

# **First Experience in Implementing an Open Source Health Information System for a City Hospital in a Developing Country**

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***Abstract:* The challenges in implementing Information Technology Systems for a Health Organization are many and are not limited only to technical challenges. There are even more challenges that need to be faced when the Health Organization is a Local Government Unit (City) in a Developing Country such as the Philippines. These challenges can be generalized into the following categories: Organization(People), Process, Technology and Sustainability. This paper will present the experiences of a small I.T. consulting company in engaging with a Local City Government to implement the whole I.T. infrastructure using Free and Open Source Software (FOSS) for a newly built 50 bed hospital to serve the healthcare needs of the local population of 250 thousand inhabitants.**

## Introduction

In the last five years, there have been several implementations of Electronic Medical Record Systems in the public health clinic setting in the Philippines using Open Source software [1]. On the other hand, there has been little available published reports of the use and deployment of Free and Open Source Software (FOSS) to operate public government hospitals.

Three years ago, the City Government of Navotas [2] decided to use GNU Health [3], to run the operations of the first, new, public hospital that was still under construction. The hospital was being built to serve the healthcare needs of the city's 250 thousand inhabitants [4].

The Navotas City Hospital (NCH) was inaugurated on November 21, 2014 [5], and officially began operations in June of 2015 [6]. The vision of the Hospital Director and the City Mayor was for the hospital to have "paperless" operations for increased efficiency, transparency, quality of service, and accountability.

It was with these requirements that the City Government engaged Integrated Open Source Solutions (iOSS) [7], in order to make the vision become a reality. Being a brand new hospital, the whole I.T. infrastructure had to be designed and implemented from the ground up.

The author, who is the founder and president of iOSS, was given the opportunity to design and implement the whole Information Technology infrastructure of NCH using Free and Open Source Software. The details of the project will be explained in the succeeding paragraphs.

### System Outline

Successful implementations of Information Technology within an organization require a combination of People, Process and Technology [8] moving together to achieve defined goals. A fourth element, Sustainability, was added by the author in order to relate how the project was pursued despite a long duration from initial talks to contract signing and first payment received for the project.

#### **People - Navotas City Hospital stakeholders:**

<b>Stakeholder Title</b>	<b>Stakeholder Position</b>
Project Funder	The City of Navotas Mayor's Office
Project Owner	Hospital Director
Project Manager	Hospital Administrative Assistant / Consultant
System Admin (Functional)	Hospital Administrator
System Admin (Technical)	Hospital I.T. Analyst
System Users	Hospital Section Heads (16 sections)
Consultant - Medical Informatics	External Consultant (National Institute of Health)
Consultant - Information Technology	External Consultant (iOSS)

Success of the project hinges on the acceptance and buy-in of each of the stakeholders listed above. With regards to the Navotas City Hospital I.T. project, the project funder and the project owner were on-board and committed from the start of the project. Since this was a new hospital, the hospital required on-site computer proficiency tests to all new applicants. Thus the hospital staff already had some level of computer proficiency upon being hired by the hospital.

The Medical Informatics consultant had recommended the Free/Libre GNU Health software to the hospital, and was part of the team engaged by the hospital to implement the software, and to map the current hospital workflows to GNU Health.

The main challenge on the People perspective was in getting the section heads and hospital administration to commit to meeting regularly, and to allocate a separate time, aside from their current duties, to study and work with the consultants to customize and map the workflows into GNU Health.

## Process

The Cobit 5 framework [9] was recommended by the author to be used for the I.T. project implementation for NCH. The Project Team applied the Scrum Methodology [10] to iteratively define and deploy customizations to GNU Health for the hospital.

