

# TECHNOLOGY'S LIMITATIONS: A DRAWBACK IN HEALTHCARE INFORMATION SYSTEMS' ACCEPTANCE

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**Abstract:** In the past recent years the introduction of a Hospital Information System in one of the largest state Greek hospitals took place in two phases: First, the Administrative subsystem (AS) was developed and used productively and later on, the Clinical Information subsystem (CIS) gradually was introduced. When the entire project was delivered, it was realized that although the AS was fully operational and totally accepted by the users, that was not the case with the CIS, which was only partially accepted. The majority of the physicians reacted negatively in the use of the system. Many reasons encountered to justify the medical professionals' negative reaction. Among them is today's technology limitations with which we deal in this paper. In spite of the lack of legislative and organizational structures that allow the effective acceptance of modernization, technology itself shows certain limitations regarding its adaptation and user friendliness. The current technology status is appropriately receivable for employment into Administrative working Healthcare environments but is not mature enough to support the traditional clinical practice. Further technological improvements are required if it is expected to realize an analogous progress in the use of Information Systems in Clinical departments to that of the Administrative ones. International research in the field of Ubiquitous Computing may bring us to the entrance of a new era.

## Introduction

The complexity of workflows in the hospitals' organizations indicates to the healthcare administration the employment of Information and Communication Technologies (ICT) as the means to overcome the opposed managerial obstacles. Bureaucracy, shortage of specialized clerical personnel, personnel's inertia to changes, obsolete procedures that have been overrun by the current practice, and extremely expensive patients' treatment are a few of the problems that management is called to handle.

Adapting the operation of conventional information technology consisted mainly of personal computers as we know them today (keyboard, screen, mouse, etc), the healthcare organizations have build powerful administrative Information Systems (IS) assisting,

synchronizing and sometimes controlling the flow of the performed work. On the contrary, many of the efforts targeted to the creation of the so called Electronic Patient Record (EPR) or to the support of decision making and evidence based medicine for a hospital led to unexpected failures. There is a lengthy list with the documented explanations justifying the unsuccessful attempts of the introduction of Clinical Information Systems (CIS) and the related compromises [10, 11, 15].

Among the medical professionals, it seems that physicians react negatively in the use of IT, which it is justified by the nature of their working obligations [4]. At the same time, the demands of a contemporary IS require the physicians to present skills, operational discipline, the time availability to receive training, and the ability to stay long periods of time at a desk providing data.

The "G. Gennimatas" General Hospital of Athens, has confirm the above-described reality: although the implementation of an administrative information system finished successfully, the attempt to introduce a clinical information system did not fulfill the initial intentions [8]. Many causes could be blamed such as the insufficiently provided training, the limited period of outsourcing, and even major software weaknesses. In this paper the level of technology's immaturity regarding certain areas of applications is discussed. The current technology status is appropriately receivable for employment into Administrative Division, but is not mature enough to support the clinical practice. International research in the field of Ubiquitous Computing may bring us to the entrance of a new era.

The rest of the paper firstly describes the introduction of a hospital information system in "G. Gennimatas" hospital. Then, the users' acceptance concerning the information system is discussed and technology's limitations are examined. Next, the potential of ubiquitous computing in this area is investigated and lastly, the paper ends with the associated conclusions.

## A Hospital Information System in a Public Greek Hospital

The General hospital of Athens "G. Gennimatas" is one of the largest regional state hospitals in Greece serving more than 1,5 million people. It has about 850

beds and more than 2,300 employees. The hospital's campus is extended in a space of 64,000 square meters and it is based on eight buildings.

Information Technology applications were introduced at the General Hospital of Athens "G. Gennimatas" in the early 90's. Ever since that time "G. Gennimatas" hospital was considered as the pilot site for the application of IT projects by the Ministry of Health and Welfare.

The introduction of the so-called Hospital Information System (HIS) took place in two major phases: firstly the administrative information system was introduced and it was followed by a clinical information system.

