

Abstract

While the volume and diversity of data available to researchers, policy analysts and decision-makers is growing, it is clear that traditional methods and approaches aren't enough to realize the potential of these new data sources. The environment in low-income countries poses some additional challenges to the ways to collect, analyse, disseminate and use data.

This paper investigates technological trends and enabling initiatives and opportunities that can significantly improve collection, analysis and dissemination of relevant, accurate and timely information for policy action in low income countries. Examples of innovative approaches in emerging areas like mobile data collection, big data, visualisation, and data dissemination, are presented and investigated in terms of their potential for improved policy action.

Introduction

The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda has identified how new goals and measurable targets could be framed in the wake of transformative shifts, calling for a data revolution for sustainable development, with a new international initiative to improve the quality of statistics and information available to citizens. “We should actively take advantage of new technology, crowd sourcing, and improved connectivity to empower people with information on the progress towards the targets.”¹

Information needs and challenges in low-income countries

Information needs underpin policy action in our global, diverse, and fast changing environment in many different ways.

Availability of appropriate data can for example better steer allocation of resources and tracking required to battle poverty. Judith Randel in her blog “Investments to End Poverty - A Call for More and Better Data” argues that we need data on how finance reaches different regions, down to the sub-national level, and even to the level of households and individuals. “Without this information, all resources, including private sector resources, cannot be optimally allocated and tracked, progress in contributing to poverty reduction cannot be effectively monitored, lessons about effective and efficient policies cannot be learned and people in developing countries cannot be empowered to demand accountability”.²

Data collection in low-income countries is difficult due to the high cost of direct data collection, lack of established government information sources and low access to internet. The mobile phone is a notable exception as it is the first ICT tool that has reached remote areas in low-income countries. Mobile communication technology used in health provisioning services is therefore a good example of how it is possible to overcome the lack of modern information and communication technologies (ICTs) to enable service delivery and gather data for policy action. mHealthInfo.org offers information on the current use, potential and limitations of mobile communication technology in low-resource settings.³ As of the end of 2013 there are more than 70 projects that are utilising mHealth in developing countries and the number is likely to grow with the global explosion of new mobility-related capabilities and innovations.

Policy action is highly dependent on information however there are many challenges. Some challenges are equally applicable to developed countries for example how to improve timeliness of information in a fast-changing world, how to extend local information or link data sources to better understand the global picture, and how to afford data collection of suitable quality amidst growing non-response rates and cost pressures.

Some specific challenges in low-income countries:

- Difficult direct data collection due to the low penetration of technology.
- Difficult access to households.
- Affordability of traditional (for example household face to face) methods of data collection.

¹ http://www.un.org/sg/management/pdf/HLP_P2015_Report.pdf

² <http://community.businessfightspoverty.org/profiles/blogs/judith-randel-investments-to-end-poverty-a-call-for-more-and-bett>

³ <http://www.mhealthinfo.org/>

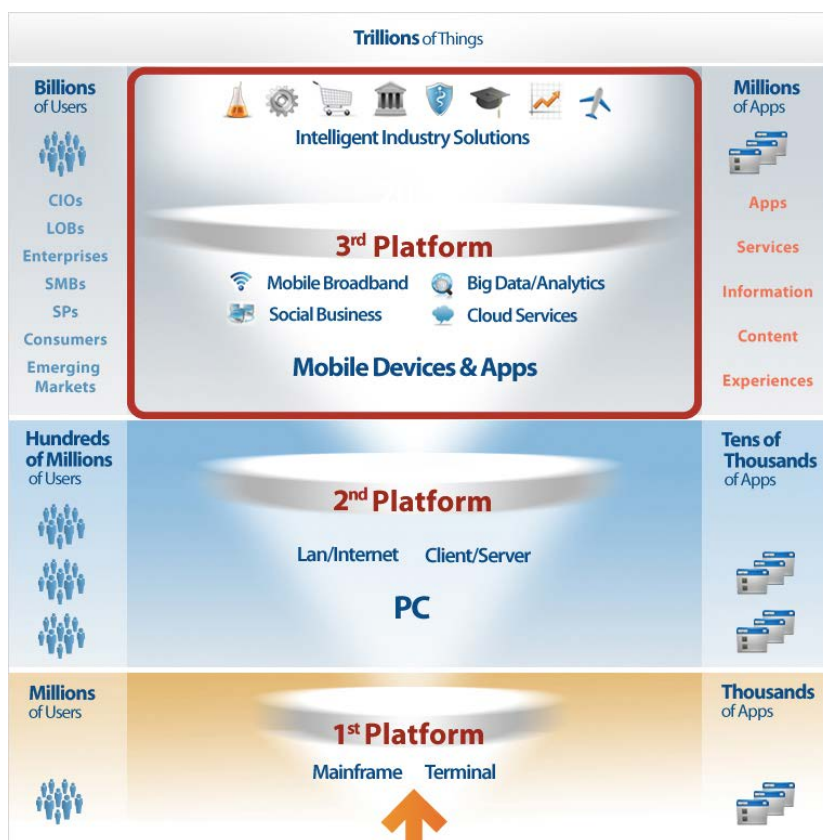
- Administrative data sources from the government are often not available or do not fit the purpose (for example not covering areas of interest).
- Poor timeliness for example information becomes available for analysis and policy action years after it has been collected.
- Lack of data at the dis-aggregated level that would be required to inform policy action.
- Information sharing and transparency is not widely adopted.
- Lack of skills and expertise to analyse and use data for policy action.

