FREE AND OPEN SOURCE SOFTWARE (FOSS) FOR ELECTRONIC HEALTH RECORD MANAGEMENT IN DEVELOPING COUNTRIES

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ABSTRACT

An increasing number of open source projects over the past decade have found their way to the health sector, particularly in developing countries. Some of the more than 1,500 applications which have already been published in the public domain were particularly successful, others died a quiet death. FOSS means more than free software: for many projects it also involves a completely new approach to novel software development methods to be embedded in even new business models. Since a few years, open source applications became available for the full management of medical records and some of them have grown into complete integrated hospital information management systems. This article tries to give an overview of important potential advantages, disadvantages and challenges for medical FOSS applications with special interest in the electronic medical record.

Keywords: Open source software - Developing countries - Health information systems - Electronic medical record

RESUME

Un nombre croissant de projets à sources libres ont trouvé les dix dernières années le chemin vers le secteur de la santé, plus particulièrement dans les pays en voie de développement. Quelques unes des plus de 1.500 applications médicales qui ont été publiées dans le domaine public, ont connu un grand succès. D'autres ont disparu sans laisser beaucoup de traces. FOSS veut dire beaucoup plus que des logiciels gratuits : pour beaucoup de projets, cela signifie une méthode complètement nou-velle pour le développement de logiciels pouvant être intégrée dans des nouveaux modèles de busi-ness. Depuis quelques années, des applications à sources libres sont devenues disponibles pour la gestion complète de dossiers médicaux et certaines se sont même développées en solutions com-plètes pour la gestion intégrée d'informations hospitalières. Cet article essaye de rassembler un nombre d'avantages potentiels, de désavantages et de défis des applications FOSS médicaux avec un intérêt spécifique pour le dossier médical informatisé.

Mots-clés: Logiciel d'accès ouvert - Pays en voie de développement - Systèmes d'informations de santé - Dossier médical informatisé

INTRODUCTION

In recent years, we have seen an impressive rise in the number of Open Source applications in health care worldwide. Although the phenomenon is not new (Octo Barnett already made available the source code of an ambulatory medical record system called COSTAR in 1970), real world FOSS implementations in medical production environments really gained momentum in the last decade. In 2011, more than 1500 FOSS pro-jects with a health care focus have been identified by Black Duck Software across a number of forges and software repositories, representing an increase of 31% compared to 2010.

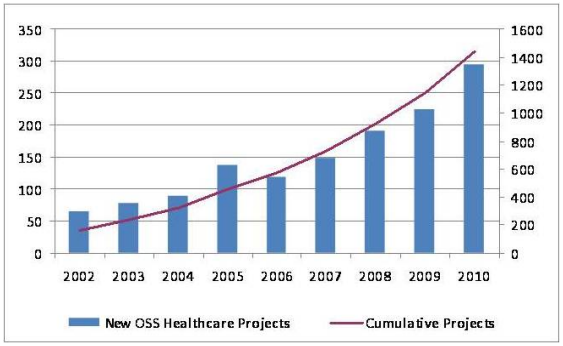

Figure 1: New Health Care Open Source Software Projects Since 2002.

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The term FOSS covers a series of software applications that share some important characteristics [1,2,5,7,10]. First of all, there is the protection of series of freedoms according to the Free Software Foun-dation founded in 1985 by Richard Stallman:

- Freedom to run the program, for any purpose
- Freedom to study how the program works and to adapt it to one's needs
- Freedom to redistribute copies of the software
- Freedom to modify/improve the software and release the modifications to the public

Obviously, source code access will be a precondition for some of these freedoms. Furthermore, key charac-teristics of open source software (OSS) also include that:

- It's free: obtaining the software goes without costs
- It's open: the source code being readable by anyone, it can be modified by anyone
- It's collaborative: OSS draws its strength from the fact that people who improve or modify it must make the result of their efforts available to the other members of the open source community.

METHODS

A literature review was performed for open source software implementation efforts in developing countries after January 1st, 2000 and completed with lessons learned from a series of 22 open source hospital infor-mation systems implementation projects we conducted between

2006 and 2012 in Rwanda, Burundi, Mali and DRC.

