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Article · December 2013

DOI: 10.1016/j.protcy.2013.12.322

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Procedia Technology

The 4th International Conference on Electrical Engineering and Informatics (ICEEI 2013)

An Applied Approach to Teach Hospital Information Systems Development using an Open Source ERP Framework

SM. Motahar[a,]*, N. Safie[b], M. Mukhtar[a], SM Aljunid[b], S. Mostafavi[c]

[a]*National University of Malaysia, Faculty of Information Science and Technology,UKM, Bangi, 43600, Malaysia*
[b]*United Nations University International Institute for Global Health, Jalan Yaacob Latiff, Kuala Lumpur, 56000, Malaysia*
[c]*Staffordshire University, College Rd, Stoke-on-Trent, ST4 2DE, United Kingdom*

Abstract

The objective of the paper is to represent an international pilot project to teach development of free and open source hospital Information systems at the national level using a live pre installed Enterprise Resource Planning (ERP) System. We have developed live image with pre installed free and open source ERP framework -Tryton® (A fork of openERP®) and a free and open source health and hospital information system GNU Health® that supports electronic medical records (EMR) which is developed on top of the ERP framework as the second layer. We considered the two layer system as a domain specific application development framework for further agile development of information systems in the healthcare information technology area. Participants were health informatics professionals invited from ministry of health from selected developing countries to participate in the ERP training program at United Nations University International Institute for Global Health (UNU-IIGH) to learn agile development of open source hospital information system based on the ERP concept to adopt the solution in public hospitals and clinics in their respective country. During three days extensive course, participants used a live image of pre installed ERP system and a cloud hosted ERP configured as a distributed clinical information system to support the training and they learned how to configure the solution in a practical and step by step procedure. We have evaluated the course including feedback from the participants through a questionnaire and interview. The result showed a great potential of live open source ERP tools to support the training. It is expected that the results can be used for improvement of development of the other courses in other universities and institutions especially for subjects covering implementation procedures and critical success factors of free and open source ERP framework adoption in hospitals and Health centers with more focus on rural areas.

Selection and peer-review under responsibility of the Faculty of Information Science & Technology, Universiti Kebangsaan Malaysia.

*Keywords :*Hospital Information Systems, ERP, Clinical Information Systems, Electronic Medical Records, ERP Training;

* Corresponding author.
E-mail address: mohammad@motahar.org

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1. Introduction

Public health plays a key role in disease prevention in developed world as well as developing countries. To address the global issues related to public health, United Nations (UN) has established an international agency of the World Health Organization (WHO) to coordinate attempts to address global issues related to public health. Almost all countries of the UN established ministries of health to address local issues related to public health. Public health decision-making is critically dependent on the timely availability of sound data and the role of health information system is to generate, analyze and disseminate such data [1]. Hospital information systems are just one instance of health information systems with a hospital as healthcare environment, respectively, health care institution [2].

United Nations University (UNU) is the academic arm of the UN for further research in global issues addressed by the UN and its agencies. Considering the critical role of hospital information systems in developing countries, United Nations University at International Institute for Global Health (UNU-IIGH) has started development of an academic and industry solution based on free and open source software. The aim was to adopt the entire solution in a series of capacity building training workshops of "collaborative development of health and hospital information systems based on ERP framework". The objective is to reduce the high rate of failure of implementing such complex information systems for developing countries[3]. Therefore a series of workshops have been designed in accordance with the conceptual approach in the development of capacity building courses with the aim of transferring the knowledge of adoption of such systems to allow participants to actively involve into further development of such systems and to allow them to realize their development goals. The adoption of free and open source information systems in general is always challenging and several studies have investigated different approaches in the adoption of free and open source software (e.g. [4] [5]).

1.1. Conceptual Background

In the informatics area, understanding of business process is critical. Information systems are subject to change as they should address the problem of alignment of business process that are dynamic in today's world. In health informatics, healthcare processes are also subject to change either by internal or external cause[6]. Therefore, according to the objective of the course we focus on teaching alignments of business process and configuring packages instead of only diving into module development and customization. Figure 1 Shows the percentage of papers on each topic in his literature review.