Technological progress and Innovation

Technological changes have been influencing the ways in which people work and live during the whole history of mankind. The information revolution underpinned by the progress of information and communication technology (ICT) and the growing role of the internet as an all-purpose media have increased the pace of innovation and enabled transformation of many industries.

Analysts agree that we are going through a new period of significant change. This technologically enabled change called the “Third platform” (with the first being the mainframe era and the second the PC era - see Figure 1) is seen as a main technological enabler for innovation. The "3rd Platform" is built on a foundation of cloud, mobile, social, and Big Data technologies. IDC predicts that it will enable the all-important digital transformation, evolution, and expansion of every industry over the next several years and beyond.⁴

Figure 1: The Third Platform (Source: IDC)



⁴ <http://www.tcs.com/SiteCollectionDocuments/White-Papers/3rd-Platform-Enabling-Digital-Transformation.pdf>

Mobile

Mobile drives affordability of mobile devices (particularly smartphones and tablet computers) and their expansion across different demographic populations and geographic regions in developed as well as developing countries. An example of new opportunities enabled by the expansion of mobile infrastructure and use is Africa's smartphone revolution.

Ovum analyst Richard Hurst says Africa remains a growth spot for smartphone sales "due to the limited fixed-line infrastructure, the ubiquitous nature of mobile across the continent, and the fact that many will have their first Internet experience via the mobile device".⁵

Global companies are responding to this trend with various initiatives. Microsoft has launched initiative 4Africa with the aim "to empower every African who has a great idea for a business or an application and to turn that idea into a reality which in turn can help their community, their country, or even the continent at large".⁶ With the eLearning initiative in Kenya, despite low smartphone penetration in the region, more than 2,000 students and 100 staff at Inoorero University in Kenya are already using Google apps to assist in their education.⁷

Investment in mobile business opportunities and government initiatives like mHealth and eLearning will spread the development and application of mobile technology throughout the continent, providing increasing opportunities for the use of mobile-generated data for research and policy action.

Social Media

The growing popularity and global reach of Social Media like Facebook and Twitter presents an interesting new data source for social and economic research. Social Media and related methods and technologies, for example crowd sourcing and social collaboration, can also serve as a new data collection approach.

Findings from the report Social Media and Public Policy that investigated the question: "Can evidence drawn from social media enhance public services and inform the development of social policy?" indicate that "Social media presents a growing body of evidence that can inform social and economic policy. It has value for government, the policy community and public service delivery organisations."⁸

Big Data

Big Data provides opportunity for new (potentially global) data sources, and new methods and technologies that can store, process and analyse vast volumes of often poorly structured data. Advanced analytics methods combined with huge computing power can enable real-time analysis and automated decisions.

The UN Global Pulse report Big Data for Development: Challenges & Opportunities writes that "Big Data hold the potential - as yet largely untapped - to allow decision makers to track

⁵ http://www.itweb.co.za/index.php?option=com_content&view=article&id=71203:Africa-to-lead-smartphone-growth&catid=260

⁶ <http://www.microsoft.com/africa/4afrika/default.aspx>

⁷ http://www.elearning-africa.com/eLA_Newsportal/africas-smartphone-revolution/

⁸ <http://www.alliance4usefulevidence.org/assets/Social-Media-and-Public-Policy.pdf>

development progress, improve social protection, and understand where existing policies and programmes require adjustment”.⁹

Cloud Computing

Cloud computing relies on the sharing of resources to achieve economies of scale over a network. It has the potential to bring advanced capabilities to the masses by giving organisations access to vast amounts of computing resources on demand. The cloud can therefore enable affordable use of platforms for data collection, dissemination and analytical processing of big data.

Open Data

In parallel to technological changes, we are witnessing significant changes in government direction and regulation. Open data direction presents an exciting opportunity for the wide use of previously not accessible data sources, particularly from the government and science sector.

