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Evidence-Based IT Development: Toward a New Contract Model for EPR Projects

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Abstract

Evidence-based IT development aims at developing a new commercial contract model for IT projects where the customer's payment is dependent on measurable effects of using the vendor's system. The idea is to establish a strategic partnership in which customer and IT vendor share the responsibility of providing IT solutions that meet agreed-upon, measurable effects. The project investigates effects of the use of electronic patient records, how collaboration between vendor and customer can be regulated, and how contract fulfillment could be determined on the basis of evidence of effects.

Keywords:

Evidence, development, EPR, contract, effects, measure, usage, clinical process, vendor.

Introduction

Today IT projects regulate the relationship between customer and vendor by means of specifying requirements in terms of system functionality. This entails that the overall purpose of implementing a system in an organization is transformed into a requirements specification defining the system functionality. The requirements specification subsequently constitutes the key contractual element that guides the development process and the ongoing negotiations between customer and vendor. This often leads to a classic problem: The vendor fulfils the contract and delivers a system according to the requirements, but the users do not appreciate it as a system that meets their needs [1].

In the traditional contract model of IT projects, the predicted value of a project constitutes the basis for contractual settlement. The contract model does, however, only cover a minor part of the total IT project challenges. In practice, a major part of the challenges, in terms of change management, organizational implementation, changes in work organization, establishment of new work practices, and so forth, is not included in the contract. In fact the traditional contract model constrains the possibilities of evaluating whether the introduction and use of a system produce the effects intrinsic to the overall purpose of the IT project. The cost-benefit relation is very unclear in most IT projects and often new IT systems do not produce any utility value at all [e.g. 2, 3, 4].

The project reported on in this paper aims at turning evident shortcomings of the traditional contract model "upside down": The idea is to base contracts on objective measurements of the achieved values of IT projects. It is our hypothesis that by substituting system functionality with measurable, agreed-upon effects of using the system, the contract will provide a more appropriate means for managing the customer-vendor relationship and for working systematically toward developing efficient solutions that meet customer goals. We term this evidence-based IT development. The result of the project will be a new commercial contract model where the customer's payment is dependent on measurable effects of using the vendor's system.

The project is part of a larger research program on Healthcare IT (HIT) supported by the Danish Research Council [5]. The topic of HIT is IT-supported communication and coordination in the healthcare domain. The purpose of the program is to develop conceptual frameworks, contract models, design principles, prototypes, and methods to support the design, implementation, and use of collaborative healthcare information systems. This research approach is based on analyses of existing systems and empirical studies of development practices. The current participants in HIT are 15 senior researchers and Ph.D. students from Roskilde University, The Technical University of Denmark, and The IT University of Copenhagen. The participating non-academic partners currently include Roskilde Amt, Københavns Kommunes Sundhedsforvaltning, Hovedstadens Sygehusfællesskab (H:S), Sundhed.dk, CSC Scandihealth A/S, and Acure A/S.

The evidence-based IT development reported on in this paper is a research-in-progress project [6] with participants from Roskilde University, CSC Scandihealth A/S, and Roskilde Amt in the following they are referred to, respectively, as RUC, CSC, and RA.

First we will outline research related to evidence-based IT development. We then continue by presenting the idea and goal of our project followed by a more detailed description of the project and how it will be organized. We end the paper by discussing some challenges to our approach and by summing up in a conclusion.

Related Research

Our interest in and definition of evidence-based IT development stems from two sources of inspiration: Performance-based procurement and objectives-based usability engineering. Recently the topic of evidence-based development has also been brought forward as an approach to improve the adoption of research findings among software-engineering practitioners [7].

Performance-Based Procurement

Performance-based procurement has primarily been reported on within the construction industry [8], though one IT related case has attracted considerable interest: In an effort to improve their ability to manage large, high-risk IT projects effectively, The California Franchise Tax Board has developed and used performance-based procurement [9, 10]. In this case, performance-based procurement has been deployed by a large IT customer to manage relations with multiple vendors. The key objective of performance-based procurement is risk sharing, which is accomplished through performance-based payments. Vendors only get paid if and when the benefits stated in the contract (in terms of increased income, operational savings, and cost avoidance) are realized after implementation of the systems. This is assumed to increase vendor commitment to success through their assumption of up-front project costs, and it limits the customer's expenses and liability for unworkable systems.