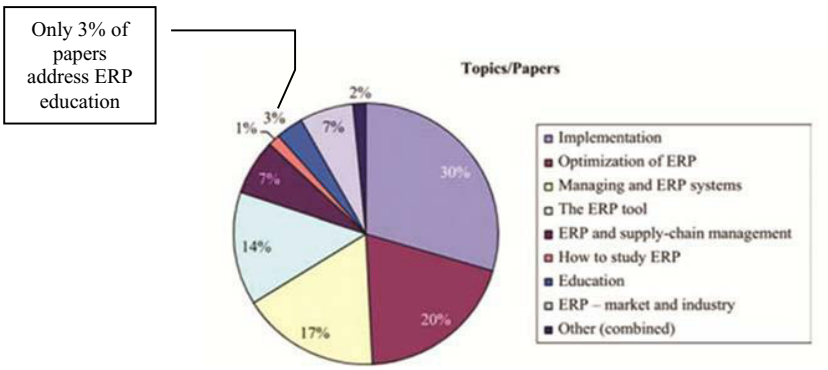

Fig. 1. Topics/Papers in ERP since 2000 to 2009 (Adopted from [1])

There are large volumes of published papers studying ERP Systems. However, as is the case with any new IT field, research in the ERP area is still lacking and the gap in the ERP literature is huge[7]. Therefore Several studies have been made to address research agendas in major areas by pointing out that teaching ERP is among the topics that requires more attention from researchers and practitioners [8]. Schlichter has written the most comprehensive literature review in the field of ERP [9]. In his review of 885 peer reviewed journals from 2000 to 2009 only 3% of papers addressed topics related to education in ERP.

Moon (2007) reviewed 313 articles from 79 journals on the topic of ERP since 2000 to 2006. He points out that the number of journal articles on education seems to be relatively few. He claimed that only a few articles attempted to go further by conducting experiments on the validity of using hands-on experiences [10]. Hawking and Foster outlined their experience in Victoria University where they conducted a training using an ERP system. By focusing on Human Resource (HR) modules of SAP®, they conclude that using a real ERP system in their training allowed students to gain hands on experience and feeling of the value of the course [7]. Another attempt was done by Kirkham and Saymour at University of Cape Town to use a live ERP system during their training. Authors with industrial experience in ERP believed that it is very important to integrate hands on ERP experience into the curriculum [3]. In another major study, Gerogiannis applied a Project Based Learning (PBL) approach in the ERP training course at technological education institute of Lariessa. Students were divided into groups to work with a live version of SAP R/3® system and teachers tried to act as project facilitator. They concluded that using their practical method allowed students to do small projects in the live ERP based on SAP R/3[11]. In a pilot project conducted in Mali, Bagayoko concluded that there is a great potential of adopting open source tools and packages in the field of health.[12]. They trained a local developer team and the team successfully customized and localized the billing module of the open source hospital information system. They suggested a local implementation strategy based on local labor market by investing in the expertise to reduce the risk of failure and to capitalize the knowledge of development and customization of such systems in developing countries and hospitals. Using a free and open source ERP as an alternative for teaching hands-on ERP concepts instead of expensive and proprietary SAP ® has been suggested by Ayyagari [13]. In his case study of using openERP ® Ayyagari suggested adopting a live open source ERP system for teaching ERP concepts by playing exercise and related hands-on components using the real tool during the class.

Supported by the literature [10,11,12,14,14,15] and the past industrial training experience of the first author, He concluded that participants including health professionals with IS and non IS background should gain a practical knowledge of the system using a live ERP framework developed entirely using free and open source tools and packages. Therefore a live hosted package was implemented for participants to be used during the training . Although there are many benefits of adoption of such live ERP systems, there were still limitations with it to adopt into the training like internet connection issue for participants during the first session of the workshop. Despite providing access to the live demo, we developed a live ERP system in a Virtual Box® image file using entirely free and open source software to be delivered to participants during the training. The tools and packages we used to create the system are described with more details and the experience of the Author using the live demo is discussed.

2. UNU-IIGH Short Course

According to it's official website, United Nations University International Institute for Global Health (UNU-IIGH) is a research and training centre of UN University inaugurated by the UN Secretary Council General in April 2006 as an in-house community of scholars mandated to conduct research on issues that address the challenges of global health which are of concern to the UN and its Member States particularly the developing countries . The Institute's UNU-IIGH research and capacity building themes include accessibility, efficiency and quality of service delivery of healthcare systems; newly emerging and re-emerging diseases; non-communicable diseases and control policy, information technology in health; climate change and health and impact of globalization on health . UNU-IIGH conducted a two-day extensive short course on Open Source Hospital Information Systems Development with the aim of building human resource capacity on Open Source Technology in developing countries. The course was attended by 47 participants mostly from the Ministry of Health of Malaysia and Indonesia, public and private hospitals, universities as well as non-governmental organizations. This course was designed specifically to provide

initial knowledge for development and implementation of open source hospital information systems in developing countries.

