Improving Productivity of Radiology Department

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Abstract

Over the years, impact of digitalization has been implemented in every aspect of human life, including the healthcare and hospital environment. Vendors and manufacturer are making the competition to implement to be the highest, the fastest, and the best solutions to the market and become the world leader that can attract the hospital and healthcare facility to use their system and their products. However all of the digital equipment are not standardize, the integration of system, data management and archive are the main problems in Radiology department even though using standard medical image (DICOM) protocol. We propose digital solutions in Radiology department that implemented using known as RIS or Radiology Information System and PACS or Picture Archive Communication System that using open source software and easily adaptable technology with no boundaries of applications and vendor neutral. Our paper shows that through digital solutions provided by radiology department will improve the productivity of doctor, radiographer and administration people. Digitalization products with RIS and PACS also answer the needs of speed and manageable image storage in the hospital.

Keywords: Radiology, RIS, PACS, Productivity, Image Processing

I. Introduction

Digitalization has been applied in most of the aspect of human kind recently, and it’s become more of the technology driven to lead to costumer to better solution, fast and accurate. Healthcare and hospital business are also applying the digital technology, with various field of digitalization from Radiology, Laboratory, Sterilization and et cetera. Digitalization also becomes the key point to increase the productivity and the output of the healthcare and hospital. Saving time, cost reduction, reduce of waste, synergy between wards, unit and operator are the productivity that improved by using digitalization. [1]
With the incremental growth of hospital and clinics in Indonesia more than 39 % annually [2], demands of new medical equipment products are still increasing and promising. Each hospitals and clinics are in constant competition to each other’s, to become better in service excellence, wide range of applications and customer satisfaction. Looking at these trends, plenty of medical equipment supplier trying to provide the best solutions and products update to fulfill the hospital needs. The current innovations that blossom are the needs of fast and accurate information about the human body. This digital innovation is known as Digital radiology. These digital solutions are spread tremendously across the hospital field, where the main objectives are to cut the cost and to improve the service to patients. More and more new equipments are coming with digital formats and the images produced by the new digital equipment are become a huge, wasting of resource and not effective in the storage and access that potentially facilitated by Radiology Information Systems.

PT. ABC also actively participates in medical and healthcare business by supplying the Radiology department. Having appointed by XYZ Healthcare a Belgian based company, to be the sole agent in Indonesia with range products of films, consumables, computer and digital products of Radiology makes PT. ABC are famous and become the 2nd biggest player in Radiology films field. XYZ Healthcare provides full range solutions for data archive known as IMPAX. And XYZ through PT. ABC are selling this products into Indonesian market with the specific target of chain hospital and teaching hospital. However over 3 years since the projects started, none of the products nor solutions sold to the hospital in Indonesia, with various reasons but the biggest are pricing issue. Learning from PT. ABC mistake, our competitor are switching the portfolio from world class principals and brand into a medium-cheap but limited application solutions from India and China. And eventually this options are become a breakthrough and remarkable.

Management of PT. ABC think that, if they don’t make an alternative solutions against this facts, PT. ABC market will soon be gone and the competitive advantages are obsolete, and last PT. ABC costumer will soon move to competitor products. PT. ABC must create products that cover the state of the art of the XYZ IMPAX but can penetrate to the market like various products from India and China that already sold expansively in Indonesian market. Another perspective of facing the challenges are disruptive technology, the concept invented by Christensen in 1997 are very popular in order to find the feasible solutions and answer the challenge in digital technology war.

II. Framework

According to Saari 2006, Productivity is define as ratio of output to inputs ; basically it is like an average measure of the efficiency . And meanwhile production is define as process of combining various material inputs and immaterial inputs in order to make something for consumption or finished goods. [3]
According to the Jensen, Michael and Murphy, Kevin, performance is productions or productivity ability to generate income that creates finished goods, because the income from production is generated in the real process and has value added in the end. So the production performance can be measured as the average of the income or as an absolute income that has value added and finish products [4].

There are two main mechanisms that can affect the productivity growth, increasing competition which drives out poorly performing sales and the adoption of new technologies. Increasing competition such as increase the sales, reduce the price and create additional products that can broaden the product diversifications. Adoption of new technology is implementing ICT in the business process and reduces unnecessary non value added work [5]. According to Tracy, 2012 Radiology Information System (RIS) is defined as computerized database of information that used by radiology departments to store image, manipulate image, and distribute patient radiological data and imagery to all over the radiology network and respective user that have the access of the information. And it’s also explained that the system basically consists of patient tracking of information and scheduling not only to meet the doctor’s needs, but also to receive the result, the diagnosis reports and even image tracking capabilities over the network of the radiology department. RIS are implemented in many hospitals nowadays and the improvement of the workflow are tremendous not only for the time saving of the patients but also for the radiologist because it’s shortened the process, deliver consistent image and clear image quality for diagnosis and expertise. [6]

According to Brya, 1999 the workflow in many radiology departments was considered as a closed system; because from the moment patient enter the radiology department, taking the x-ray, waiting for the result, and processing the image according to the subject of the body parts, delivering the image to the doctor, and giving the result back to the patient are under one system and manually repetitive. Therefore PACS benefit and advantages are undoubtable, important and cost effective. Not only saving the time of the patients, saving time for the nurse and radiologist, but also considered as the important aspects on improving the effectivity and efficiency of the hospital itself [7].

