Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 28 (2014) 610 – 618

Procedia Computer Science

Conference on Systems Engineering Research (CSER 2014)

Eds.: Azad M. Madni, University of Southern California; Barry Boehm, University of Southern California; Michael Sievers, Jet Propulsion Laboratory; Marilee Wheaton, The Aerospace Corporation
Redondo Beach, CA, March 21-22, 2014

A systems approach to healthcare efficiency improvement

Jose Monreal, Jr.[a,*], Ricardo Valerdi[a], L. Daniel Latt[b]

[a]*University of Arizona, Systems and Industrial Engineering, 1127 E. James E. Rogers Way, Bldg. 20 Room 225, Tucson, AZ, 85721, USA*
[b]*University of Arizona, Orthopaedic Surgery, 1609 N. Warren Avenue, Suite 110, Tucson, AZ, 85719, USA*

Abstract

Healthcare patient outcomes and healthcare costs, in the context of the healthcare delivery system, is a prominent societal issue for the U.S. Although improvements have been achieved, they are silo-centric, specific to a single area or discipline. It is clear that improvements need to be transferred across the healthcare delivery system in a broader sense. To that end, the ability to measure a change in the system is paramount in determining progress and in what parts of the system are impacted. The research work presented describes a case of how an Electronic Medical Record (EMR) system implementation can be measured within a systems or systems engineering context. In the first phase, time motion study has been employed to assess physician workflow. In this manner, data collection, analysis, and inferences elicited can be quickly assessed by subject matter experts for effectiveness. The objective of this collaborative work is that it demonstrates a systems engineering driven application of the improvement of an orthopaedic office that may then be generalized to a broader context. This works employs a phased approach which allows for synchronization between one set of tools or methodologies from one phase that inform and provide insight for the next. Additionally it facilitates an iterative effort as each phase will assess and reassess the key stakeholders and take into account the process/product life cycle thus allowing refinement of the previous phase and its results. The progression from one phase to another provides the means of measuring the progress and impact. The partnership between the Department of Orthopaedics and the Department of Systems and Industrial Engineering at the University of Arizona, provides a real-life setting for testing our hypotheses. All of the features described in this implementation make up a methodological framework that will render implications for engineers, physicians, patients, and policy makers.

Systems Approach; Electronic Medical Records; Time Motion Analyis

* Corresponding author. Tel.: +1-520-861-8815; fax: +1-520-572-4758.
E-mail address: jmoreal@email.arizona.edu

doi:10.1016/j.procs.2014.03.074

1. Introduction

Healthcare patient outcomes and healthcare costs are a prominent societal issue for the U.S. Numerous authors have documented the extent to which major factors are key drivers in the reported U.S. healthcare expenditure at the levels of 16% of our Gross Domestic Product. This is increasingly significant when U.S. healthcare expenditures are reported to be higher than other comparable nations but without the same quality level in health outcomes.[1] The advancement of health informatics is identified by the National Academy of Engineering as one of the grand engineering challenges [2]. In 2009, the passage of the Affordable American Recovery and Reinvestment Act (ARRA) signaled deliberate focus on the use of technology to help improve the healthcare delivery system [3] for example by reducing prescription errors, reducing the cycle time of administrative processes such as billing or scheduling, and eliminating or reducing duplicate data collection.

The research work presented in the paper describes how we use a multi-phase systems approach to develop a deliberate connection between the contexts described above and specific systems engineering tools used to improve a specific portion of the healthcare delivery system. For example, we propose to evaluate and provide analysis using various systems engineering tools in the product development life cycle. Additionally, our intent is to demonstrate the benefits of systems engineering methods in the implementation of systems that utilize people and technology in complex processes. This is turn will allow the project to serve as launching point for the next phase(s) in this collaborative research. To provide a specific example we describe the use of time motion study methodology to assess physician workflow. In this manner, we can collect data, analyze, and draw inferences that can be assessed by subject matter experts for effectiveness. Our objective is that this work, done in a collaborative manner, demonstrates systems engineering driven application in the improvement of an orthopaedic office setting that can then be generalized to a broader context.

The learning that can elicited by successfully applying systems engineering methods or processes in the improvement of a highly complex and important societal needs adds not only the systems engineering discipline but to a broader topic of enterprise transformation of the healthcare delivery system. The diagram depicted in Figure 1 - Systems and Systems Engineering Approach, is a representation of the how the work or use of specific tools form each level are used to build and inform the next level. In all phases or levels, the stakeholders are taken into account and this process provides a feedback loop with respect to the product or process life cycle. This is an important distinction, an iterative process, in systems engineering methodology.

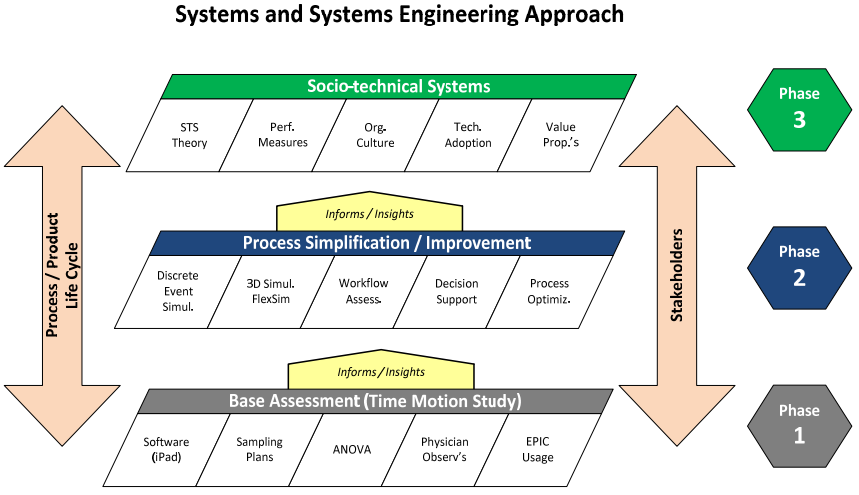

Figure 1 - Systems and Systems Engineering Approach

A specific site or area approach has been utilized in manufacturing settings with such tools as lean manufacturing, six sigma, and visual factory methods. These same tools are being utilized in the healthcare setting with limited success. A certain area(s) may be improved, but the system as a whole does not realize discernible improvements. Recent literature demonstrates a newer, more holistic approach where the entire enterprise is taken