

Using Togaf for Building a National Implementation Strategy for E-Health Services and Technologies in Burundi

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Keywords: e-Health enterprise architecture, TOGAF, Health information systems, Burundi

Abstract: In order to better align existing and future ICT implementations in the health domain with the strategic options defined by the National Plan for Health Development, the Ministry of Health (MoH) of Burundi initiated in 2014 the development of a national e-health enterprise architecture based on the TOGAF methodology. A first part of the development cycle consisted of a detailed analysis of regulatory documents and strategic plans related to the Burundian health system. In a second part, semi-structured interviews were organized with a representative sample of relevant MoH health structures. The study demonstrated the donor driven unequal distribution of hardware equipment over health administration components and health facilities. Internet connectivity remains problematic and few health oriented business applications found their way to the Burundian health system. Paper based instruments remain predominant in Burundi's health administration. The study also identified a series of problems introduced by the uncoordinated development of health ICT in Burundi such as the lack of standardization, data security risks, varying data quality, inadequate ICT infrastructures, an unregulated e-health sector and insufficient human capacity. The results confirm the challenging situation of the Burundian health information system but they also expose a number of bright spots that provide hope for the future: a political will to reclaim MoH leadership in the health information management domain, the readiness to develop e-health education and training programs and the opportunity to capitalize the experiences with DHIS2 deployment, results based financing monitoring and hospital information management systems implementation.

1 INTRODUCTION

In 2005, the Ministry of Public Health and Fight against Aids (MoH) of Burundi has developed a National Health Policy covering the period 2005 to 2015. This policy was later translated by the MoH and its technical and financial partners into a series of objectives and results in the National Plan for Health Development 2011-2015. Amongst the objectives were the reinforcement of the National Health Information System and the restoration of the MoH leadership in the field of health information management. Therefore, a number of priority actions have been identified:

- The development of an e-health strategic plan for strengthening the national health information system
- The development of an integrated and competitive health information management system
- The development of effective tools for planning, monitoring and evaluation
- Increasing the availability of ICT tools (hardware, networks and software) at all levels of the Burundian health system
- The promotion of data driven research activities in the health sector

Integrating e-health in the national health policy yielded from the beginning enthusiasm from the donor community and in the course of the past decade, a growing number of ICT tools have found their way to the Burundian health sector. But most of these tools have been introduced for supporting projects lead by NGOs and foreign technical and financial partners whereas hardware and software solutions almost systematically served well the donor objectives, but inter-project coordination and interfacing remained exceptional. Several successful e-health tools remained hidden in silo-projects and only produced a fraction of their potential benefits. Without corrective action, the Burundian health sector threatens to evolve towards a cacophony of divergent non-integrated health informatics implementations. In order to cope with this threat, the MoH initiated in 2014, with financial backup of the Belgian Technical Cooperation, the development of a national e-health enterprise architecture based on The Open Group Architecture Framework (TOGAF). In a first step, an initial analysis of human resources, business processes, hardware, software, communication and networking infrastructure related to health information management, had to be established. This study describes the objectives, methods and findings of this analysis.

2 MATERIALS AND METHODS

The main objective of the study was to provide a reliable estimation of the existing human and material resources and issues related to health information management in Burundi. The research hypothesis was that an industrial framework like TOGAF could be used for this, even in the challenging environment of one of the poorest countries in the world. If successful, the study results were to become the first step in a complete e-health enterprise architecture development cycle according to the TOGAF methodology, and therefore needed to provide data for the development of 4 essential sub-architectures:

- **Business architecture:** what are the MoH business needs in terms of health information management?
- **Application architecture:** which health information management applications have already been implemented in the field and to what extent do they address the business needs?
- **Data architecture:** what data is needed and collected today by the MoH and what is the quality of it?

- **Technology architecture:** what are the necessary technologies (software, hardware, and networking) and which ones are used today in the health domain in Burundi?

A first part of the study consisted of a detailed analysis of regulatory documents and strategic plans related to the Burundian health system.

In a second part, field visits and semi-structured interviews were organized with a sample of relevant structures of the MoH. A standardized study-specific interview guide was developed and systematically used by the interviewers.