Prasanna Lal Das from World Bank writes in his blog that “while the number of countries with open data programs has grown rapidly over the last two years, the commercial value of open data remains untapped, especially in developing countries. This represents a lost opportunity to reduce poverty and increase shared prosperity. It is also a deterrent to developing country governments to continuing opening more government data”.¹⁰

The Open Data Barometer takes a multidimensional look at the spread of Open Government Data (OGD) policy and practice across the world. The study is structured in three sections to reflect the different stages involved in realising the benefits of open data, and the different groups who may be involved in, and may benefit from, open data. The three sections are:¹¹

- Readiness – identifies to what degree a country has in place the political, social and economic foundations for realising the potential benefits of open data.
- Implementation – identifies the extent to which government has published a range of key datasets to support innovation, accountability and more improved social policy.
- Emerging impacts – identifies the extent to which open data has been seen to lead to positive political, social and environment, and economic change.

The number of Government Open Data portals in developing countries is growing and there are some success stories such as Kenya that launched the Open Data portal in July 2011 and is already 22nd on the Open Data Barometer’s list.

The open data movement has recently taken significant steps forward with the announcement of public and private sectors (including some key private players like Google and ESRI) to “extend support to Obama’s climate data initiative that concluded with the launch of the Climate Data Initiative, an ambitious effort bringing together extensive open government data and design competitions with commitments from the private and philanthropic sectors to develop data-driven planning and resilience tools for local communities”.¹²

⁹ <http://www.unglobalpulse.org/sites/default/files/BigDataforDevelopment-UNGlobalPulseJune2012.pdf>

¹⁰ <http://blogs.worldbank.org/opendata/open-data-development-impact-crucial-role-private-sector>

¹¹ <http://www.opendataresearch.org/project/2013/odb>

¹² http://geospatialworld.net/News/View.aspx?id=28612_Article

Data Revolution

Business strategists, IT leaders, and solution developers are conceiving and building disruptive new business and consumer services and business models, effectively reinventing their industries. Many analysts argue that the statistical industry is going through a similar change offering new opportunities to empower information-based policy decisions in developed as well as developing countries.

This is however a potentially disruptive change to the supply and demand of data, with amateur hackers and machine-readable technology becoming a central part of its analysis. In the blog “The specter of big data is haunting the world, but has the data revolution already occurred?” Prasanna Lal Das argues that while “traditional experts may be hoping for a gradual evolution, a parallel revolution led by practitioners in the private sector may already be underway”.¹³

Innovation opportunities and impact on policy action

Data collection

Use of mobile technology as a data collection platform provides good opportunity to address some collection challenges in developed as well as developing countries related to the nature of the working environment, for example large geographical area with poor infrastructure and communication systems.

CASE: Using mobile phones for data collection to support OVC in Tanzania, Mobile data collection, cost effective, flexible and timely collection

In Tanzania, mobile phones are used for data collection by volunteers to support nearly 38,000 orphans and vulnerable children (OVC) in areas like education, primary health care, psychosocial support, shelter, child protection, vocational training and economic strengthening. The information is captured, synthesized, and is easy to analyse in a database that is available to staff and partners, including the Tanzanian government. CRS partnered with D-Tree International, a non-profit organization dedicated to improving the quality of care by using hand-held technology.¹⁴

Expected outcomes are:

- Increased level of confidentiality, trust, and accuracy in data collection
- Increase in motivation, retention and performance of community volunteers
- Promotion of e-learning, information sharing and timely informed decisions

Findings from the two other recent pilot projects using mobile phones for high frequency data collection in Tanzania and South Sudan described in the paper “Collecting high frequency panel data using mobile phones”¹⁵ are very promising. Data has been collected on a wide range of topics in a manner that is cost effective, flexible (i.e. questions can be changed over time) and rapid. And once households are included in the survey, they tend to stick with it: respondent

¹³ <http://blogs.lse.ac.uk/impactofsocialsciences/2014/03/05/specter-of-big-data-revolution/>

¹⁴ <http://www.crsprogramquality.org/storage/pubs/ict4d/ICT4D-OVC-cell-phones-Tanzania-rev.pdf>

¹⁵ https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=CSAE2012&paper_id=299

fatigue is not an issue. Authors concluded that mobile surveys can collect data in a very timely manner and have great potential to provide rapid feedback and address existing data gaps at limited expense.

New data sources

Big data is an attractive new data source. National and international organisations that produce official statistics have started investigation to find out how big data can help to measure more accurately and timely economic, social and environmental phenomena. An international team of experts has developed a paper “What Does ‘Big Data’ Mean for Official Statistics?”, listing the following categories of big data:¹⁶

- Administrative (arising from the administration of a program, be it governmental or not), e.g. electronic medical records, hospital visits, insurance records, bank records, food banks, etc.
- Commercial or transactional: (arising from a transaction between two entities), e.g. credit card transactions, on-line transactions (including from mobile devices), etc.
- From sensors, e.g. satellite imaging, road sensors, climate sensors, etc.
- From tracking devices, e.g. tracking data from mobile telephones, GPS, etc.
- Behavioural, e.g. online searches (about a product, a service or any other type of information), online page view, etc.
- Opinion, e.g. comments on social media, etc.

