting to be learnt from the implementation in the MOE. Some indicators that may help to understand what the current and future outcomes and impact of the PISI may be are: a) the nature and rate of incorporation of new data and databases into the Platform, b) the degree of institutional buy-in (shown by the growing number of institutions who actually consider themselves partners of the initiative), c) the adoption of the platform as a day-to-day tool by analysts, managers and citizen stakeholders, and d) the development of applications (such as online and printed reports) that actually use the data.

## **B. Incorporation of new data**

The PISI has grown significantly since its inception. From including data from a few MOE units, it now comprises extensive data on educational statistics, teacher and administrative payroll and school infrastructure for the whole country and since 1992, but also the last two national population censuses (1994 and 2002), the last two national living conditions surveys (2000 and 2006), the two most recent school nutrition censuses, as well as all financial data for the ministries of health and education from 1998 to date, data on all primary health service provision since 2002, births, deaths and morbidity (including specifically HIV/AIDS) from 2001 to date, and data from the national public investment system for all the country (2008 and 2009). These data are fully integrated and analyzable, constituting a formidable body of information. As data become incorporated by sector the rate of growth has diminished. While health data are still actively growing and tertiary-care level data are still pending, most available data from the education sector have now been integrated.

## **C. Institutional buy-in**

Institutional buy in can also be considered to show a positive trend. Based on the example of the MOE's implementation of web intelligence tools, the Ministry of Health began tentative implementation in late 2007 and full implementation early in 2008. More recently the national secretariat for nutrition began adopting the platform in 2009, as did the presidential secretariat for planning. Much more cautious has been the approach by the national statistics institute, and this constitutes a significant challenge. "Mi Familia Progresá" an inter-ministerial initiative in charge of implementing a conditional cash transfer program fostering education and health for poor and rural families is also now considering its inclusion in the PISI.

## **D. Adoption of the platform for day-to-day operations**

Although production is still incipient, Platform users have found answers to questions about data across sectors that would previously have been very difficult to answer. The MOE has now fully incorporated the PISI into its daily operations: staff in the planning unit regularly consult the PISI in preparing reports and as inputs for planning activities with the ministry's higher authorities, as well as with other units. The MOE human resources unit also regularly consults the PISI and increasingly teacher and resources allocation planning is being fed by data and analyses built on the Platform. Researchers and analysts in some NGOs have started consulting the data on a regular basis as well.

## **E. Development of data applications**

At this point the translation of data from the PISI into specific, accessible applications is still incipient and mostly driven by the USAID/Dialogue for Social Investment project, but shows promise in terms of what can be done. As mentioned previously, the MOE has published a *Municipal Educational Progress Index* for 2002 to 2006<sup>8</sup> and has used this extensively in negotiation and planning with municipalities. This experience is being replicated with the preparation of a Municipal Health Investment Guide. Both publications are direct applications of PISI reports. Similarly, an individualized Municipal Social Policy Status Report will be published in August, for use by municipal authorities and leaders, MOE and MOH analysts and donors to assess health, education and development conditions in municipalities they may wish to work with. The PISI has also been recently used to assess the rate of change in enrollment in municipalities served by the conditional

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<sup>8</sup> Available at: [www.mineduc.gov.gt](http://www.mineduc.gov.gt), as well as on the project website: [www.proyectodialogo.org](http://www.proyectodialogo.org) (in Spanish)

cash transfer program. All three of these examples show the potential for applications at the micro-territorial level, making the data much more relevant for citizens and their representatives.

## **V. Challenges**

The technology chosen for the Platform appears to induce positive behavioral changes. Although the tool was developed in industrialized countries and for business applications, implementation was not an imposition (Heeks 2002) or a “solution seeking a problem” (Cohen, March & Olsen 1972), but rather a choice by actively engaged decision-makers. Web intelligence is a technology that treads lightly: being non invasive and requiring no changes in data sources and institutional processes, it lets “owners” (given that these are public data it might be more appropriate to call them stewards) of the data decide what to share and under what conditions (Akrich 1992, cited in Heeks 2002:109, has called these “actuality-supporting” applications). Centered on the new technology, a “perfect storm”<sup>9</sup> of five factors (Brown, Chervany & Reinicke 2007) came together in Guatemala: a) a committed and supportive leader while the system became established, b) knowledgeable managers, c) good communications between ministries, donors and projects supporting the initiative, d) well-developed hardware, software and data systems (especially in the MOE), and e) an effective approach to implementation on the project level.

On the latter point, the initiative has benefited from a clear vision – pulling together social sector data from a broad range of sources – and enough “design improvisation” (Heeks 2002) to keep the design close to what is actually happening in implementation. Restating the initiative as an effort in planning, rather than in IT, exemplified this approach, as did the decision to move from specialized analyst training to broad stakeholder development through training. Early involvement of non-technical users with technology and content experts at the data-linking phase also helped develop the system from a socio-technical perspective.

