Medical Requirements for Selecting Local Picture Archiving and Communications Systems

Influences from Information Technologies and Business Models

Ivan Evg. Ivanov
Technical University
Sofia, Bulgaria
email: iei@tu-sofia.bg

Dimitar Tcharaktchiev
Medical University
Department of Medical Informatics, USHATE
Sofia, Bulgaria
email: dimitardt@gmail.com

Vesselin Gueorguiev
Technical University
Sofia, Bulgaria
email: veg@tu-sofia.bg

Desislava Georgieva
New Bulgarian University
Sofia, Bulgaria
email: dvelcheva@nbu.bg

***Abstract*—For a period of 10-15 years (2005 - 2018), the number of PACS (Picture Archiving and Communication System) offered on the market has increased more than 10 times. Despite this growth, some of the main disadvantages of this class of systems persist: the systems are complex and expensive to acquire, replace, maintain, or repair. This paper aims to show an approach that allows us to choose the right PACS for the needs of a particular group of hospitals and health care institutions. This choice takes into account the limitations of IT and business requirements.**

Keywords- regional (local) PACS; PACS selection; regulatory requirements; business requirements; medical requirements.

I. INTRODUCTION

The last two decades have seen a steady increase in the clinical application Picture Archiving and Communication Systems (PACSs) [1]. The reason for this increase is the desire to both reduce costs and improve patient care. At present, this is a sustainable trend, which suggests its significant impact on the speed of changes in medical infrastructure. The problem is to select PACS for long-term use that is adaptive for extensions, user-friendly for medical personnel and easy-to-connect to other medical institutions, upper-level PACSs and medical information systems.

II. PACS MAIN COMPONENTS AND STRUCTURE

The history of the development of PACS goes through several stages. Perhaps the most characteristic of all these stages was that the systems were oriented towards the practically identical infrastructure architectures [1]-[4]. This trend of the regularity of the infrastructure is preserved, notwithstanding the increase in the use of newer programming technologies and newer types of medical devices. One of the main features for comparing modern PACSs is the ability to adapt to the specific infrastructure, i.e., to the possibility of removing or adding new PACS nodes or communication buses.

The general infrastructure of modern PACS contains the following elements (see Figure 1):

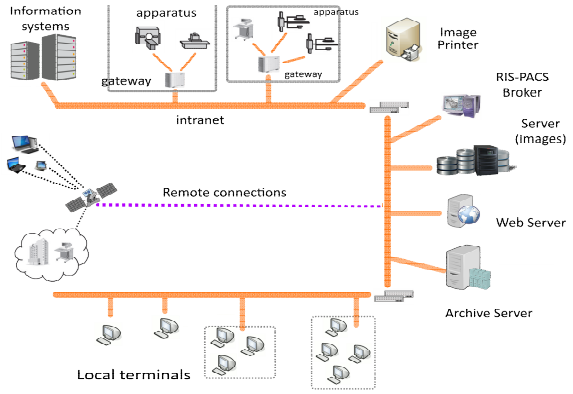

Figure 1. The general infrastructure of modern PACS (adapted from [4]).

- Apparatus that generates medical images in an appropriate format (most often, PACS uses one or more versions of Digital Imaging and Communications in Medicine (DICOM).
- An image storage server. This is the PACS' key component.
- The archiving system is the second key component of a PACS.
- The interoperability brokers responsible for solving the task of integrating the PACS with the other information systems in the health organization.
- The terminal workstation (i.e., the computer system for displaying medical images).
- The printer for medical images.
- Remote connection to PACS. Now, it is mandatory function for any more or less "professional" product in this group.