*The Administrative Information System:* The Administrative IS (AIS) was introduced in the early 90's and since then it has been evolved covering most of the administrative services of the Hospital. The Ministry of Health and Welfare employed a public serving organization, KHYKY, to develop the associated software. The application software for the Pharmacy's Department was launched in 1993. In less than a year later, the applications for the Patients' Admissions Office and the External Patients' Appointments Office were delivered. Then, the following sequence of software applications were delivered by the KHYKY to the Hospital for use: the Patients' Billing Department's application, the Warehouse, the Supply, the Dietary and last the Accounting Department's application which interconnected all the previous ones. All the installed applications were accepted and used productively by the hospital's personnel although they did not have any previous experience in IT systems. Since 1997, the system is used productively by the employees, assisting in the efforts to improve both the working conditions for the hospital's staff and the services the hospital offers to the patients too.

*The Clinical Information System:* After the successful implementation of the administrative IS, the next step was obviously the introduction of a Clinical Information System (CIS) to support the clinical departments [12, 13]. So in 1998 a project was initiated regarding the introduction of a CIS. Initially two clinics were chosen to be the pilot ones. Training offered to the personnel of both clinics and it was agreed with the developer of the CIS to satisfy all customization demands that would be asked by these two clinics in order to succeed the greatest acceptance and usage of the CIS.

After the completion of the pilot stage, the next step in the plan referred to the activation of discrete procedures in a number of clinical departments simultaneously. Thus, eight clinics were selected and the following operations were first introduced: sending drug orders to Pharmacy, sending clinical orders to the hospital's laboratories, keeping records on patients' follow up and issuing discharge documents. Prior to the introduction of those procedures, a training program was applied in order to let the users get familiar on the operation of the system. Most of the provided training was given in a classroom and a smaller, and perhaps insufficient portion of it, was "on the job". It is worth mentioning that most of the users had already been

trained within the means of other projects on introductory computer operation courses.

Right after the completion of the second phase of the project the following fact was realized: the personnel of the clinical departments although they had already taken all the agreed training, they did not accept and utilize the system, the way they were expected to.

The decision that was made in order to overcome the problem was the outsourcing of certain operations: data entry as well as training functions was decided to be outsourced for one year's time. The vision was that in the near future, medical doctors as well as nursing personnel should start to use CIS when they will have adequate training either as "on the job training" from the data entry operators or as explicit training through the training programs.

Even after the completion of the outsourcing period no major improvement was done regarding the utilization of the system from the medical doctors. Although all this period the system was more or less functioning due to the data entry operators, the majority of the physicians have not persuaded to use it, unlike nurses who adapted their every day work in order to include the IS. As a result, 3 years after the start of the implementation of the CIS, it did never roll out to the full extent of the hospitals' clinics, and is now used only by most of the nurses in the clinics for certain operations.

### **Users' acceptance and the limitations of technology**

Clinical Information Systems (CIS) contribute major benefits in the direct support of patient care, providing great advantages over the paper record in reporting, organizing and locating clinical information [1]. At the same time, CIS can assist physicians' decisions by providing protocols, reminders and alerts. Despite of that fact of the great offered advantages, there are many cases where the CIS have not been successfully implemented [10, 11, 15]. In most of these cases, the lack of physicians' acceptance led to the discontinuation of the CIS implementation.

In the case of "G. Gennimatas" hospital, we experienced analogous behavior. The personnel of the clinical departments were occupied with the regular duties and there was no much of time left for effective "on the job training". To a certain degree, the flow of work in the clinical departments was demanded to change due to the introduction of the CIS, altering traditional medical procedures followed for many years, making it, especially for the older physicians, more difficult to accept the use of the system.

The contemporary data-entry practice includes the use of the keyboard and the mouse device, which require an operator to spend some time seating in front of a terminal. The nature of the physicians' work does not allow the extensive use of a terminal since the medical doctors are required to be present at various locations within the clinic while offering their services. The traditional terminals do not provide such a user friendly environment for the physicians due to the time consuming process of typing, most of the medical

professionals do not have enough time for typing practice, and the typing process is getting tedious for the older ones.

On the other hand advanced technological features that have started to be used, they are not yet fully integrated in HIS:

*Speech Recognition Systems:* Speech recognition technology is developing rapidly and is being continuously applied to new areas of the economic activities. Recently, speech recognition systems have seen such marked improvements in accuracy rates, specialized vocabulary development and CPU processing speed that it has become a factor in improving productivity in many vertical markets.

According to economic analysts, the medical dictation is the largest vertical market in the speech technology industry [6]. With such systems, physicians are able to save time by entering data in the patients' records and the associated diagnostic reports with voice to text applications, letting the system automatically transpose the audio to text. Unfortunately such systems have not yet been localized for the Greek language, which would be a tremendous advantage regarding the users' acceptance.