However, this effort is not exempted from challenges. Paradoxically, as more data are included, there is a tendency of users to blame the tool for the quality and timeliness of the data it presents; data which were previously not even available. This has translated into a threat in the MOE itself, as decision makers continue to commission their own, independent data collection efforts that are then not included in the PISI. Furthermore, as mentioned above, it has been something of a challenge to convince the National Institute of Statistics, as the traditional entity responsible for official data, to fully buy into the platform. Finally, extensive applications of the data to real-life situations will depend much more on the development of analytic capabilities in staff and citizen groups than on the deployment of sophisticated data-management tools.

## **VI. What Happens Next?**

Although this initiative started three years ago, its full meaning is only just beginning to be evident, and there are more questions than answers at this point. How will information gatekeepers react to efforts to add value to information through oversight and participation, rather than just through management and policy decision making? What can we expect in expanding the Platform's user base? What will the project face in moving from management to fostering transparency, citizen's participation, and increased oversight? These important questions are only starting to be evident as the development of the Platform moves from implementation to use.

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<sup>9</sup> Thanks to Kurt Moses for the suggestion of this term.

Information can be conceptualized as a resource with mixed public and private qualities (Eaton & Bawden 1991). On the one hand consumption by one user does not prevent consumption by others. On the other hand, unlike pure public goods, users can be excluded by system gatekeepers. In this sense, data in a shared but limited network can be defined as “club goods” (Aanestad, Monteiro & Nielsen 2006). For the Platform this appears to have had a positive effect on the “owners” of data, who are more willing to share within a known network. Cautious participants join as they see early adopters reap benefits of membership in this “data club” (Alvarado & Somerville 2009).

However, this introduces the challenge of defining limits to who is inside and who is outside (see Aanestad, Monteiro & Nielsen 2006:12). This issue is both cultural/attitudinal and political. Data sharing redefines the meaning of “information is power”: participants become comfortable with the notion that power in the network is based on distribution of data and influence, rather than on concentration. Power in gate-keeping now depends on controlling the “means of information” (where it is deposited, how it can be used), rather than information itself. Though information does not degrade in sharing (Arrow, *referenced in* Eaton & Bawden 1991:157), circulation can still be controlled, and what gatekeepers control is the means of making information valuable.

The project is promoting use of the Platform as a tool for democratic dialogue<sup>10</sup>. In the education sector, an on-line, searchable report of municipal educational performance was prepared linking data from the MOE and the Presidential Secretariat for Planning to generate a thematic map highlighting municipalities with challenges and successes. Though this can be used for analysis, it is meant especially to foster dialogue at the local level and between central and local governments. Municipal authorities, local leaders and activists can consult this tool for management, policy planning and advocacy purposes. A printed version built with the same data has wider circulation, given the low access to computers in the country. Similarly, an online tool on the MOE website provides information about each school's enrollment, promotion and performance, but few users know it is available or can access it due to low access to the internet. However, if uncomfortable questions were raised based on the data shown, would the MOE be tempted to take these reports off-line or stop new experiments?

There is a need to develop more reports that make better sense to citizens. The limitations in technology and education suggest a role for NGOs and citizen groups that may bridge the gap between information and individuals without access to technology or without the education to understand the data. Will they take up this challenge? This could improve access to pertinent and timely information despite barriers to access due to poverty (Meneses-Gomez & Melesse 1998).

So far the development of the Platform has focused on publishing what is already available, recognizing that as data are made available, errors and limitations in the data will become more evident and pressure will mount to correct these. However, what will the channels be to establish feedback between civil society users and data sources? Whereas the path between data producers and users inside institutions is relatively straightforward, there are few mechanisms for users outside the institutions to comment on the data and information they may use through the platform, and no formal processes for these comments to have an impact on the data. This affects decisions surrounding the “politics of representation” (Aanestad, Monteiro and Nielsen 2006) involved in

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<sup>10</sup> Democratic dialogue is a public conversation between policy stakeholders. It addresses conflict and builds consensus through the understanding of issues based on evidence, recognizing the role of participants in solutions, and as an ongoing learning process (Pruitt and Thomas 2008). Within this framework, the PISI is a resource that provides evidence (the data), shared and recognized as legitimate by all stakeholders, to build understanding.

defining *who* is counted (do citizens have a say in this or is it a task exclusively for analysts in the institutions?), and for the quality of the data (what happens when users identify problems with the data through the platform?)

Finally, issues of security in access to the data and in privacy are, as in all systems, an ongoing concern. Currently only the data for secondary school students are linked through a unique number to each individual student, but efforts are underway in the MOE to expand this to all levels. The widely networked and distributed nature of the Platform for Integrated Social Information implies a policy of open access, but underlines the need for novel solutions that might regulate legitimate use and guarantee privacy (Weitzner, Abelson, Berners-Lee, Feigenbaum, Hendler & Sussman 2007), without unduly burdening users (Joia 2007).

#### *Acknowledgement*

The work described here is part of activities conducted under project USAID/Dialogue for Social Investment in Guatemala under Task Order EDH-I-02-05-00024-00. The author wishes to thank Carlos Pérez-Brito and Sergio Somerville for discussions during implementation, as well as Jennifer Purl and two anonymous reviewers for their comments on the paper.

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