III. PACS: KEY BUSINESS REQUIREMENTS

The need to use medical images throughout all hospital departments, as well as the possibility of their remote use by authorized external organization or physician, has defined the following list of mandatory business requirements for modern PACS:

 ISBN: 978-1-61208-817-4

- Any strategy for the management and dissemination of medical images within the hospital must provide the opportunity for a wide variety of medical users to work effectively. These are not just physicians in functional radiology departments. Therefore, the system must not change physician's stereotypes of working with images but at the same time must allow managing the image quality according to needs of the diagnostic process.
- No one likes to wait to get data from some source. Clinicians are not an exception to this rule. Very often, they are even more demanding on the access time and restrictions to obtain the whole required information about the patient. The most common manifestation is the desire for almost immediate access and it does not depend on whether physicians work in traumatology, in the emergency rooms, in the intensive care department, or the outpatient clinic. This business requirement is one of the most complex problems in everyday life.
- Improving the ability to diagnose and treat many diseases has increased the use of medical images in practice. From a technical point of view, this change has led to increased size of generated images, increased number of requests to use medical images, and the size of archived history of patient morbidity needed to monitor the condition of patients. All this changed the understanding of the minimum required levels of scalability, efficiency, performance, and adaptability of the system.
- In the diagnostic process, to avoid mistakes, physicians need the best possible image quality. A very serious technical problem is the fact that the judgment of quality varies according to the particular usage of the image. The only workable solution to this problem is the presence of a system for automatic or semi-manual adaptation of the display workstation to environmental characteristics. This complicates the PACS functions responsible for handling workstations' settings.
- Every doctor has his understanding of the workstation's ergonomics. The main differences are not only in the arrangement of buttons and menus on the screen, but the scenarios of using images and meta-information in the diagnostic process
- As part of daily activities, physicians integrate information from medical images with other clinical data to make decisions about patient's diagnosis and treatment. Much of this additional information is not directly available and needs to be obtained from the information systems of other hospital departments. The main problem, in this case, is the compatibility of data storage and data transfer standards.
- Physicians not only use data from patient's medical examination, but also they generate new data about the patient's medical condition. Therefore, PACS needs to provide an opportunity not only to review existing data but also to add new data to the patient's history file. The complexity of the problem is not in the data insertion itself but in the ability to validate the added data and to verify the process of data insertion.
- Medical systems store and handle patients' data. The solution to the problem is to use very high-level standards of data security. The extension of a PACS with remote access functionality (e.g., Internet-based remote connections) increases the complexity of the problem.

Regardless of the existing rules and regulatory provisions, when a new PAC has to be installed in a hospital, it is mandatory to answer the question of how these requirements are implemented. As not all requirements are always met, the system is considered allowed if there is a mechanism to add the necessary functionality.

IV. CONCLUSION

A PACS is purchased and installed with an intention of long time use without replacement. At the same time, like most computer systems in this category, PACS has a complex structure, internal interactions, and implementation. Frequently occurring problems can create significant inconveniences at work, including blocking routine clinical activities due to the unavailability of PACS resources or functions. This constitutes a great complexity of static approaches to new PACS characteristics validation.

Therefore, we explored another way to pre-assess the suitability of a PACS for an individually selected hospital or group of hospitals.

The article represents our approach, which optimizes costs and time for selecting a new PACS for installation and long-term use. The main phases of the approach are outlined, as well as the required activities for each of the phases. The presented approach is put in practice in a government-funded project for a group of hospitals.

ACKNOWLEDGMENT

This research is supported by the National Scientific Program “e-Health in Bulgaria” D01-200/2018.

REFERENCES

[1] H. K. Huang, PACS: Picture Archiving and Communication Systems in Biomedical Imaging, VCH, 1996, ISBN: 978-1560816850

[2] H. K. Huang, PACS-Based Multimedia Imaging Informatics: Basic Principles and Applications, 3rd Edition, Wiley-Blackwell, 2019, ISBN: 978-1118795736

[3] A. Peck, Clark's Essential PACS, RIS and Imaging Informatics, CRC Press, 2019, ISBN: 978-1498763233

[4] E. Samei et al., "AAPM/RSNA tutorial on equipment selection: PACS equipment overview: general guidelines for purchasing and acceptance testing of PACS equipment" in Radiographics, Jan-Feb 2004; 24(1), pp. 313-334, doi: 10.1148/rg.241035137.

 ISBN: 978-1-61208-817-4