The benefits to be achieved by a system are defined through an extensive pre-project phase, during which the customer and a group of qualified vendors collaboratively identify and describe the business problem and outline alternative solutions. On this basis, the customer selects the preferred solution and negotiates a contract with the vendor offering this solution. This is akin to the conventional contract model of systems development but emphasizes the substantial resources expended by the group of vendors to identify and define the benefits to be achieved by the system. The vendors are not paid for this work, and the vendor getting the contract is only paid if and when they deliver the benefits stated in the contract. In this way, performance-based procurement may make it possible to fund IT projects within the customer's operational budget because project costs are not to be paid until the operational savings are attained.

Objectives-Based Usability Engineering

Performance-based procurement can be seen as an extension with more radical means of the usability-engineering approaches that emphasize quantification and iterative measurement of usability goals [e.g. 11]. These approaches represent usability specialists' efforts to establish usability as an important concern within vendor organizations. A principal artefact in accomplishing this has been usability specifications giving the worst, planned, best, and present levels of user performance for a specified set of tasks. In specifying not only the set of tasks but also the performance measure used for evaluating each task and the values defining the different levels of performance (worst, planned, and best), usability specialists define a set of effects to be achieved by the system. Usability specifications provide for an iterative process alternating between design and evaluation until all effects have been achieved. This implies, however, that they are at the same time restricted to effects for which it is possible to devise performance measures that can be established fairly quickly, inexpensively, and precisely. Consequently, objectives-based usability engineering tends to point toward more restricted effects than the ones we aim to target with evidence-based IT development.

Idea and Goal of the Project

The idea of evidence-based IT development is generally applicable to all large-scale IT projects but will in this project be investigated in the context of Electronic Patient Record (EPR) systems. Evidence-based IT development aims at establishing strategic partnerships between vendor and customer in order to develop state-of-the-art EPR solutions with proven value and a measured effect on the clinical work the system supports. Measurable effects are defined in relation to clinical work practices within documentation and decision making. Examples of measurable effects could include:

- Doctors located in different hospital units can in less than five minutes confirm a decision for a treatment, X, on an acute patient.
- Total time needed for documenting a treatment, X, is reduced by 90%.
- General practitioners rate "satisfied" or "very satisfied" with the information they receive from hospitals when patients are discharged.
- Nurses can in no more than two minutes coordinate and schedule an operation, X, for a patient.

Effects may also be viewed at a national and political level or in relation to the hospital's overall strategic goals. Our primary focus is on effects on the clinical work with a subordinate interest in how these effects relate to strategic and political goals.

The project will investigate how and to which extent vendor and customer can change their focus from IT functionality to one of measurable effects and the development of EPR solutions for which there is evidence of the effects. Evidence-based development is rooted in the following preferences:

- Effects over products and processes.
- Measurement over expectations and estimates.
- Evidence-based contracts over functionality contracts.

Evidence-based development seems promising especially for complex and business critical projects that require establishment of strategic, long-term, mutually beneficial relationships characterized by trust, mutual learning, and cooperation between vendor and customer [10]. This is indeed the case for EPR solutions in Denmark. Evidence-based development suggests an overall organization of strategic public/private partnerships pursuing the same goal, sharing risks, and coordinat-

ing interrelated projects based on intended measurable outcomes. Because everyone needs the system to be successful there is an incentive for pursuing realistic approaches. Potential prospects for the customer and vendor, respectively, include:

- Customers can focus on conceptual proposals (not detailed technological specifications) defining the problem and on desired outcomes in terms of specified effects. Changes in work organization and work practices will become easier to implement as effects are documented and the clinical staff realizes the benefits they will obtain from the EPR solution. Return on investment from IT projects can be more accurately assured and projects may be easier to fund as (part of) payments are postponed until the effects have been attained.
- Vendors will obtain a much more open and flexible position to develop EPR solutions (as compared to contracts with detailed and frozen requirements specifications). A strategic partnership with close and systematic collaboration with the customer and domain experts in terms of the clinical staff will support the development of EPR solutions with proven effects that meet customer goals. A broader range of the vendor's expertise (than in delivering IT only) is appreciated and valued. This may, for example, include organizational implementation and change management. Payment may even be relative to the value of obtained effects and may potentially yield a much higher profit than from IT systems alone.