Work is now continuing within the Big Data project sponsored by the High-Level Group for the Modernisation of Statistical Production and Services (HLG) with the aim to define key questions and priorities for the international official statistics community and establish a “Sandbox” environment to provide a technical platform to test Big Data sets, tools and methods.

CASE: Tracking Population Movements using Mobile Phones and Crisis Mapping: A Post-Earthquake Geospatial Study in Haiti

An example of the practical use of Big Data that can be applicable to rapid policy action in low-income countries is the post-Earthquake Geospatial Study in Haiti. This study found that routinely collected data on the movements of all active SIM cards in a disaster-affected nation could, with potentially high validity, be used to provide estimates of the magnitude, distribution, and trends in population displacement. With pre-earthquake census data, the method could also provide estimates on area-specific population sizes, which could lead to important improvements in the allocation of relief supplies and the quality of needs assessment surveys. The method was even seen to be feasible for use for close to real-time monitoring of population movements during an infectious disease outbreak.¹⁷

A similar method has been successfully used to analyse post-Earthquake population movement following the Canterbury Earthquake in New Zealand.¹⁸

Visualisation

Data visualization has been used in the past mainly as an approach to disseminate data in a user friendly and understandable way. It has exploded in the last 5 years due to the increased

¹⁶ <http://www1.unece.org/stat/platform/pages/viewpage.action?pagelId=77170614>

¹⁷ <http://irevolution.files.wordpress.com/2011/10/journal-pmed-mobile-phone-haiti.pdf>

¹⁸ http://www.stats.govt.nz/tools_and_services/earthquake-info-portal/using-cellphone-data-report.aspx

Figure 2: Tracking Population Movements using Mobile Phones (Source: irevolution.files.wordpress.com/2011/10/journal-pmed-mobile-phone-haiti.pdf)

Average daily numbers of sims that moved out from the communal sections surrounding Saint-Marc, Oct 15 to Oct 23, 9:00 am, 2010.

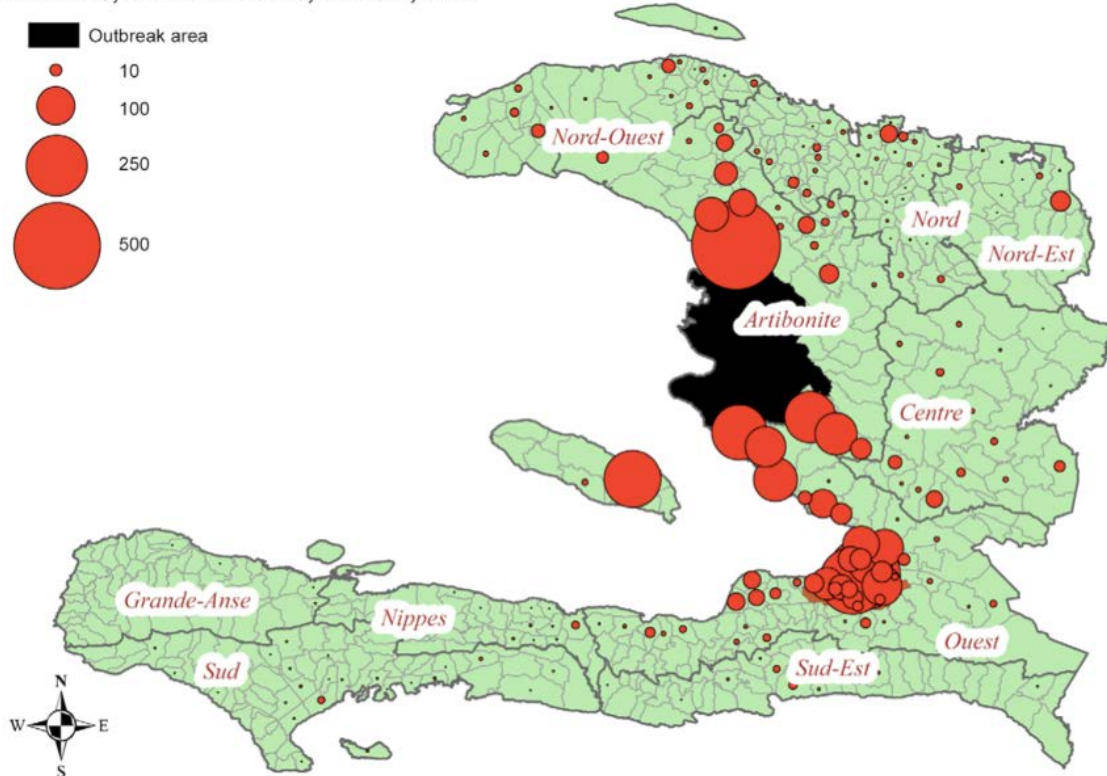


Figure 5. Average daily numbers of SIMs moving out of the cholera outbreak area. October 15 to October 23, 2010, divided per communal section of destination. The data were disseminated to relief agencies at the outset of the outbreak (October 24, 2010). doi:10.1371/journal.pmed.1001083.g005

availability of data online, advances in technology that have enabled a wide range of visualisation methods and a move from static images to interactive tools providing users with a more natural way to understand data. Infographics like the Youth Unemployment Visualization 2013 published on The World Economic Forum web site¹⁹ are effective and powerful ways to present data.

