

Towards an Understanding of the Factors That Determine Software Requirements in A Multi-Stakeholder Environment (A Case Study of Patients Record Management System)

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ABSTRACT

Requirements engineering is a fundamental aspect of the Software Process and modularized into various stages of elicitation, Analysis, Validation and Documentation. This phase determines what problem needs to be solved or what software has to be developed. Thus, in a multi-stakeholder environment, requirements definition could be a very difficult task because the users of the system needs vary with regards to various factors and if the needs of stakeholders are not met then a quality and acceptable software cannot emerge. In the cause of meeting these needs, there are factors that might influence the requirements or rather determine it. This study seeks to address challenges faced by software engineers in arriving at an effective software requirements definition in a multi-stakeholder environment. The intention is to put into perspective the challenges software engineers face in the process of requirement elicitation and definition. The healthcare sector in Nigeria will be used as a case study because it reflects the multiplicity of stakeholders in a common environment which is the focus of this study. A survey will be carried out with identification of stakeholders from geo-political zones using four states (Edo, Delta, Lagos and Anambra) in Nigeria by both administering questionnaires and organizing interviews with these stakeholders in order to gather adequate data and requirements for this research. A structured system analysis and design methodology (SSADM) will be adopted for the research. This article reports our research strategies and design directions.

Keywords: Software Requirement, Multi-Stakeholder Environment, Patients Record & Management Systems

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1. INTRODUCTION

The term requirement in the contest of software development and production has been defined from various perspectives with regards to their intrinsic meaning in describing what should be and not be in a system. These definitions have helped to clarify several issues on the subject requirement engineering thereby exposing what should be sought and how it should be done during the process of requirements engineering.

A requirement is a “function or characteristic of a system that is necessary. It is the quantifiable and verifiable behaviors that a system must possess and constraints that a system must work within to satisfy an organization’s objectives and solve a set of problems” (STEP, 1991). Similarly, IEEE, (1990) defines “requirement” as: (1) a condition or capability needed by a user to solve a problem or achieve an objective; (2) a condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed documents; (3) a documented representation of a condition or capability as in (1) or (2). Sage and Palmer classify requirements as technical system requirements, which are primarily functional requirements, and management system requirements, which include cost and time constraints as well as quality factors for requirements (Sage, 1990). Southwell, (1987) classified requirements into two major categories namely; functional requirement and nonfunctional requirements. However the IEEE Standard Glossary of Software Engineering Terminology defines five other types of requirements in addition to functional requirements which are; performance requirements, interface requirements, design requirements, implementation requirements, and physical requirements (IEEE, 90). Requirements engineering is “the disciplined application of scientific principles and techniques for developing, communicating, and managing software requirements (STEP, 1991).

Loucopoulos and Champion (1989) defined requirements engineering as “the systematic process of developing requirements through an iterative process of analysing a problem, documenting the resulting observations, and checking the accuracy of the understanding gained”. Requirements engineering can be decomposed into the activities of requirements elicitation, specification, and validation. Leite (1987) describes requirements engineering as a process in which “what is to be done” is elicited and modeled. This process has to deal with difference viewpoints, and it uses a combination of methods, tools, and actors to produce a document, called “the requirements document” that contains the needs and constraints in a proposed software system. While it is a known fact that software requirements is the key to an effective, efficient and acceptable software product, a literature search showed that poor requirements definition is still widely reported as one of the major causes of software project failures (Walid and Happel, 2009; Nicolas *et al.*, 2008) creating a major hindrance to the development and implementation software products that meet users’ exact needs (Sparrow, et al, 2006). This hindrance is more pronounced in the development and implementation of software products in a multi-stakeholder environment due to various factors that influence and determine the requirements of the software systems in such environments.

