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Using Goals and Indicators for Activity-based Process Integration in Healthcare

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Abstract

The importance and usefulness of requirements engineering (RE) techniques (elicitation, analysis, modeling, change management, etc.) have been proven oftentimes in domains such as telecommunications and cybersystems. However, in healthcare, such practices, beyond elicitation, are immature. The introduction of changes to existing healthcare processes or e-systems often fails because users' needs and operational/organizational goals may not get satisfied. In addition, healthcare is moving toward a value-based paradigm that requires a comprehensive evaluation and re-engineering of current processes, which puts more pressure on healthcare professionals to apply advanced RE techniques, such as goal and process modeling, in order to obtain much desired results effectively. In this paper, we discuss the integration of new technology-depending processes, e.g., that come with off-the-shelf solutions, with existing healthcare processes. We propose the use of an Activity-based Process Integration (AbPI) framework to investigate the impact of each potential integration on the organizational goals and user satisfaction. Performance indicators are used to reason about measurable quantities beyond goal satisfaction. The paper implements the AbPI approach with the User Requirement Notation standard and illustrates its feasibility with a real example related to wait time indication in an emergency room. Important research challenges are identified along the way.

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Keywords: Goal-oriented modeling; healthcare; process modeling; process integration; requirements engineering; URN.

1. Introduction

Existing healthcare systems, especially in Canada, suffer from critical issues such as long wait times, uneven quality, and high costs. For years, hospitals were built around medical specialties. However, to get a better system, hospitals must be organized around patients' medical needs. In that context, many governments and hospitals are slowly shifting their care models to a value-based system where patients are back at the center of interest.

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The main strategy of a value-based healthcare system is to make *value* the overreaching goal by improving outcomes while minimizing associated costs, without sacrificing the quality of provided services[1]. Increasing healthcare value requires improving healthcare quality and decreasing healthcare costs.

Despite the claimed benefits of value-based healthcare, shifting the focus to value and outcomes is not a trivial task. Prevailing healthcare systems involve interdependent components, and any change to one of the components will affect the entire system. For example, one of the commonly required changes is moving from paper-based systems to e-systems. This kind of changes not only affects the existing technological means in a hospital, but also the running workflows, caregivers' performance, and organizational goals[2]. Therefore, failing to consider one of those components results in failing the proposed solution. The absence of modeling and requirements engineering techniques that enable evaluating and analyzing current situations and potential solutions is one of the main obstacles faced by healthcare organizations[2,3].

In addition to considering multiple views in healthcare, there are also many grand challenges. One of them is that caregivers claim that introducing new processes interrupts current practices with which they are familiar and deteriorates their performance[4]. Also, the long-term value of proposed changes is often unclear to them. In most cases, caregivers resist changes, and this resistance often causes newly introduced systems to fail[4,5]. One more complain is the mismatch between users' requirements/needs and technical requirements[5]. All of the above issues represent dilemmas faced by healthcare organizations when introducing new off-the-shelf technology or e-systems. However, we believe it is feasible to tackle these particular healthcare issues with proper *requirements engineering* (RE) techniques, specifically with goal/process modeling and analysis tailored to that domain.

Very recently, an *Activity-based Process Integration* (AbPI) approach was introduced to investigate each integration opportunity of activities from a new, off-the-shelf, technology-depending proposed process into a current healthcare process, as well as the potential effect of a single activity on process structures, performance values, organizational goals, and user satisfaction[6]. AbPI is an RE approach that generates integration alternatives and enables their evaluation in achieving the desired outcomes, in support of flexible integrations and sound decisions. In this paper, we refine AbPI to capture *Key Performance Indicators* (KPIs) in healthcare and use them as measures to evaluate the integration alternatives model accurately. Another refinement is concerned with the handling of multiple existing processes rather than just one, possibly across many units. In addition, the integration of processes in healthcare raises many research questions that will be discussed in the paper such as *would using RE techniques lead to desirable results and suitable decision support? Is it feasible to model processes and goals that cut across organization units and demonstrate the impact of the integration on each unit involved in the context?* AbPI is expected to provide a modeling framework for answering such questions and highlighting remaining gaps that need to be filled through further research. Also, the paper discusses how AbPI exploits the *User Requirements Notation* (URN) to model and analyze processes and goals.

The rest of the paper is organized as follows. Section 2 provides background on URN and some related work. Section 3 explains the AbPI approach. Section 4 highlights how URN can be profiled to support AbPI. Section 5 demonstrates the feasibility of using AbPI to model and analyze integration alternatives using KPIs. Finally, Section 6 discusses some important challenges in this area and raises corresponding research questions, while Section 7 provides our conclusion.

2. Background

2.1. User Requirements Notation (URN)

The User Requirements Notation is a standard graphical language that enables modelers to capture, analyze, specify, and validate requirements[7,8]. URN combines two complementary sub-languages: the *Goal-oriented Requirement Language* (GRL) for modeling systems and stakeholders, their intentions, their relationships, and the KPIs that help measure satisfaction, and *Use Case Maps* (UCM) for workflows. The GRL and UCM views can be aligned with each other, such that processes are linked to the goals that justify their existence. URN models can also be used to reason about different design alternatives with regards to users, business processes, and organizational goals. We believe that URN can be used to model and measure value (with GRL actors, intentions, and KPIs) and processes (with UCM), as well as their evolution in a healthcare context.