

Process Transformation in Healthcare

by Prashila Dullabh, M.D.

Computerized Physician/Prescriber Order Entry (CPOE) and Electronic Medical Records (EMR) remain among the top 5 areas of focus for most healthcare organizations as validated by the 14th Annual HIMSS Leadership. As we start deploying information technology to support day-to-day clinical care, we now have the ability to replace manual tasks with automated systems. All healthcare providers will at some point need to interact with these systems in order to perform their daily tasks. It has become increasingly evident that a very clear understanding of current healthcare processes is critical to design systems that can effectively support daily clinical care. Recently publicized, failed healthcare implementations have further drawn attention to this fact.

This realization is also being echoed in various healthcare articles, seminars/webinars and case studies. On the supply side, sundry healthcare vendors are beginning to tout workflow as a distinguishing strength of their product offerings.

As we start to use technology in our daily tasks of patient care, the need to understand change and optimize processes will continue to increase. The purpose of this article is to present clear definitions for various process and workflow concepts and motivate why process modeling, analysis and redesign are fundamental to the use of information technology in healthcare. This paper will also provide a methodology for creating optimized process models.

Some definitions

Listed below are some common terms and definitions. These terms are well known and have been used extensively in other industries. They have however only recently been gaining more attention and focus in healthcare.

Process: "A set of one or more linked procedures or activities which collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships."

Workflow: "The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules."

Workflow Management Coalition (WFMC)¹

Process addresses the way work is being done while **workflow** addresses the automation of a process.

Task: A task is an ‘atomic’ process: one that is not further subdivided into component processes. It thus is a logical unit of work.

Wil van der Aalst and Kees van Hee

Process Re-engineering: The fundamental re-thinking and radical re-design of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, service and speed.

Re-engineering the Corporation, Hammer and Champy, 1993

The emphasis in process re-engineering is in the radical redesign of the current process. Often this re-design would encompass the use of technology. This is in contrast to just streamlining or simplifying a process.

Process Transformation: A radical change approach that produces a more responsive organization that is more capable of performing in unstable and changing environments that organizations continue to be faced with.

Earl 1994

Process transformation encompasses a broader context than process re-engineering. It has a cross-functional scope, with impact at an enterprise level. There is a change in both the structure and roles of individuals and technology is seen as a key enabler.

Clinical Transformation: Consists of the following components:

- Integration of enabling technology throughout the redesign process to maximize technology’s impact
- Un-tethering of information to make it available at the time and place it is needed
- Clinical process improvement and standardization across the health system and sharing of knowledge across the system
- Evidence-based medicine and clinical care
- Sustained organizational and cultural change
- Transfer of knowledge and effective communication

Lynne A. King et al, Journal of Healthcare Information Management, Volume 17.

Healthcare is clearly drawing on concepts from other industries as it starts to critically address clinical process, process redesign and what needs to be done to take advantage of new technologies.

When technology is implemented to automate a process it can replicate the original paper process or alternatively, change the way in which work is done. By virtue of automating a process it is likely that there

will be some redesign of constituent tasks as well as possibly the ordering of tasks. At a most basic level, consider electronic data entry; in an automated process the data is entered once and stored in a database for subsequent retrieval. This data can now be accessed at different locations by different applications. Using technology to automate process creates a new opportunity for process redesign. In a completely manual process it is often necessary to perform tasks sequentially because of having only one copy of a particular document. By moving to an automated process, it is now possible to load the same document in multiple applications and perform tasks in parallel. Removing or automating non value-adding steps can simplify processes. These are just some examples of the way technology can transform the way work is done. Technology changes both what we do and how we do it.

Physician/clinician Workflow: The various sub-tasks performed by a physician to complete a process like writing orders, checking laboratory and radiology results etc.

When implementing applications that physicians will interact with in performing their specific tasks, it is important for systems to be designed in a way that supports physician-specific workflows as described above. This has been a real challenge for many healthcare IT vendors. The recent problems at Cedar Sinai¹ in Los Angeles were partly as a result of physicians finding the implemented CPOE system not conducive to performing their daily tasks.

Understanding Clinical Process

In general clinical processes are complex and difficult to manage. Characteristics of clinical processes include:

- Numerous hand-offs involving a multi-disciplinary care team
- Frequent task communication between the different workflow participants
- Tendency to cross department boundaries,
- Often lengthy in duration
- Dynamic in changing with many exceptions
- Knowledge driven and dependent on information from other processes.

Because processes often impact many different departments, they frequently lack ownership and hence overall management. For example a patient enters the emergency room (ER) with a suspected heart attack. Immediately the ER physician will request an EKG, order certain blood tests and notify the cardiologist on

¹ In January 2003 Cedar Sinai in LA, suspended use of multi-million dollar CPOE implementation, because their physician community complained that the process for entering electronic orders was too lengthy and obstructed rather than aided patient care.

call, once the diagnosis has been established. Care of this patient has already impacted the ER, the laboratory, transport and the cardiology services in this hospital. Various processes are initiated in the care of this patient that cross department boundaries, require task communication and the careful exchange of information between the different caregivers.