The focus of the short course was on functional and technical applications and development of OPTIMIST GNU Health, a hospital information system. The facilitators of this short course were invited among the international experts from UNU-IIGH in the field of health economics and case mix system, hospital information systems, hospital enterprise resource planning and business process in healthcare. Optimist GNU Health is an in house development of a layered approach by entirely using free software. The optimist research group adopted GNU Health , a free and open source health and hospital information system in GNU Project that was awarded as the best project of the humanity by Free Software Foundation (FSF). After technical evaluation of the project, A Memorandum of understanding (MOU) was signed with GNU Health. The optimist research group was directly in contact with the free software foundation and Dr. Richard Stallman to make sure the project license is free and in accordance with the goals of capacity building programs in the course. GNU Health contains 12 modules and each module adds a new functionality to the system. The complete installation of modules works as a health and hospital information system that supports a wide variety of business process within health centre. It is important to mention that the GNU Health project is heavily based on its underlying ERP framework which is called Tryton®. Tryton is a free and open source ERP framework that contains base functions of an ERP system including Product Sales management, Purchase Management, Accounting and Warehouse management . The Tryton project is a fork of the famous open source ERP named OpenERP®. Since its early stage of development, First Author involved in the Tryton project and collaborated with their core developers in Europe by working for a Dutch company for adoption of the framework in manufacturing and Business to business (B2B) E-commerce web shops. The experience gained helped First Author to develop essential tools to conduct the course based on a live ERP framework with the aim of building capacity and long term objective of knowledge transfer to ministry of health in developing countries. Details of this process are described in more details in the following section.

3. Methodology

The paper presents the author's experience of developing and conducting a short course as a part of an international pilot project to teach open source hospital information system development at United Nations University. We used an image file as well as a live ERP system during the training. We have evaluated the result of the short course including feedbacks from the participants of the course. In the conclusion we discuss about the feedbacks from students.

3.1. Installing Open Source ERP Framework

Short course participants were health professionals with IS and none IS background. We requested all participants to bring their own laptop. Based on the initial questionnaire we found that there is different variety of OS including Windows XP®, Windows Vista®, Windows 7® as well as MacOS® installed on the participant's laptop. One of the participants also had an Ubuntu® Linux as his main OS on his laptop. To give participants hands on experience of working with real ERP package and to reduce the technical complexity of the ERP systems, we installed a minimum of necessary software packages on our virtual server hosted on the cloud servers . In addition we installed software packages inside a virtual machine with almost the same configuration as the cloud hosted ERP and then we exported the file to a standard portable format.

We assessed the wi-fi and we found that there are some limitations regarding the total number of participants who can connect to the internet simultaneously in the conference room. Therefore we focused more on the live version inside virtual machine using Oracle Virtual Box. The list of packages that we installed is available in Table 1.

Table 1. List of Installed software inside the image

Software Package	Version	Type
Ubuntu	12.04	Main OS
PostgreSQL	8.4	Backend Database Engine
Pgadmin	1.12	Backend Database Management tool
Eclipse	3.5.2	Integrated Development Environment
PyDev	2.7	Python Plug-in for Eclipse
Open Office	3.2.0	Office Suite Tools
Tryton	2.2.0	ERP Client
TrytonD	2.2.0	ERP Server

3.2. Base Configuration

The most important part was module installation and configuration. We chose the simplest configuration by installing only modules listed in table 2.

Table 2. List of Installed modules inside the image

Module Package	Version	Type
Ir	2.2.0	Base
Res	2.2.0	Base
Webdav	2.2.0	Base
Workflow	2.2.0	Base
Party	2.2.0	Core
Currency	2.2.0	Core
Company	2.2.0	Core
Product	2.2.0	Core
Health	1.4.1	HIS

For base type modules in the configuration, we only selected few modules to be installed in the system. There are Optional Tryton Server Modules which cover the generic business process within the organizations including: Accounting, Invoicing, Sale Management, Purchase Management, Analytic Accounting as well as Inventory Management. These Core Modules of Tryton ERP framework extends the functionality of the main platform. The Tryton Server usually comes by default with most of them. There is only a generic functionality included in these modules, Therefore for the business functions of the HIS modules, we had to install some of them. Then for a basic implementation of ERP framework in health we installed the core module of the GNU Health project which is called health module. We created a test database named “UNU-IIGH” with all above modules installed and configured as well as health module of the GNU Health project. We used the appliance export wizard to create the export machine file into a single OVA/OVF file. By using this format, all files will be combined into one format named open Virtualization format to be delivered during the session.