With the growing demand for more effective methods for analysis of big data to enable real-time decisions based on non-structured data there is now increased demand for visualization. According to the Intel white paper Big Data Visualization: Turning Big Data Into Big Insights “visualization-based data discovery tools don’t just enable users to create attractive infographics and heatmaps. They create business value by enabling more workers to gain more insights from more data. Instead of waiting weeks or months for static reports, employees can analyse and visualize real-time data on their own. They can also collaborate with co-workers using online, interactive graphics to generate new ideas and identify previously unseen trends”.²⁰

An example is the effective combined use of GIS-enabled mobile collection and visualisation of data with the aim to halt deforestation.

¹⁹ <http://www.weforum.org/community/global-agenda-councils/youth-unemployment-visualization-2013>

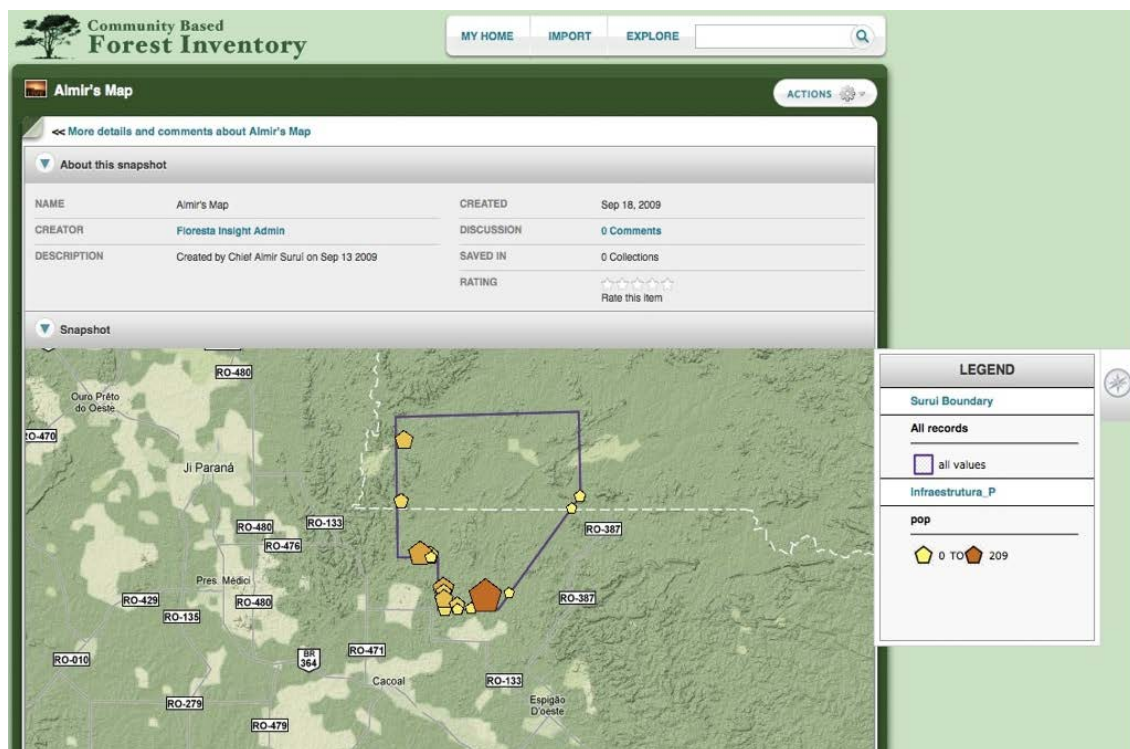
²⁰ <http://www.intel.com/content/dam/www/public/us/en/documents/white-papers/big-data-visualization-turning-big-data-into-big-insights.pdf>

CASE: Surui Carbon Project, Mobile data collection, Visualisation, Environmental protection.

The Surui Carbon Project is a radical new model for international development and environmental protection. Its aim is to halt deforestation and its associated greenhouse gas (GHG) emissions in an area under intense deforestation pressure in the Sete de Setembro Indigenous Land (TISS). Rugged handheld devices with interfaces specifically designed for non-technical users are used by Surui people to capture high-quality geo-coded data which is then passed to conservation scientists and Surui advocates for examination using advanced visualizations (see Figure 3) and comparing of data with satellite imagery to identify illegal logging and evaluate the Surui people's role in the global carbon market.²¹

This project has a 30 years span (2009-2029) showing that we need long-term vision and commitment to achieve aspirational development goals.