The practice of medicine today also involves shared care, where a multi-disciplinary team contributes to the overall well-being of a patient. In this environment, effective information communication becomes all the more relevant.

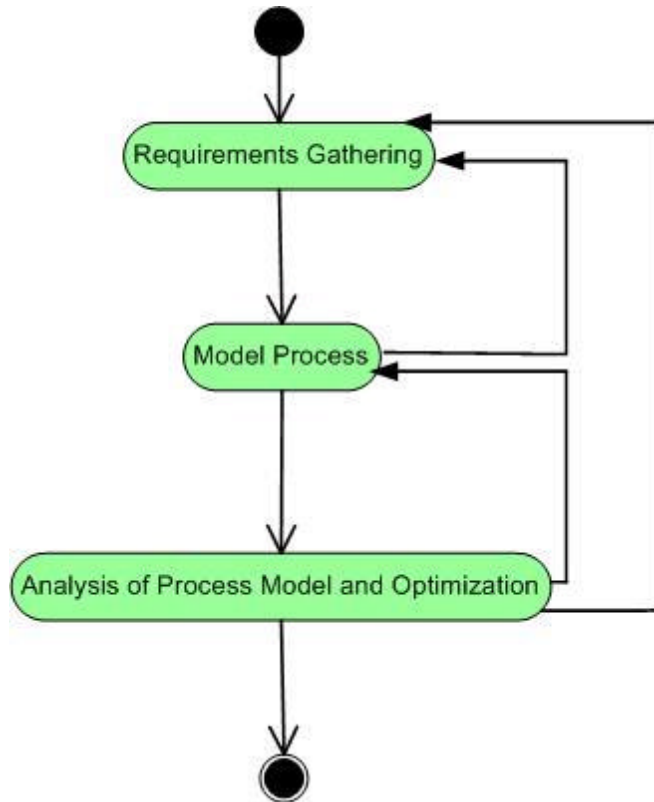
Process Modeling

Model: An abstract representation of a system, constructed to understand the system prior to building or modifying it.

Object Oriented Systems Development, Ali Bahrami

Process Model/Definition: A flowchart or textual description of a process that defines associated activities, routes, rules, and documents.

Developing optimized process models involves a series of activities as indicated in the diagram below.



Activity Diagram for Process Modeling

The first step is to identify and understand the various aspects of the current process. When creating the process model it is important to involve both the process owner and the various individuals that participate in the process. This exercise provides a communication opportunity between the involved parties and helps them understand the key operations associated with the process, as well as forms a consensus on how things should be done. Often individuals involved in a complex process have a very limited view and by participating in such an exercise the context of their task within a larger process becomes clearer.

Developing a process model is iterative and it may be necessary to return to the requirements gathering or modeling phase in order to capture all the necessary details of the process. Process modeling provides a very a structured approach to documenting both your current and future processes. It is also an invaluable tool in understanding the information flow in a process. In healthcare more than any other industry, processes are information-driven, therefore understanding the flow of information is critical to redesigning a process.

Functional and non-functional requirements

Processes have both functional and non-functional requirements. Functional requirements describe the behaviors (functions or services) of a system that support the process participant's goals, tasks or activities. Non-functional requirements address constraints or qualities that a system should have. Qualities are properties or characteristics of the system that the various participants care about and hence will affect their degree of satisfaction with the system. When dealing with CPOE the need to have 'just-enough' decision support and alerts would be an example of a non-functional requirement. Constraints, unlike qualities are certain limitations on the system and therefore cannot be changed. In healthcare many of the non-functional constraints are as a result of various laws, regulation and/or established hospital practice. For example it may be standard hospital protocol to have all verbal orders, signed in 24 hours. Many of the non-functional constraints in healthcare are role-related.

Sources for non-functional requirements would include identifying constraints in the process, i.e. only the attending can authorize certain procedures. Careful attention should be paid to the objectives, values and concerns of the different workflow participants. It is important to identify all the categories of people that will need to interact with the process, their specific roles and understand what quality attributes are important to these individuals. As an example we need to address physician specific workflows when doctors are interacting in the process to fulfill their various tasks. Consideration should also be given to various laws and regulations that may be applicable.

There are different methods that are used in eliciting non-functional requirements; one of the more frequently used approaches is that of use cases. A use case is a scenario of a typical interaction between a user and a system that captures a users' goals and needs.

The representation of non-functional requirements can be done graphically or through a textual description. Computer Aided Software Engineering (CASE)² tools are available to model non-functional requirements.

Output of Process Modeling Phase

Based on the previous definitions the output of a process modeling exercise could be either a textual or graphical representation of the process. In this article focus has been given to graphical process models.

There has been significant formalization in the area of process modeling and there are a number of different process modeling languages available today. The purpose of using a standard set of symbols according to a set of defined rules allows for unambiguous interpretation of the given process model. Some examples of the modeling languages available today are; Event-driven process chains (EPC), Business Modeling Language (BML) and Unified Modeling Language (UML).