RESULTS

Originally, many OSS products were of the "horizontal infrastructure" type, with generally well-defined requirements9. The healthcare domain covering a more complex and less clearly defined application field with a need for more "vertical" business applications, has been lagging behind in terms of available FOSS implementations for many years. However, healthcare FOSS seems to have come to a certain level of maturity and a recent deployment of significant numbers of open source electronic health information systems has been seen in developing countries [3,12,13,14], including a number of comprehensive and sophisticated electronic health record systems, despite remaining scepticism, mainly due to ignorance.

Potential benefits of FOSS

A first element, crucial to developing countries, is the fact that open source software is cheaper than proprie-tary software due to the absence of license fees. A number of proprietary advocates will state that license fees are only one component of the total cost of ownership (TCO) of the software, next to installation costs, training costs, maintenance & support costs etc… and that license fees only account for 5 to 10% of the TCO [12]. This is true in developed countries where the other cost factors are labor intensive and related to high salary costs, but if we adjust calculations for developing countries with much lower salaries, the license costs may run up to more than 75% of the TCO. Excessively high license cost still is one of the thriving factors for software piracy in the south.

FOSS' adaptability of the freely available source code to local functional, cultural, organizational or lan-guage related needs is a second important advantage of FOSS for the developing world [2,3,4,11]. Indeed, the tendency of proprietary vendors to ignore local needs is especially marked in developing regions where purchasing power is low [10].

Thirdly, the opportunity for developers to freely experiment with open source software will help to develop local technology skills at marginal cost (for free in fact), fostering a local ICT software and services econo-my [2,10,11].

Fourthly, open source software enables evaluation of the quality of the way the program is written: skilled programmers can evaluate the product and the source code itself is part of the documentation sot that programming errors can be addressed at once, without depending on external parties.

Finally, FOSS development has been associated with parallel development rather than linear, involving large communities of globally distributed developers [9]. This approach is based on the belief that collaboration and not competition creates optimal and sustainable solutions [11]. This has proven in the past to deliver more secure [4] and stable [1] solutions and to guarantee more sustainable software that doesn't depend on the goodwill and commercial interest of a single company. Availability of the source code and guarantees re-garding "non-buy-in" rightfully become commonplace in calls for tenders and contract negotiations about software developments.

What about the electronic health record?

Many early health record related FOSS projects have started as ad-hoc solutions for smaller practical prob-lems that were later posted in the public domain [4]. Only at the beginning of the 21st century emerged a small number of more comprehensive electronic health record systems. Today, some of these pioneering sys-tems have developed in a growing number of developing countries into successful electronic medical record and hospital information systems with implementations in many sites:

- OpenMRS [3, 6] developed a unique multi-country community of developers and implementers building and adapting a tool for managing and tracking clinical encounters in low resource countries. OpenMRS is a longitudinal electronic medical record system being implemented by a diverse team in more than 50 clinical sites in 20 developing countries worldwide and is mainly used for the fol-low-up of patients suffering HIV/AIDS (50.000+ patients in Kenya alone), malaria and tuberculosis.
- OpenClinic GA [12,13,14] is a multilingual open source integrated hospital information management system, putting the electronic health record at the centre of a suite of administrative, financial, statis-tical, pharmaceutical, lab and other modules. OpenClinic has implementations in more than 25 Afri-can sites in Rwanda, Burundi, DR Congo, Mali and Ivory Coast and today manages more than 1.000.000 patient records including more than 10.5 million registered health service deliveries.

Trial and error often drove the implementation of complex electronic medical record (EMR) systems in the difficult contexts of developing countries. Nevertheless, a number of critical success factors lessons can be learned from these successful implementations:

- It cannot be stressed enough that EMR systems in developing countries should be easy to use. EMR systems using the ubiquitous web interface have proven to generate shorter end-user learning curves.
- A FOSS EMR should be based on a well-defined business architecture [2,3], including a generic data model coupled to a flexible concept dictionary, preferably linked to international coding and classifi-cation systems like ICPC-2, ICD-10, LOINC or SNOMED-CT [2,12,14]. The dictionary appears to be essential for flexibility and multilingualism and the strength of the data model will dictate the scalability and flexibility of a system [3].
- In developing countries, healthcare information systems have been driven to a large extent by the need to report aggregate statistics for government or funding agencies [3].