Figure 3: Visualisation in Surui Carbon Project (Source: rhiza.com/act/)



²¹ <http://rhiza.com/act/>

Data Dissemination

Technological innovation and standards are enabling direction towards direct open access (machine-readable data dissemination) however raw data remains important.

On-line open data technologies and standards have significant impacts on accessibility of information to researchers and policy makers. An example is the Microdata Cataloging Tool used by International Household Survey Network (IHSN).

CASE: On-line open data, Dissemination, Web based data catalogue, easy access to information, finding and comparing relevant data

NADA is a web-based cataloging system that serves as a portal for researchers to browse, search, compare, apply for access, and download relevant census or survey information. It was originally developed to support the establishment of national survey data archives. The application is used by a diverse and growing number of national, regional, and international organizations.²² NADA, as with other IHSN tools, uses the Data Documentation Initiative (DDI), XML-based international metadata standard.

Many organisations in low-income countries don't have access to technical expertise, infrastructure and resources to establish and maintain open data portals. European Union funded DaPaaS project has an aim to provide a Data- and Platform-as-a-Service environment, where 3rd parties (such as governmental organisations, SMEs, developers and larger companies) can publish and host both data sets and data-intensive applications, which can then be accessed by end-user applications in a cross-platform manner.²³

Enablers

Standards and frameworks

Collaboration on a global level needs to understand new data sources (particularly their data structures and contextual metadata) and require adoption and use of information management standards and frameworks. The Data Documentation Initiative²⁴ and Statistical Data and Metadata eXchange²⁵ frameworks and standards have been used in the research and statistical community for more than a decade despite the rapid pace of technological change constantly producing new de-facto standards. The promotion of existing applicable standards for data revolution initiatives and investment in development of mapping between standards can significantly accelerate innovation and data re-use. The situation in low-income countries however sometimes requires the development of specific frameworks and standards to enable easier access to relevant information.

CASE: International Aid Transparency standard, open data and standards, easier to find, use and compare data

The International Aid Transparency Initiative is a voluntary, multi-stakeholder initiative that seeks to improve the transparency of aid in order to increase its effectiveness in tackling poverty.

²² <http://www.ihsn.org/home/software/nada>

²³ <http://project.dapaas.eu/>

²⁴ <http://www.ddialliance.org/>

²⁵ <http://sdmx.org/>

The IATI standard is a common, open standard for the publication of aid information with the aim to make information about aid spending easier to access, use and understand.

Since the introduction of the IATI Standard, over 200 agencies (IATI signatories, NGOs and private foundations) have begun publishing data on their activities in the common IATI format. With the exception of a pilot study in the Democratic Republic of the Congo, however, the increasing richness of this new source of data is yet to be fully exploited.²⁶

Technology

Technology is one of key enablers for innovation, however in low-income countries we are often limited to technology that people already use or has a good potential (for example mobile technology in Africa).

With the new big data technological platforms, it is now possible to store, process and analyse vast volumes of structured or unstructured data. Parallel processing and in-memory computing provide the computing power required for real-time analysis and decision making, however challenges remain as to how to bring these technologies to developing countries.

The cloud computing model will provide significant opportunities as new low cost solutions for data collection and analysis become available as cloud-based services. Investment will be required for base infrastructure in low-income countries as well as industry specific cloud-based solutions (for example eHealth or eLearning) to fully exploit the potential of technological innovation.

A possible approach and requirements are explained below in the proposal of the Enhanced Cloud based Model for Healthcare Delivery Organizations in Developing Countries.

CASE: Cloud Based data storage and analysis, Healthcare delivery

Healthcare Delivery Organizations (HDOs) in Nigeria and other developing countries have been faced with quite a number of challenges which have resulted in high death and morbidity in the region. Research undertaken to address this issue proposed a cloud based model with enhanced features that integrates HDOs in developing countries into the Cloud. The model is aimed at providing a platform that will adequately aid the operations of HDOs in developing countries by securing medical records and providing information that will assist various stakeholders and policy makers in decision making within the region.