A precondition for this type of vendor-customer collaboration – and for meeting the above mentioned prospects – is the development of a contractual model based on specified and measurable effects of EPR usage. The goal of this project is to devise, test, and refine such a commercial contract model for strategic partnerships and evidence-based contracts. Due to the size and complexity of EPR projects, the impact of such a model is potentially very big for both vendors and customers (in our current project, CSC and RA).

Description of the Project

The project is focused on the development and implementation of EPR solutions supporting clinical processes and addresses the following general *research questions*:

- How can methods for measuring effects be developed?
- How can effects specific to the clinical work process be related to overall strategic and political goals?
- How can EPR projects be based on evidence-based contracts?
- What does evidence-based contracting entail with regard to organizational consequences, cooperative practices, needs for new tools and techniques, and so forth?

Participants

The project is constituted by a close collaboration between CSC, RA, and RUC:

- CSC constitutes the vendor organization developing, implementing, and testing EPR solutions in terms of IT infrastructure and applications as well as critical clinical processes. CSC will – free of charge – provide RA with access to the EPR system modules necessary for identifying and documenting effects during the project. CSC will be responsible for system development, installation, configuration, data migration, and technical support.
- RA will provide the experimental field for the project. RA has the role of the customer organization defining the needs and desired outcomes in terms of specific effects as well as testing and evaluating CSC's EPR solutions. RA is responsible for selecting and preparing clinical departments, staff, patients, and patient data for inclusion in the project. RA is responsible for preparing selected clinical processes according to desired SFI[1] descriptions and GEPJ[2] requirements. RA is also responsible for providing the clinical staff with introduction, training, and support appropriate for participating in the project.
- RUC is responsible for the overall project of developing the evidence-based contract model. RUC acts as the research organization facilitating the collaboration, developing and refining approaches to evidence-based IT development, and investigating their trial use. RUC will participate in defining and specifying desired clinical effects and in relating effects to strategic and political goals. RUC is responsible for developing methods measuring effects and for designing, managing, and facilitating experiments where effects are measured and evaluated.

CSC, RA, and RUC collaboratively share the responsibility for knowledge sharing, evaluating the project and its experiments, and the development and evaluation of the final project result in terms of the commercial evidence-based contract model.

RA's EPR Project

CSC and RA have during the past years developed and implemented an EPR module managing the prescription and use of drugs ('OPUS medicin'). The OPUS module is the first large-scale EPR application that has been fully implemented in Denmark.

The next phase in RA's long-term and ambitious EPR project is to develop a clinical process module supporting clinical documentation and decision making. Based on the experiences from implementing the OPUS module, RA has decided to adopt a three-stage strategy for the clinical process module:

[1] SFI ('SundhedsFagligt Indhold') is a national initiative defining the documentation needed for standard patient workflows.
[2] GEPJ ('Grundstruktur for EPJ') is a national requirements specification for clinical documentation in EPR systems.

1. In 2004-2006 most existing paper-based clinical documentation is converted to a read-only online platform based on the 'Grønne system[3]'. This platform will provide the clinical staff with an initial experience of using online documentation while maintaining most of the structure of the well-known paper-based medical record. Ideas, needs, and requests for changes in the information structure and the provided functionality will emerge and change through the clinical staff's practical use of the online documentation.
2. During 2005-2007 a number of experiments will be conducted in which clinical staff participates in using and evaluating prototypes that change the structure of the medical record, gradually aligning the structure to GEPJ as well as adding new and complex functionality.
3. During 2006-2009 a GEPJ compatible clinical process module is expected to be gradually implemented as documented evidence for effects intrinsic to the clinical process are produced in stage 2. The success of this gradual implementation is crucial to RA's EPR efforts.

Stages 1 through 3 reflect an overall process where the development of the clinical process module is closely tied to a gradual organizational implementation of new clinical work processes.