*Palmtop Computers:* In the last few years, a number of portable information appliances, from Handheld PCs to Pocket PCs and PDAs, have become available to assist the mobile work force. These devices not only assist in managing appointments and contacts, but also provide a tool for replacing paper-based business processes with forms-based applications. Quick access to current patient information, writing or renewing drug prescriptions, capturing dictation, and patient monitoring are among the ways mobile devices can improve efficiency in the health-care sector.

Within this context, the utilization of such devices for "G. Gennimatas" hospital is under consideration. The considered objective is to help physicians in the use of the clinical system during the morning visits to the wards. At that time, and due to the nature of the procedures, it is impossible to utilize some kind of a traditional PC. On the contrary, a palmtop computer seems to be an adequate, if not perfect, solution.

*Pen Computers:* Pen computing represent another technological advancement regarding friendly data input. The input device or pen has all the functions of a mouse [2]. It requires less space than every other input device and is easier to use than a mouse. Additionally it is much more familiar to the user since it is used like traditional pens. An interesting functionality of it is that it supports unstructured information, which in the case of physicians is a great advantage.

### **Ubiquitous computing as a potential in overcoming acceptance barriers**

The above mentioned technological advances, even though they are not yet utilized in "G. Gennimatas" hospital, they do not seem very promising towards fully reversing the current situation regarding CIS acceptance. It seems that major changes in the way that

we currently realize and interact with technology are needed.

The next paradigm, shift in computer technology involves the move towards ubiquitous computing, in which computers will be embedded in individuals' natural movements and interactions with the environment [7]. During the near future, ubiquitous computing is expected to become a reality, integrating the advances from both mobile and pervasive computing.

According to Weiser, "a fundamental measure of progress in computing involves rendering it as an inseparable part of every-day experience while simultaneously making disappear" [7]. In traditional computer environments, users actively choose to interact with computers through the traditional user interfaces such as the screen, the keyboard or the mouse. In ubiquitous computing things are likely to be different. Information Systems will be embedded in our physical environment and will be seamlessly integrated in our every day tasks [8].

Imagine the following scenario: an arriving patient to the hospital is instantly recognized by the installed biometrics and registered in the Information System. A nurse is called to assist the patient guiding him to the examination room. Point of Care (POC) analytical instruments perform the various required tests and the results automatically update the patient's record. The appropriate specialist is informed by the system about the patients' health situation, while he is walking towards the examination room (through the PDA or whichever kind of device he has chosen to use). When the physician approaches the patient and he starts the physical examination, he decides to recall an old MRI that the patient has already done. He naturally speaks in the examination room and the MRI is acquired and projected to the available high-resolution screen, together with the radiologist's diagnosis. The physician talks to the patient and he returns to his office where he consults his e-book as well as his favorite medical site concerning analogous cases. Finally the specialist is ready to submit his medical diagnosis as well as the appropriate medication or procedure by speaking to his PDA.

Although the above scenario seems a bit futuristic, it is inevitable that the time that it will be a reality is definitely approaching. Ubiquitous computing gives the direction and has already built a solid technological background. Nevertheless the shift towards ubiquitous computing poses multiple novel technical, social and organizational challenges which should be investigated [3]. But the potentials seem more than promising. In the approaching ubiquitous computing era, the perception of various activities may be changed, especially on knowledge management as well as user interaction, allowing to focalize rather on patients than on procedures.

### **Conclusions**

The introduction of a clinical information system in a large public Greek hospital verified the findings in the

literature, which refer to the medical professionals' hesitation to use conventional Information Systems. The nature of the medical profession requires the doctors and nurses to be away from desks while, at the same time, they both need information to base their decision and treatment respectively.

Successful and efficiently operational Hospital Information Systems demand the application of a different kind of user interface for the medical professionals. The current technology obliges the medical professionals to adjust their practice to serve the purpose of entering data to the Information System. A patient's updated record may assist in the doctor's decision making without having solved the problem of the individual that will spend the time to succeed it. The overhead with respect to time and cost created by the data entry and today's user interfaces will be over run by the technological advances of Ubiquitous computing. The current technology's immaturity does not allow the medical professionals to enjoy the benefits of the integrated Hospital Information Systems.

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