3 RESULTS

3.1 Mission analysis and field visits

The study of regulatory documents and strategic plans took place in October and November 2014. After that, a series of field visits and interviews have been organized with 39 relevant MoH and -related structures in the Bujumbura province (the permanent secretary and all MoH directorates, major health programs, donor agencies, NGOs, public and private health facilities and educational institutions). In the period from November to December 2014, the e-health architecture development team also visited 5 other provinces (Muramvya, Gitega, Ruyigi, Kirundo and Ngozi), covering 5 provincial health offices, 5 health district administrations and 12 hospitals. In total, management staff of more than 15% of the MoH structures have been questioned about the mission, the mandate and the vision of their organization, their objectives and the way their work is organized. After that, a detailed analysis was made of health information management related human resources, ICT solutions and non-ICT (paper based) instruments at their disposal and procedures used for exchanging health information with other (MoH or non-MoH) organizations. Finally, an analysis was performed of health information management problems, expected benefits and potential threats of health ICT for each component of the MoH.

3.2 Hardware

The study showed that computer hardware has most often been supplied to the MoH by donor-driven intervention programs. There is no organization-wide management of computer equipment and distribution of hardware over the different MoH directorates, provincial- or district administrations and hospitals is

very heterogeneous: some structures which are supported by several donors are over-equipped, others remain without any computer hardware at all. Under impetus of recent national and provincial policies and international hype, a growing number of health centers in Burundi started buying computer hardware with their own funds, unfortunately without having a clear idea of how to integrate such tools in their existing activities.

Generally speaking, hardware specifications are low standard: desktop PCs with Windows XP and Windows 7 operating systems, of which a large number have limited functionality due to computer virus infections (no budget is available for keeping antivirus software databases up to date and many of the PCs have no access to internet for performing these updates anyway). PCs are almost always accompanied by an uninterruptible power supply (UPS) but due to the lack of battery maintenance, the protection offered by these UPSs is minimal.

Many of the executive health staff make use of laptop computers which in about half of the cases are their personal privately owned equipment.

Printers are rarely shared in a network and toner or ink cartridge supply is problematic due to the unavailability of toner cartridges on the Burundian market or the lack of budget for operational costs.

Electronic files and documents are commonly transferred between computers using USB memory sticks, which constitute an infamous source of virus infections.

3.3 Networks

Most of the central MoH structures in the Bujumbura region have access to a wired or Wi-Fi based LAN. Many times, these networks are only connected to the internet by grace of donor funding, which is always limited in time (and sometimes also in data volume). Few larger structures (central MoH site, reference hospitals) have been connected to a national optical fiber network offering reasonable internet connectivity. However, for most of the small and medium-sized health facilities, broadband internet prices remain prohibitive and bandwidth offered by local ISPs in Bujumbura is poor and unstable although considerable improvement has been seen in the past few years.

Installation of internet connections is hardly coordinated, with some structures sometimes accumulating several (poorly performing) parallel connections on the same site: 4 different wired internet connections have been identified at the site of the national blood transfusion site, in addition to the

numerous individual 3G-USB modems already offered by several donor programs. In spite of the inadequate internet bandwidth, most central level MoH structures still state that an internet connection has become indispensable for their daily activities.

Away from the national and provincial capitals, the situation is worse: wired internet connections are unavailable and performance of 2G and 3G wireless data networks is unpredictable. Some donor agencies (such as EU) have equipped MoH structures with VSAT connections which provide stable and reliable bandwidth but come with high operational costs. Many of these satellite internet connexions remain unavailable part of the time due to inappropriate use (downloading movies or audio) consuming all of the monthly foreseen VSAT credit in only a few days.

3.4 Software

Almost all of the end user computers run Microsoft Windows operating systems completed with Microsoft Office applications, with the exception of a number of desktop and server computers running Linux Mint or Ubuntu at the directorate of the national health information system.