4. Teaching Experience

One of the main purposes of the short course was to equip participants working in a health information system environment with a fundamental knowledge of the concepts and components of an open source hospital information

system. We delivered pen drives including the exported disk image file of the virtual machine created based on the instructions in the previous section. We asked 3 student interns at UNU-IIGH (including fourth author of this paper) to help participants in configuring their Virtual Box® to import the image. During the technical session participants were introduced to the architecture of the project and then they started immediately to run the server and client and to follow step by step exercise starting from simple and basic tasks (e.g. starting/stopping/restarting the server) in their own virtual machine.

When we found that participants have enough confident of working with the system (Menus, Tabs, etc.) we started to focus on HIS module as shown in Table2 by giving a case study of a sample hospital. We provided a sample of hospital organizational structure and we asked participants to configure the modules based on the information provided. Participants explored the system inside their own laptop. By focusing on the case study, participants explored general aspects of the HIS system. Figure2 shows a screenshot of the client.

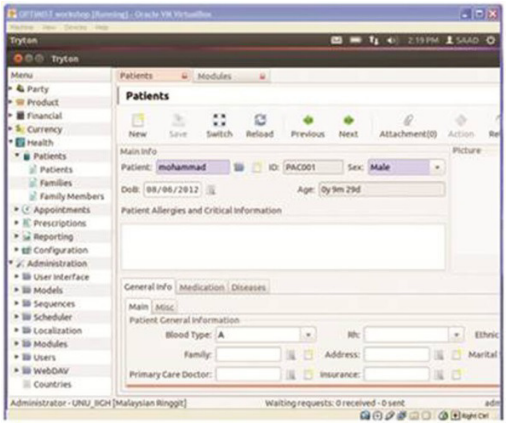

Fig. 2. An Screenshot Of the Optimist GNU Health thought at United Nations University

5. Results

Participants even those without IS background could understand and appreciate ERP framework concepts and flexibility of HIS systems working on top of this framework. During the course all participants could create a sample company and to configure base modules and HIS module. Participants successfully mapped general business requirements of a hospital to the ERP modules including units, wards, beds, etc. By providing an image file, participants spent their time on functional parts and they learned to do small technical changes as well without involving into the technical complexity of installation of ERP systems. Although we had participants who never worked with any Linux packages, Based on the interview sessions after the course, we found that they are confident on how to run the ERP server in Ubuntu® in their Virtual Box® and how to make small changes in the ERP framework.

5.1. Some Technical Challenge

Despite not affecting the quality of the delivery of the course in major, There was a limited access to the local network to do sharing, due to the fact that course was conducted at conference room at United Nations University International Institute for Global Health and the local network was in the control of the HQ of the United Nations University in Japan with restricted access to the resources in local network which was not in accordance with the requirements of a network connections of a simulated ERP packages.

During the second day we assessed the wi-fi and we found that there are some limitations regarding the total number of participants who can connect to the internet and to the live server simultaneously in the conference room. Therefore we focused more on the image file and we asked participants to check the live server as their assignment.

6. Conclusion

Initial results showed a great potential of using ERP framework tools in a pre configured image file in the teaching ERP adoption course for hospitals. Using the live image as a support together with the image file in a virtual machine can assist participants to gain hands-on experience in configuring the system.

It is expected that the results can be used for improvement of development of the other courses in other universities and institutions. To continue teaching ERP framework adoption, we will improve the image file by including more automated functions and to bundle more learning tools inside the image. Our future work in this area will also continue focusing on contributions to the layered approach and to continue contributing to the modules and to focus on providing recommendation for implementation procedures and critical success factors of adoption of free and open source ERP frameworks in hospitals and Health centers.

Acknowledgements

In The development of the short course as the first of its kind, First author spent 3 years working closely and in person meeting and interview with Core Tryton Developers and some of their community corporate and individual members in the Netherlands as well as GNU Solidario and their respective community members. We appreciate academic support of United Nations University, International Institute for global health, National University of Malaysia and Staffordshire University.

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