This article has addressed process models in a very generic sense. A number of different kinds of process models can be generated during the process modeling exercise. These models offer different views and different levels of abstraction. Depending on the kind of process being modeled it may be necessary to produce more than one process diagram.

One example of a process model is a Data Flow Diagram (DFD), which is part of the Structured Systems Analysis and Design Methodology (SSADM). These DFD's describe the data flow through a process and the overall objectives of the process. They frequently start with a context diagram, which represents the overall purpose of the domain, e.g. a patient transport process. Successive models break the top-level process down further completely subsuming the parent process. So at each successive level you may for example, deal with transport in different departments in a hospital. Another type of process model is an activity diagram. Activity diagrams are used in UML, which does not make use of DFD's. This model depicts the various activities/tasks that make up the entire process. UML makes use of other models as well e.g. UML state diagrams and UML class diagrams to provide a complete representation of the domain being modeled.

Process Analysis and Optimization

After the initial process model is complete, the next step is to perform an analysis of the model. By having a modeled process it is possible to see redundancies and analyze processes for bottlenecks that had previously not been apparent. By looking at the designed process you may notice the number of steps that are currently required to complete a process. It may be possible to eliminate steps or to perform steps in parallel to decrease the time for process completion. By running a simulation of a workflow model you can compare estimated completion times of a process, and compare this to actual times. This may be one way to uncover possible bottlenecks. The process model also provides information on the current technology

² Case tools - Software used for the automated development of systems software. CASE functions include analysis, design, and programming.

infrastructure and what if any aspects of the process are already automated. Using the existing process models as a basis, one can develop a model of the desired process.

Process models are analyzed both quantitatively and qualitatively. By doing a qualitative analysis you want to ensure that the model you have created is logically correct i.e. that the process will run to completion and does not contain errors that would prevent its completion. You would be looking for deadlocks³, e.g. if an automated patient discharge process was designed such that there was no way to support communication from transport back to the ward, then that process would not be able to complete as expected. You also want confirm that you did not design any livelocks⁴ e.g. assuming you had two successive steps, A and B. Step A required that you submit a form and some supporting documentation to Step B. Step B on processing the information establishes that some additional information is required and the process routes back to A. A completes and submits the information, but this time around no supporting documentation is submitted. Step B receives the completed form but sends a message back to A requesting supporting documents, and Step A is in a state where it believes that the supporting documentation has been submitted. This results in an infinite loop or livelock. As part of the analysis you need to ensure that there are no incorrect or absent inputs and outputs.

A quantitative analysis of the process model is focused around developing an optimized model for that particular process. When doing a quantitative analysis you will focus on the performance of the process i.e. time for process completion, potential for failure, resource utilization and the final product or service quality. Some examples of performance measures would be the time for pharmacy order fulfillment and the average length of patient stay,

There are a number of methods for analyzing the performance of a process. One of the more popular methods being simulation. Simulation allows one to perform various “what if” analyses on the models that have been created. The use of simulation tools assists in developing a better insight into the process you are trying to model. These tools are therefore useful in developing optimized process models.

Similar to the process-modeling phase, the output of the analysis phase is a number of different graphical models. There are a number of commercially available tools for creating process models and analyzing them, for example, PROTOS, COSA and IBM Business Process Modeler. Every process is unique in its characteristic because of the way in which the people, applications and practices interact to generate the end result. Thus, the choice of a process analysis tool depends on the characteristics of the process investigated. The more complex the process is, the greater the demands on the tool.

Benefits of Process Modeling and Analysis

Process models:

- Provide a graphical aid to understanding the current situation
- Serve as an alternative analysis tool for current healthcare processes

³ Deadlock – when a process is blocked so that it cannot be completed

⁴ Livelock – when a process becomes stuck in a never-ending loop

- Are a means to standardize process
- Make it easier to represent complex processes where visualization is important
- Serves as a communication tool
- Provides simplification by using a higher level of abstraction. Important for complex systems where it is easy to get overwhelmed with details of the system
- Define the desired future process
- Help to identify the requirements for the new process
- Demonstrate the benefits of the proposed workflow solution.
- Serve as a blueprint for future automation

The process models that are created of the current and future process are a valuable tool to demonstrate and explain the benefits of the new solution. By comparing the digital and analogue process models, prospective ROI's can be calculated and productivity gains can be demonstrated which are important in building the business case for subsequent automation.

Conclusion

Healthcare will increasingly use technology to automate processes in its efforts to respond to the challenges of declining budgets, increasing pressures to improve operational efficiencies, cost containment and improving patient safety. The need to understand and redesign current processes will therefore continue to increase.

In the area of clinical transformation, process analysis and redesign are fundamental building blocks. When documenting processes it is crucial that both functional and non-functional requirements get represented. The rigor applied to this task will to a large extent determine the success of these projects that have impact at an enterprise level.

Process modeling and analyses, is key to documenting and standardizing the current process, defining the desired new process and communicating the business value of a proposed new workflow solution.

Dr. Prashila Dullabh is a partner with Tunitas Group where she leads the clinical transformation practice. She can be reached at 301-816-0226 or via email at prashila@tunitas.com.