Although health specific software implementations remain rare, a clear tendency towards web-based business applications is being noted, often based on Linux/Apache, MySQL databases and PHP or Java development:

- The MOH started in 2014 pilot implementations of the DHIS2 data warehouse as a replacement for the outdated MS Access based GESIS health data collection solution.
- iHRIS human resource information system deployment also started end 2014 with the first implementation pilots scheduled early 2015.
- Hospital information system (HIS) implementations remain rare (less than 10% of the hospitals), with all of the health facilities in our study sample running OpenClinic GA. The majority of the HIS solutions are concentrated in third level reference health facilities.
- OpenRBF has been implemented for monitoring of results based financing (RBF) programs at the central and provincial levels.
- Joomla and Drupal are the most popular solutions for website content development.

Some successful m-Health applications (the RapidSMS based KIRA Mama project and SIDA-info) provide promising results today.

Epi-Info and SPSS are the leading statistics software solutions. General and analytical accounting systems are used by several health sector structures of Burundi: Asyst and QuickSoft (local development), SAGE Saari, Popsy, and Banana were found in about half of the interviewed health facilities while Tompro was recently introduced for project-oriented accounting at the central MoH level.

3.5 Paper based instruments

The vast majority of the provincial and health district administrations are using ICT-tools for reporting health data to the central level (GESIS), but a number of hospitals and almost all health centers still rely on paper based instruments for routine data collection. Information is written down in registers by administrative clerks and clinical staff and sent on a monthly basis to the health district administration (emergency surveillance information is sometimes reported more quickly using SMS). Health districts then forward compiled health facility data to the provincial level, where eventually provincial reports are sent to the central level in Bujumbura.

A minimum of 25 paper registers must be kept by all health centers and around 75 registers are in use in an average district hospital. Additionally, donors and health intervention programs claim parallel and redundant reporting from the health facilities and district administrations they support, all of which represents an impressive administrative overhead.

Paper based instruments are also predominant for health record keeping in most (90%) of the hospitals. All of them are facing health information quality management issues.

3.6 Health information management problems detected

Over the past 10 years, the existing health sector ICT landscape of Burundi grew organically, with most of the project-oriented solutions being provided by donors and health programs. This happened in an uncoordinated way, leading to:

- Lack of standardization: health information representation is hardly standardized and few international classifications or coding systems are in use (with the exception of some of the DHIS2 and HIS modules using ICD-10).
- Data availability risks: many databases are hosted in donor countries outside Burundi, with true data accessibility risks for the MoH. Also, many MoH agents use personal computer

equipment without appropriate backup procedures or anti-virus protection.

- Data protection risks: data access rights are not being organized in layers according to the role people fulfil in the health administration; most often one has full access to all of the information or no access at all.
- Varying data quality: multiple issues explain the poor quality of data collected in the field. There is (1) the lack of intrinsic motivation of MoH staff that don't produce data for their own purpose; (2) the important administrative burden caused by redundant health data collection processes; (3) many MoH agents don't have the necessary qualifications for producing reliable data; (4) the absence of personal consequences linked to the production of erroneous information; (5) donor funding for the collection of project specific health data at the same time compromising the global and systemic collection of routine data for which no financial incentives exist (RBF).
- Varying data promptness: the lack of reliable (electronic) communication instruments delays the transmission of health information between different levels of the health system.
- Lack of data completeness: data is sometimes considered a factor of power and the lack of perceived personal interest in information sharing may hinder the effective, complete and systematic exchange of health sector data.
- Defective and insufficient computer equipment: a number of MoH structures have no access to appropriate ICT hardware and due to the lack of maintenance procedures, many of the existing equipment has become defective. Computer virus infections also constitute a major problem for the MoH administration.
- Inadequate ICT infrastructure: today, access to stable electric power is out of reach for many of the MoH structures, even in the larger cities. UPSs have been provided with most of the computers, but their defective batteries often don't provide any protection against power failures (sometimes power failures can last for several days, which heavily compromises the reliability of electronics in every day's work). Affordable broadband internet is unavailable for most of the MoH components. Donor project-funded internet connectivity is always limited in time and does rarely bring a sustainable solution.
- Unregulated e-health market: although e-health solutions are being considered "medical devices" by WHO, no standards or regulations

have been put in place for introducing ICT-tools in Burundi's health system. E-Health solutions deployment therefore escapes today from any health authority control.