Implementation of redun-dant registration solutions (like DHIS) on top of existing clinical registration procedures have added an important administrative time-consuming burden to already understaffed facilities, inevitably leading to poor quantity and quality of reported data. EMR implementations enabling generation of aggregate reports (in standardized formats like SDMX-HD) from source data registered at the point of care can (partially) eliminate redundant statistical registration and therefore provide an immediate return on investment to end users [4,14]. OpenClinic has demonstrated the feasibility of such ap-proach with the implementation of the Global Health Barometer project [14], automatically central-izing every night a large set of care delivery indicators from a heterogeneous set of 22 sub-Saharan health facilities.

- EMR systems are by no means stand-alone solutions. They should provide standardized interfaces enabling integration with other health information systems: laboratory management, medical imag-ing, billing, scheduling, reporting or research and statistics. Integration is essential in order to avoid data entry redundancy and associated coding errors and to clearly demonstrate end user benefit [5,9,11,14]. In any case, a real world EMR promoting better quality of care should aim to develop where possible a holistic patient view based on integration of patient-related from multiple sources.
- The development of local expertise, possibly in the form of local small business enterprises or gov-ernment lead initiatives is an absolute necessity in order to achieve sustainable results [2,10]. Such local expertise will not only help to provide fast and efficient local user assistance [7] but can also greatly improve correct identification of local organizational realities, which must always be consid-ered as legitimate when feasible [2]. Developing local expertise often requires setting up of appro-priate (long term) training and education initiatives supported by local governments and international buyers such as the Rockefeller e-Health Centre of Excellence in Kigali (Rwanda) [7,14]. Successful training programs should combine technological skills with medical understanding preparing stu-dents for the specific context of health informatics.

Challenges

Regardless of the chosen software solution, be it a FOSS EMR or not, a number of challenges persist in de-veloping countries:

- Patient identification remains a headache [12,13]. Patient cards or biometrics based identification has brought some relief, but the problem is far from solved.
- Prompt and effective help to users is a vital factor in ensuring widespread use of an EMR system throughout a health facility. This not only has to do with availability of local expertise but also re-lates to development of a customer-oriented attitude of support staff. The implementation and sup-port of large scale regional health informatics training programs might be very beneficial to cope with this challenge.
- Technical challenges include unstable power supply and lack of battery back-up, inadequate backup procedures, poor systems and network security leading to virus and spyware propagation and high-cost low-bandwidth Internet connectivity [3]. Although these problems tend to diminish over time, they still present major obstacles for effective EMR implementation in the majority of health facili-ties.
- Monitoring of systems usage and clinical impact evaluation is lacking in the vast majority of FOSS EMR implementations [2,3,11].
- Free software doesn't mean that no costs are involved in implementing FOSS EMR solutions. User training, software and systems maintenance, etc… still account for a relevant budget in most health facilities. Encouragingly, results from different implementations (University Teaching Hospital of Kigali and district hospitals of Rwamagana and Nyamata in Rwanda) have shown that integration of financial processes (billing, accountancy) with clinical registration can dramatically improve the fi-nancial status of the facility (up to 100% income increase…) which will then contribute to guarantee the long term sustainability.

CONCLUSION

From the combined experiences over the last decade, we can conclude that FOSS EMR implementations can be successful even in very challenging contexts of developing countries. Still, in order to enable country- or continent-wide expansion of such solutions, to the benefit of the population at large, important investments in local health informatics skills are needed. Local authorities and international organizations (such as WHO, Worldbank and the African Development Bank) as well as many other funding agencies can play a major role to catalyze, to coordinate and to realize this process [11].

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