## Technology

Free/Libre and Open Source Software was used for the I.T. Infrastructure

### Server Infrastructure:

Server Function	Software deployed
<b>Firewall:</b>	<b>PFSense [11]</b>
	<ul style="list-style-type: none"> <li>- VLAN - For separation of machines by section/department</li> <li>- Controlled Internet Access based on VLAN membership</li> <li>- Internal Domain Name Server</li> </ul>
<b>Server Virtualization</b>	<b>Proxmox [12]</b>
	<ul style="list-style-type: none"> <li>- Implemented Proxmox with software RAID 10 in order to easily create and deploy virtual machines, and to maximize the use of the physical server.</li> </ul>
<b>Internal Communication and Collaboration (ICC) Tools</b>	<ul style="list-style-type: none"> <li>- <b>Nethserver [13]</b></li> <li>- services: Email, Calendar and Event Scheduling, Instant Messaging, Shared folders, Open LDAP for single sign-on.</li> <li>- <b>Moodle[14]</b></li> <li>- Open Source Learning Platform that the hospital will use as a document repository and as a collaboration and learning resource.</li> </ul>
<b>Reporting Tool</b>	<b>Jasper Reports Server [15]:</b>
	<ul style="list-style-type: none"> <li>- For generating custom reports needed by the hospital management</li> </ul>
<b>GNU Health Servers</b>	<ul style="list-style-type: none"> <li>- <b>GNU Health Test Server:</b> This environment is for individual users/sections to study/explore/learn GNU Health.</li> <li>- <b>GNU Health Data Preparation:</b> This environment is to be used for importing/entering/preparing initial data needed for production use.</li> <li>- <b>GNU Health Integration/Training Environment :</b>This environment is to be used for integrating process flows across sections, and for testing the system with production ready data</li> <li>- <b>GNU Health Production Environment :</b>This environment is to be used for production/live use by the hospital.</li> </ul>

## Sustainability

### Timeframe of engagement of iOSS with the City of Navotas:

2013 July	First exploratory talks with the client were initiated.
2014 March	Navotas City hired a new Hospital Director/City Health Officer
2014 August	iOSS unofficially was engaged by the City of Navotas to customize and implement GNU Health for the new hospital that was under construction
2014 November	:The Navotas City Hospital was inaugurated and blessed
2015 June	The Navotas City Hospital officially began accepting patients
2015 June	The agreement between iOSS and the City of Navotas for the GNU Health customization and implementation was finally signed and approved.
2015 September	The first payment on the contract was released

From the timeline listed above, it took 2 years and 2 months from the first meeting up to the first payment by Navotas City to iOSS. From a sustainability point of view, iOSS could not maintain a team and pay for their salaries for two years, while waiting for the contract to be awarded, signed and the first payment to be released.

iOSS engaged with the City of Navotas with a team of one person, the author of this paper. The author also retained his current work as I.T. professor at Asia Pacific College throughout his engagement with the City of Navotas. The author was the local developer, implementer, system administrator, project manager, and technical requirements analyst for the project. The Navotas City Hospital engaged a medical informatics consultant, a project manager, and hired one full time I.T. Staff. The core team was composed of the four roles just mentioned.

Additional technical expertise for GNU Health was provided by Dr. Luis Falcon, creator and maintainer of GNU Health. A Jasper Reports developer was also sourced through Upwork [16] and engaged through a deliverables based arrangement.

The author initiated and cultivated close personal ties with Dr. Luis Falcon, and with the GNU Health development community [17]. Because of the relationship that was cultivated, the author could make requests to the community and get replies regarding technical issues of the software.

This relationship was key in allowing the author to do his own customization development on GNU Health, thus not requiring iOSS to source and hire a separate developer for the project.

## Results and Discussion

The Navotas City Hospital I.T. project is still on-going at this time. The internal collaboration and communication tools have been implemented and are now in use by the hospital staff. Current mapping of workflows into GNU Health and testing by the users is on-going. The method for implementing the systems is a phased approach, beginning with the patient admission and administrative modules, and then continuing on with the clinical aspect (electronic medical records) of the patients.

## Conclusion

The Navotas City Hospital I.T. project has provided the author with a unique opportunity to apply a complete range of Free/Libre and Open Source Software for all of the I.T. requirements of the hospital. Keys to success of the project hinges on: commitment and buy-in of all stakeholders involved, a phased, incremental deployment, and a sustainable, long term engagement of the I.T. consultant implementing the project.

## Acknowledgment

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