The architecture consists of a Cloud Service Provider (CSP), healthcare delivery organizations (HDOs), Data Security and User Authentication Engine (DSUAE) which protects medical records and prevents unauthorized access, and a Data Mining/Analysis and Pattern Prediction Engine (DMAPPE) which generates output that is capable of facilitating decision making in the health industry.²⁷

Methods

Mick P. Couper from the Survey Research Center of University of Michigan has investigated three key technology-related trends for data collection (big data, non-probability samples and

²⁶ <http://www.aidtransparency.net/>

²⁷ International Journal of Computer Applications (0975 – 8887) Volume 74 – No.2, July 2013, http://www.academia.edu/6136687/Enhanced_Cloud_based_Model_for_Healthcare_Delivery_Organizations_in_Developing_Countries

mobile data collection) and argues that these developments are unlikely to replace traditional survey data collection but will supplement surveys and expand the range of research methods.²⁸ Methodological challenges like selection bias and coverage, lack of stability of data sources, and opportunities for manipulation could impact data quality and slow down adoption of these data collection methods.

New innovative methods and algorithms are emerging, particularly as a response to the demand for processing and analysis of big data sources by private sector and academia. Machine learning, algorithms for sentiment analysis, pattern recognition and other methods for crunching big data are finding their place in commercial platforms enabling completely new ways of data analysis.

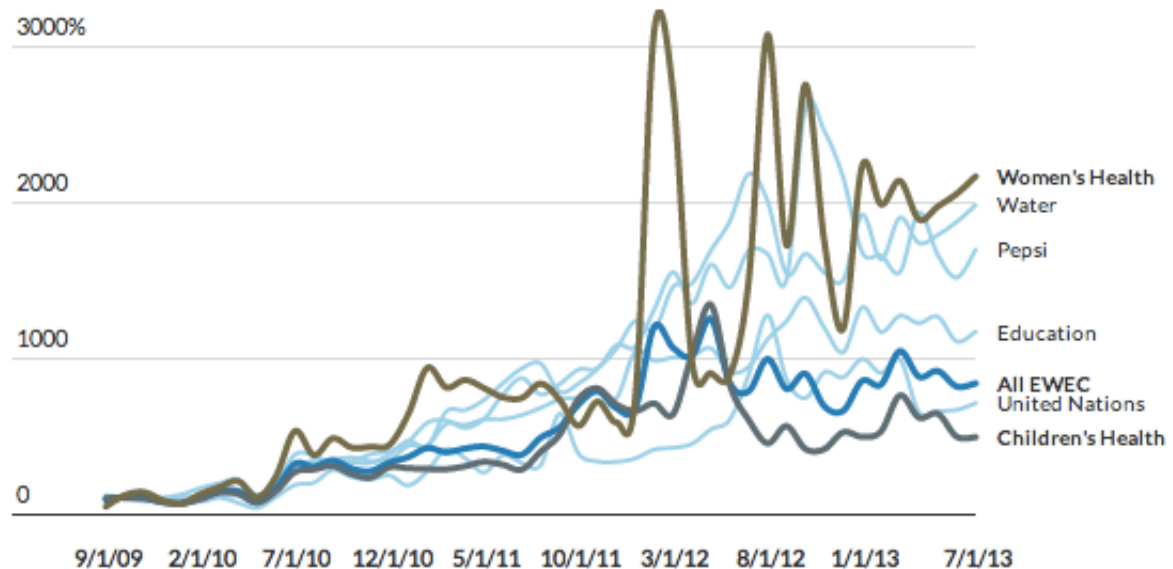
CASE: Advocacy Monitoring through Social Data, Big Data Analysis, Womens and Childrens Health

One example that shows opportunities as well as challenges with these new methods is a result of one of Global Pulse's sponsored analyses of the impact of the Every Woman Every Child movement.²⁹ The project's aim was to determine whether there has been any change in general public awareness of issues related to children's and women's (particular mothers) health reflected in Twitter conversations.³⁰

Figure 4: Social Data Analysis (Source: <http://www.unglobalpulse.org/EWEC-social-data-analysis>)

Tweet increase: Children's and women's health

Tweets on "United Nations", "Human Rights", "Pepsi", and "Education" included for comparison.



[Get the data](#) [Embed](#)

²⁸ <http://www.europeansurveyresearch.org/sites/default/files/files/Couper%20keynote.pdf>

²⁹ <http://www.everywomaneverychild.org/>

³⁰ <http://www.unglobalpulse.org/EWEC-social-data-analysis>

The project team was able to access and analyse an archive of all public tweets from September 2009 to July 2013. They developed a taxonomy of relevant keywords to identify messages related to women's and children's health and trained a monitor to recognize relevant tweets. The resulting 14 million tweets about women's and children's health were then analysed to identify spikes, trends and possible connections with real life events and campaigns (see Figure 4). Issues like "Twitter inflation" (increased numbers of people using the Twitter service during the observation period) came up during investigation however the study shed some insight on who is engaged and paying attention to the issues, from a demographic perspective.

People

The benefits of Innovation and the Data Revolution are not going to be realized without passionate and skilled people. It is important to initiate partnerships and projects that can improve capability by leveraging current global movements in open governance and the data revolution.