III. Digitalization products

Plenty of hospital implement digital products only to connect between the equipment into the DICOM printer, where the printer will print a films in the plastic materials showing the part or full part of the body that having radiation process. The image printing is the evidence and the reference for the doctor to read the diagnosis of the disease and symptoms of the illness. With the normal average of the patients per month around 3000 – 4000 patients, in 2 year we can have more than 72.000 stack of plastic films in the x-ray filing rooms.
Eventhough hospitals are implementing digitalizations, but the fact is that the image data managements are still manual approach. The impact of the big filling is becoming unmanageable. Therefore implementing full digitalizations is mandatory and this will lead to cost saving process in comparasion with buying new equipment.

III.1 Picture Archive Communication System (PACS)

Digitalization in radiology department is not only connecting all medical equipment under single network and communicates to each other. But beyond this, users can have
access of patient data and image for further analysis and further discussion during the post treatment process. Users can also access the image from remote locations and diagnose the potential diseases that attack the patients. Patient also can access their image and ask for second opinion from other doctors. Image storage can be online and patients don’t have to bring the films that cannot be read by them, and doesn’t consume big space.

PT. ABC develops opensource application called OSIRIX, which run in the apple systems. Why OSIRIX are clear since its opensource, users can also have medium to full access of all menu and applications. And PT. ABC builds the interface from the equipment and OSIRIX in order to easily integrate and image storage purposes. The interface we called PT. ABC-PACS developed using PHP and SQL. It’s setup as the host of the OSIRIX, where OSIRIX will role as application of Radiology function, and PT. ABC PACS will role as data management. The interface of the patient selection as shown below:

![Image of patient data](image1)

**Fig 3. Select patient name and registration**

Sub menu of examination in PT. ABC PACS functions. Another function that has been developed is online diagnosis using word editor.

![Image of examination options](image2)

**Fig 4. Type of examination**
Doctors doesn’t have to write down the analysis, but they can type the analysis and diagnosis of the patient while image observations and preview are shown the right side of his/her monitor.

**Fig 5. Image review and diagnosis**

### III.2 Radiology Information System (RIS)

Radiology Information System applications that develop called PT. ABC-RIS are the platform develop tailor made based on customer expectations and hospitals goals. Image below are the network.

**Fig 6. PT. ABC-RIS network topology**
In the network topology all equipments are connected under single system, and image printer also connect not only to the equipment but also the user and web client. Users can print the image directly into the printer or store the image under image storage server. User can also make the print from remote locations and access the image via web browser and for PT. ABC-PACS menu.

Existing workflow for patients:

![Existing workflow for patients](image-url)

Total time needed :59 minutes (average time sample during peak hour 09.00AM – 12.00PM)

*Fig 7. Old patient workflow Before (PACS/RIS)*

New workflow for patients:

![New workflow for patients](image-url)

New total time needed : 29,2 minutes (average time sample during peak hour 09.00AM – 12.00PM)

*Fig 8. New patient workflow after (PACS/RIS)*

Existing workflow for doctor:

![Existing workflow for doctor](image-url)

Total time needed : 12 minutes (average time sample during peak hour 09.00AM – 12.00PM)

*Fig 9. New doctor workflow (after PACS/RIS)*
New workflow for doctor:

![Workflow Diagram]

Total time needed: 7 minutes (average time sample during peak hour 09.00AM – 12.00PM)

IV. Conclusion

By applying the RIS and PACS designed by PT. ABC, hospital get more productivity by accelerate the administration process, image viewing, image reporting and image transfer from one point to another. Also image storage that has been a big problem because of image size of each patient are different. By online storage image archive are easy to manage, patient no longer need to bring the piece of films, radiologist can read and review the image without any waiting and manual process anymore.

Benefit of the RIS/PACS

- Productivity of the hospital environment are increase due to time saving
- Eliminates error and misfile the films
- Eliminates fraud and mismatch of invoice since scattered payment
- Improve patient satisfaction for reduce waiting time, process and consultancy
- Doctors and nurse can give more time to the patient for better treatment and diagnosis
- Image archive and access are secure, smooth and redundant

For future research should address on security aspects for image manipulation and data storage for patient. Digital encryption and secure storage are mandatory if someone wants to have access for the image or raw data of the patients.
References


Glossary

**RIS** : Radiology Information System

**PACS** : Picture Archive Communication Systems

**DICOM** : Digital Imaging Communication in Medicine

**EMR** : Electronic Medical Record

**CR** : Computed Radiography

**CT Scan** : Computed Tomography Scanner

**MRI** : Magnetic Resonance Imaging