- Lack of health applications: most of the software solutions deployed in the health sector are generic office applications, statistical analysis applications or aggregate data reporting instruments. Few health application implementations such as hospital-, laboratory- or pharmacy information systems have found their way to Burundi's health system.
- Insufficient human capacity: on the one hand, qualified staff who are capable of effectively using ICT-tools in their work environment are missing in most of the MoH structures. On the other hand, there is a plethora of unmotivated and underqualified staff occupying positions in the MoH administration preventing young and better qualified workers from being recruited. Additionally, health-ICT related training and education opportunities are not aligned to the needs expressed by the different directorates and health facilities.
- Organizational problems: the organizational structure of the MoH reflects in no way the important transversal role of ICT in today's healthcare. The statute of ICT professionals at the MoH is far from attractive; they are considered an administrative burden rather than a valuable asset of the organization.
- Ineffective dissemination of information: the absence of a reliable communication network limits the dissemination of regulations, practice guidelines and policies from the central MoH level to the peripheral structures.

4 CONCLUSIONS

The TOGAF methodology, after applying some simplifications, offered the appropriate instruments to quantitatively and qualitatively describe the status of health ICT tools deployment in the health sector of a low-resource country like Burundi. The output of the study was later used as a starting point for the further development of an e-Health Enterprise Architecture for Burundi's MoH, which has been officially validated on July 29th, 2015.

The study results more or less confirmed the challenging situation of the Burundian health information system, but they also exposed a number of bright spots that provide hope for the future:

- There is a political will to reclaim MoH leadership in the health information management domain by enforcing compliance with international consensus and standards for future e-health initiatives, putting the MoH in a regulator/gatekeeper position.
- The human resource deficit in health informatics is huge and many of the country's education institutions will have to collaborate on national and international levels to provide necessary ICT training programs. Burundian academic institutions and the donor community seem to be willing to invest in this.
- DHIS2 implementation got substantial support from the government and donor agencies. Extensive training programs have started in December 2014 and a lot of enthusiasm exists to make the implementation of a flexible national health data warehouse a reality.
- Hospital information management systems implementation has been convincingly successful in several hospitals and provides clear evidence for the feasibility of HIS implementation in Burundi.

An important challenge remains to capitalize the experiences from the few success stories and to integrate these in a new coordinated, well adapted and appropriately funded e-health strategy for the country in the next 5 to 10 years. According to the architecture vision developed in this study, such a strategy should account for:

- The creation of a national MoH datacenter in Bujumbura that centralizes shared databases and applications and provides a professional infrastructure with stable electricity, access control, data backup and redundancy.
- The development of a multi-technology (optical fiber, 3G and VSAT) VPN-based health care intranet connecting central, provincial and district level structures.
- The implementation of shared generic applications for the public health sector: accounting software, workflow management, a unique central website, a virtual library, a geographic information system and an MoH owned mail server (preventing loss of valuable information when staff using gmail.com or yahoo.fr accounts leave the organization)
- The implementation/strengthening of a series of health specific business applications such as DHIS2, iHRIS, OpenRBF, OpenClinic GA HIS,

- LMIS and a series of health resource registries (a facility registry being one of them)
- The implementation of tablet and smartphone based patient oriented health data collection tools in health centers and at the community level (KIRA Mama and SIDA-Info)
- The implementation of an SMS-to-IP gateway enabling health facilities that have only access to plain GSM and SMS connectivity to participate in the country's electronic data collection mechanisms.
- The development of 3 health informatics teaching programs to cope with the important human capacity building needs: (1) a Master in Health Informatics program in collaboration with universities from neighbouring countries, (2) a specialization program in applied health informatics for health professionals and (3) the creation of a biomedical technician bachelor program.
- The creation of an autonomous health informatics directorate at the MoH with departments in charge of (1) standardization and regulation, (2) health informatics infrastructure management (datacenter and intranet), (3) health informatics education and promotion and (4) helpdesk and support functions.

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