Requirement elicitation is all about knowing the desires of stakeholders (Sadiq et al., 2009). Stakeholders are the individuals or organizations who stand to gain or lose from the success or failure of a system. For a software system, this includes managers, designers, and users of a system. Multi-stakeholder systems are distributed systems in which subsets of the nodes are designed, owned, or operated by distinct stakeholders (Curtin, et al 2007). Multi-stakeholder systems pose a number of critical challenges to both researchers and practitioners and the consequences of Multi-stakeholder systems for system development, operation, and evolutions are manifold. Multi-stakeholder systems are often composed from already existing services and components. This means that in the future, requirements engineering (RE) approaches need to be aware of existing technological solutions. This shifts many RE decisions from design-time to runtime when, e.g., services are often already in operation when being considered for integration. Also, as Multi-stakeholder systems are operated by distinct stakeholders they can change uncontrollably and rapidly. If one stakeholder modifies some part of the system, this can have severe implications on the users of other nodes. Providing adequate knowledge on how to deal with such changes is thus another challenge. In Multi-stakeholder systems, negotiation processes ensuring stakeholder agreement are important to provide and maintain mutually satisfactory solutions. This also means that understanding the goals of different stakeholders and resolving potential conflicts becomes essential. Dealing with these challenges requires the adoption of proven Requirement Engineering approaches in an integrated manner. The focus of this study therefore is to identify requirements engineering issues in a multi-stakeholder environment using the health institutions as a case study.

2. RELATED EFFORTS

Soliciting and gathering user requirements is a critical first step for every software development project. Conflicting views from different stakeholders on what should be implemented in a software system makes the task of requirements elicitation especially difficult in a multi-stakeholder environment. Because multiple stakeholders are drawn from different disciplines and hence do not share a unique problem definition, (Rooksby et al., 2006) political, social, economic and environmental factors influence the requirements definition process in such environments. Healthcare system is a typical case of a multi-stakeholder environment. Having the correct information about a patient is crucial, and accessing medical information quickly can save lives. But a Stanford University study showed that 81 percent of the time, physicians lacked the necessary information to make informed medical decisions (Tang et al., 1994). Despite the fact that the most advanced medical system in the world, Clinton, (2005) observed that patient safety is compromised every day due to medical errors, duplication, and other inefficiencies and hence opined that harnessing the potential of information technology will help reduce errors and improve quality in our health system. The application of information technology in health care is unceasingly evolving as the quality of patient care in contemporary times seems to depend on the timely acquisition and processing of clinical information related to the patient (Brailer, 2005). Cholewka (2006) asserted that a significant paradigm shift has occurred in health care service delivery from an era of physician centeredness to emphasis on quality of patient care, from isolationist practices by caregivers to networking in a global world, and from competition to collaboration among practitioners. In tandem with this trend, improvement in technology and advancement in information systems have been adopted in the health care industry as a business strategy to improve the quality of care (Wilcke, 2008). Developing a software system for healthcare delivery requires requirements elicitation from the various stakeholder groups. This research work aims at determining the factors that influence the requirements definition in a multi-stakeholder environment such as a hospital environment. Specifically, the study will focus on issues on requirements engineering in a multi-user environment using a Patients Records management System as a case study. Works consulted are listed at the end of the article

3. RESEARCH MOTIVATION & PROBLEM STATEMENT

3.1 Research Motivation

This research work is inspired by the need to understand the peculiar nature of requirement elicitation for a software system from multiple stakeholders which is gradually becoming the trend in today's distributed system environment to enable software engineers develop adequate strategies to eradicate barriers and obstacles in eliciting quality requirements in such environments. The multi-disciplinary needs in hospital environment and the multi-purpose requests for Patient's Information Records by various stakeholders within a hospital environment makes it a suitable case study. Particularly, the researcher is motivated to use automation of patients medical records as a case study after witnessing a situation where sickle cell anemia patient had to be rushed to a hospital about 100km away from where she had an attack because her health records or history was solely domiciled in that hospital. The patient almost lost her life in the process all because of lack of quick access to her medical records and history in her current location though there were standard and well equipped hospitals with expert medical professionals in her current location.

3.2 Problem Statement

The inability to design and implement a digital and de-centralized Patients Health Record Management System has negatively affected and is still affecting Healthcare delivery in most developing countries including Nigeria. This is mainly due to the distributed natures of healthcare systems and the presence of multiple users with varied viewpoints on what is required in a healthcare system. Eliciting software requirements that meets the needs of all stakeholders can be very difficult due to the divergent views and interest of the stakeholders across different environments. This has hindered the design and implementation of critical and real time software systems that are meant to improve the lives of people.

