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Open Source PACS: Does it Really Decrease Costs of Healthcare IT?

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During the last two years the radiology department at the University Hospital in Pisa, Italy, has introduced PACS technology, implementing an open source PACS. Pisa University Hospital is the second largest hospital in Tuscany after Florence University Hospital, with 1,519 beds and 77,725 admissions for inpatients in 2006. The IT team working at the Division of Diagnostic and Interventional Radiology has been involved in many projects in the field of IT applications in radiology, developing new IT solutions for radiology. Particular efforts have been devoted to the implementation of a prototype PACS system, based on an open source solution that also offers teleradiology and e-learning features.

Does it Really Decrease Costs of Healthcare IT?

In 2003 the hospital was provided with a commercial RIS (RA2000, Siemens, ASP model). At that time there was no plan for introducing a PACS system, so the IT group moved toward possible low-cost integrated solutions. The O3-DPACS solution, provided with a research agreement with the University of Trieste, has enabled two radiology departments in Pisa to have a digital archive for radiological images that allows radiologists to report exams, checking images on diagnostic monitors.

The purpose of adopting an open source PACS has been to improve radiological workflow, and to evaluate the benefits and drawbacks of open source software, with in-house radiology information system management. We present the proposed model and report the results obtained during a real-world validation.

Currently, hospitals and institutions all over the world are upgrading their systems to reach a completely filmand paperless environment. Radiological modalities have been converted into digital imaging producers following

DICOM standards, and PACS is becoming an essential requirement across the hospital environment. Since images are not printed any more, every physician in the hospital must be able to access the PACS database and visualise patients' studies on monitors.

Due to its central role in a paperless environment, the PACS system is one of the most critical and cost-demanding informative system modules in the healthcare scenario. Therefore, providing a hospital with an IT infrastructure for medical images is a big issue: it needs time and resources, starting from the project design, to server and client installations, the introduction of the system into radiological workflow and the management of the running system. In our PACS adoption project, we started by analysing the radiological requirements to evolve toward a paperless environment and we evaluated different solutions available on the market.

We found the possibility to use an open source software very interesting. According to a new report by the California HealthCare Foundation, open source software will decrease the cost of health IT and help physicians share information.

What are the Advantages of Open Source?

The term open source does not actually mean 'free', but pertains to the possibility to modify the code permits personalisation made by the IT in-hospital group. Having access to the source code and to any change in it, would grant the adopter greater control of the system and more possibilities to survive failures in this support. Another advantage of open source software could be in interfacing PACS with other systems, for instance RIS, EPR or HIS: licencing the software to interface systems represents the biggest upfront costs.

Introducing O3-DPACS to Pisa

In 2005 Pisa University Hospital signed a research agreement with the Bioengineering and ICT group of the University of Trieste. They provided O3-DPACS open source software, as well as support to the in-hospital IT team for the implementation in the Pisa environment. O3-DPACS was implemented to provide PACS functionalities to two radiology departments (S.Chiara and Cisanello) located in buildings about 4km from each other. Through this project, digital images and associated patient data can be transferred electronically among medical staff over a 100 Mbps connection network, through a dedicated fibreoptic channel, and become available throughout the departments.

The IT group started in 2005 by testing the O3-DPACS software in a laboratory, connecting just one modality, a CT, and one client workstation. In this way, with the remote support of the software developers, the IT group became familiar with the O3-DPACS configuration and features. After some weeks of laboratory testing, the analysis of the departmental image productivities guided our choice of the best low-cost hardware.

Installing PACS in the Real Setting

The solution was to realise the archive server with an ordinary PC, using an AMD Athlon XP 3000+, 2 GB RAM and a 2 TB NAS storage. The RAID hard disk configuration provided a security level against hardware failure. Security breaches are handled through encryption and firewalls.

The first production step involved the S.Chiara radiology department. All the DICOM modalities belonging to different vendors (CT, MR, CR and DX) were connected to the archive server and several clients (testing different DICOM software) were configured to query-retrieve images from the PACS server. Some integration issues were solved, sometimes with modality- provider support.

The second step followed the involvement of the Cisanello radiology department. To improve the DICOM server performance, another ordinary PC was used to store images from Cisanello modalities. In this way the workload was divided between the two PC processors, but the clients of both departments were configured to access images on both archives.

All the modalities are now configured to automatically send exams to the archive servers, so that they are immediately available for reporting. Radiologists from any client in both departments are able to access the images and share all relevant current and prior clinical information pertaining to any patients. This PACS-guided workflow, characterised by rapid retrieval and presentation of a current study and comparison studies, resulted in a speeding up of the production of an imaging report from an image study and related exams.

Good performances for PACS mean from the user perspective that a query against current exams should last less then five seconds, regardless of the acquisition date, and the time for retrieving an exam should remain in the order of the network transfer time. In Pisa radiology departments, radiologists have to wait a very short time: for example to retrieve a CT of more then 500 images they need about 25 seconds. Obviously, this performance time should remain stable in the long term and not degrade in a significant way.

The department's IT group developed sufficient competencies in hardware, systems and applications: all the available internal knowledge was used to plan and implement the system. Once the system was in production, fast failure response times were controlled by the department's IT group itself. They can promptly react to malfunctioning, solve more than 95% of the problems and provide the best information for the most effective intervention by the developer team.

The IT departmental group acts also as an interface to users, physicians and other personnel, teaching them how to use the system and helping in solving personal issues with it. High level support is the key to a good implementation of any technology in the real world scenario.

In two years, both radiology departments collected 7TB of images and O3-DPACS was appreciated for its stability, robustness, interoperability and reliability. In the project development, we evaluate the scalability feature of the adopted PACS. An healthcare informatics system should implement solutions that could be applied to low load environments up to multicenter systems reaching also regional integration environments. This should foster vertical integration and reduce costs. We observe also the economicity of using an open source PACS: an healthcare informative system should not require high investments if not necessary and should try to guarantee the greater reliability at the lowest cost.

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