CASE: The Big Idea Pilot, Knowledge and Skills

An excellent example of such initiatives is "The Big Idea Pilot". This project aims to "equip young people with knowledge, skills and platforms to effectively interpret and use data in order to mobilise citizens to take action, and hold their governments accountable for the issues that are most important to young people and their broader communities, within the framework of the MDG targets and indicators."³¹ The project is going to involve different stakeholders like young people, civil society organisations, government officials, open data experts, media representatives, academic institutions and private sector enterprises taking into account each of the participating countries' specific environments.

Partnerships

Examples of successful innovation highlight the importance of partnerships and public-private collaboration. New approaches require data, capabilities and skills that can only become available through collaboration and public private partnerships. The special report (Big Data, Big Impact: New Possibilities for International Development) for the World Economic Forum in 2012 that analysed the potential of big data for policy action, has called for all ecosystem actors to commit to active and open participation:³²

- Governments can take the lead in setting policy and legal frameworks that protect individuals and require contractors to make their data public.
- Development organisations can continue supporting governments and demonstrating both the public good and the business value that data philanthropy can deliver.
- The private sector can move faster to create mechanisms for the sharing of data that can benefit the public.

CASE: Network of Global Pulse Labs in different regions, Creating An Innovative Ecosystem

An example of a partnership with the aim to leverage Big Data for development purposes at the global level is the creation of a network of Pulse Labs in different regions of the world with a headquarters lab in New York, USA since late 2009, a lab in Jakarta, Indonesia, which opened in 2012, and a lab in Kampala, Uganda that opened in late 2013. Pulse Labs bring together

³¹ <http://restlessdevelopment.org/big-idea-pilot>

³² http://www3.weforum.org/docs/WEF_TC_MFS_BigDataBigImpact_Briefing_2012.pdf

government experts, UN agencies, academia and the private sector to pioneer new methods and frameworks for using Big Data to support development goals.

Factors that are conducive to the success of in-country Pulse Labs include: regional vulnerability to global crises; existing real-time data collection initiatives; a nascent open source technology community; a vibrant local business environment; accelerating mobile phone coverage; and a track record of grassroots innovation.³³

Benefits

These examples of innovation demonstrate significant impact on data quality.

- **Relevance:** policy action in low-income countries requires multiple uses and users of information, and their requirements may change over time. New needs may arise that require new types of data. Big data sources, increased granularity of data and flexibility provided by mobile panel data collection can improve relevance.
- **Timeliness:** one of the most common benefits of new data sources and methods. Mobile data collection and new big data sources will have a significant impact on timeliness providing opportunity for rapid policy action.
- **Accuracy:** availability of additional information, for example location data, can increase accuracy however there is more work required to fully understand the benefits and challenges with the accuracy of big data sources.
- **Innovation:** in data dissemination for example use of visualisation methods and establishment of open data portals has positive impacts on accessibility and interpretability.
- **Coherence:** availability of global data sources and improved integration methods can improve coherence across datasets and countries.
- **Credibility:** similarly to accuracy there are discussions about credibility of some big data sources for example social network data. Alternative data sources are however positive for credibility because they can provide supplementary information to test established outputs.

Conclusion

A recent draft report from the working group run jointly by the Center for Global Development and the African Population and Health Research Centre on Delivering on the Data Revolution in Sub-Saharan Africa lists eleven recommendations directed at national governments, international technical agencies and donors, and civil-society and research organisations. While the majority of recommendations are focused on more effective and sustainable funding models for statistical systems and NSOs in countries in Sub-Saharan Africa there are six recommendations that are directly linked to trends and approaches described in this paper:

- Encourage open data. National governments should release all non-confidential, publishable data, including meta-data, free of charge in an online format that can be analysed and is machine-readable.
- Build quality-control mechanisms into data collection.
- Participate in and report to the International Aid Transparency Initiative (IATI).
- Support sectoral and NSOs to use open data.
- Monitor progress and generate a platform for greater accountability.

³³ <http://www.unglobalpulse.org/pulse-labs>

- Participate in public private partnerships to support data efforts, including crowd sourced data collection initiatives, data verification and analysis.

Case studies and examples reveal key success factors required to spearhead the use of innovation to enable policy action in low-income countries:

- A pilot project approach provides a staged and controlled environment to test how innovation would work in practice.
- Use of technology and methods, suitable for the environment in low-income countries, for example mobile infrastructure, GIS and visualisation.
- Leveraging alternative data sources by using crowd sourcing and harnessing new big data sources.
- Development, use and promotion of open data standards and practices to enable reuse of data and increase transparency.
- Partnerships across development organisations, government and private sectors that are crucial to mobilise skills and capabilities required for implementation.

Technological trends, examples of innovation and their benefits on policy action in low-income countries listed in this paper are far from exhaustive list. This paper should be seen only as a beginning in wide discussion and analysis, required to understand how can innovation enable policy action in low-income countries.