The researcher believes that if the factors that determine software requirements in such environments are known, then adequate tools and techniques can be adopted to address the challenges of requirement elicitation, definition and specification in a multi-stakeholder environment. An effective Patients Record Management System is still far from taking its place in Nigeria's healthcare delivery system and patient safety is compromised every day due to medical errors, duplication, and other inefficiencies resulting from lack of necessary information to make informed medical decisions. Part of the problem has been attributed to the difficulty in obtaining sufficient and acceptable requirements for the design and implementation of a Patients Record Management System in Nigeria. This problem and other Requirement Engineering process challenges can be resolved if the factors that determine software requirement can be sufficiently exposed.

3.3 Research Questions

The research questions that emanates from the foregoing are:

1. Who are the stakeholders in a Patient Records Management System?
2. What are the requirements from each stakeholder group for a Patient Records Management System?
3. What factors are relevant in the development of a Patient Records Management System?
4. What are the factors that determine software requirement in a multi-stakeholder environment?

4. AIM AND OBJECTIVES OF THE STUDY

The aim of this research work is to determine the factors that affect requirements definition in a multi-stakeholder environment during software development using a Patient Record Management System as a case study. The objectives of this research are as stated below:

1. Identify the stakeholders that utilize Patients Records.
2. Elicit requirements from each stakeholder group for a Patients Record Management System.
3. Determine the factors that influence software requirements elicitation in a multi-stakeholder environment.
4. Develop a prototype Patients Record Management System.

4.1 Research Significance

The significance of this study to the academia is that it will help researchers to look deep into improving Requirement Engineering processes so as to enhance efficiency in software development and software engineering as a whole. Also, the successful design and implementation of a Patient Record Management System will significantly reflect the requirements of all stakeholders, and serve as a key to improving healthcare delivery in Nigeria. The bottom line for healthcare providers is to improve the quality of care for patients. An interoperable system such as the one proposed in this study will reduce time spent on administrative tasks, phone calls, office business, and most importantly it will provide immediate access to required information about patients so that medicare can be received by patients at the medical facility closest to them. That means:

- i.* More complete information available for treatment decisions;
- ii.* New and more efficient options for patient interaction;
- iii.* Enhanced ability to demonstrate performance consistent with regulations and recognized professional standards;
- iv.* Potential for reduced operational costs and more effective use of resources;
- v.* Reduced or streamlined management responsibilities;
- vi.* Less paperwork;
- vii.* Automation of repetitive tasks; and
- viii.* Better efficiency in dealing with other providers and outside parties.

In fact, the benefits to healthcare providers fall into four categories:

- i. Quality of care;
- ii. Administrative efficiencies;
- iii. Patient communication; and
- iv. Public health and security.

5. PROPOSED RESEARCH METHODOLOGY & SCOPE OF COVERAGE

5.1 Proposed Methodology

A structured systems analysis and design methodology (SSADM) was adopted in this study. A case study methodology was used to identify the stakeholders in an electronic medical record system. Questionnaires, documents review and interviews were the major tools for data collection. The sample population consisted of administrative and medical personnel in health care institutions. A convenient sample drawn from Delta, Edo, Lagos and Anambra states in Nigeria was used in this study.

5.2 Scope of Coverage

This study will cover a significant part of Requirement Engineering and its processes with a view to addressing challenges been faced by software engineers in obtaining effective software requirements in a multi-stakeholder environment and arriving at actionable position. It will put into perspective healthcare delivery in Nigeria with regards to its practice and timely access to adequate information that help healthcare providers reach a decision on the required treatments for patients. The fact that immediate access to personal medical records can mean the difference between life and death, hence the need to deal with the issue of patients' health record/history as a viable tool for improving the quality of healthcare delivery in our society.

5.3 Elicitation

The researchers welcome inputs from readers as the work progresses. Updated reports from the work will also be published periodically.

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