The Project Experiments

The project is designed to support RA's strategy, in particular stages 2 and 3. CSC will release a first version of a clinical process module in terms of a fully functional platform in fall 2005. This module fulfils the technical requirements for the experiments in stage 2 and it may also turn out to be the module implemented in stage 3. The platform is highly flexible and configurable. It is based on the SNOMED CT Concept-ID classification system and supports all requirements stated in GEPJ v. 2.2. The experiments in stage 2 are to be conducted as a process requiring a close collaboration between CSC, RA, and RUC, as well as substantial participation from clinical staff. All experiments with EPR solutions and the related iterative evaluations are to be managed through an overall evidence-based development approach. Effects specific to the clinical work process will continually be defined, refined, measured, and related to overall strategic and political goals. As a means of relating effects to strategic and political goals, the EPR-supported clinical processes will be developed as standardized patient trajectories in accordance with SFI and GEPJ.

The experiments in this project should not be confused with classic IT prototyping experiments focusing on evaluations of user interfaces and interaction based on prototypes with limited functionality and small data samples. The experiments of this project aim at measuring effects from clinical processes supported by fully functional EPR modules with complete patient records. Such experiments are sometimes referred to as proof-of-concept projects. An experiment could for example be conducted in a clinical department during a two-month period involving 50% of all patients. Such experiments require thorough planning involving development of new EPR supported patient trajectories, specification of desired effects of using the EPR solution, configuration and installation of the EPR module, simulated or real integration with other systems, migration of patient data, training of the clinical staff in using the system as well as conducting work according to revised patient trajectories. In order to make realistic measurements of the desired effects, the experiment must continue until the involved clinical staff is confident in conducting the new work practices.

Project Phases

The project consists of three phases:

Phase 1, *Analyzing*. This phase includes descriptive analyses of various contract concepts used by CSC. The aim is to develop a thorough insight into the complicated conditions and challenges within different traditional and alternative contractual approaches to EPR development and systems development in general. This phase also includes identification, specification, and analyses of potential measurable effects that RA will pursue with regard to the projected clinical process module. The result of this phase is a shared understanding among CSC, RA, and RUC and a platform for developing ideas for evidence-based IT development and contract models.

Phase 2, *Experimenting*. This phase supports stage 2 in RA's strategy for the clinical process module as described above. It involves conducting a number of experiments with the aim of identifying and evaluating elements in EPR solutions that produce effects as desired by the clinical staff. These experiments will form the core activity in a continual elaboration of our ideas and approaches to evidence-based development. They may be regarded as laboratory experiments where CSC and RA engage in a strategic development partnership in a controlled context with limited risks and room for investigating different ideas, hypotheses, and approaches.

Phase 3, *Final Proof-of-Concept*. Based on the experiences gained in phases 1 and 2 the project is planned to conclude by conducting and evaluating a complete commercial EPR delivery managed by means of evidence-based contracts. This could for example be CSC's clinical process module implemented for another customer (in Denmark or abroad). The aim of this phase is to conduct a comprehensive proof-of-concept evaluation of the project's final version of a coherent evidence-based commercial contract model.

While phases 1 and 2 may run in parallel phase 3 is dependent on the successful development of an evidence-based approach and contract model.

Discussion

The idea of evidence-based development is akin to the concept of evidence-based medicine in healthcare. The two contexts differ, however. In healthcare there is an established tradition of measurement, often conducted through controlled, comparative studies in which statistical analysis relates effects with causes. In systems development, effects are rarely meas-

[3] RA's current system handling patient administrative information.

ured. Further, it might not be of great importance to link causes and effects because the prime interest is simply to obtain the effects. Our prior research suggests that a number of effects can be stated rather simply and may not be difficult to measure [6].

Evidence-based development is not a panacea. While we believe the idea holds promise, there are also pitfalls, limitations, and outstanding issues that call for further investigation. These include:

- Effects must be adequately defined, controlled, obtained, and measured within a reasonable period of time. This is not always possible. Within the healthcare domain, aspects like care and nursing might be hard to quantify in measurable terms.
- Measurable effects are a result of multiple factors including a broad range of organizational factors. If vendors' payments are made dependent on effects of system use, then vendors must be granted influence on the pace, extent, and managerial enforcement of customer participation in the development process as well as on the organizational implementation of the system. Customers must be able and willing to engage in cooperation on such conditions.
- Small vendors may be excluded (or forced to engage in strategic partnerships with other vendors) because they lack the resources to enter into projects in which they are not (fully) paid until after the system has been delivered and the stated effects attained.
- If measurable effects are fixed prematurely, the result may be that projects are confined to known solutions for known needs. Openness toward problems and needs that emerge during the project is a requirement.
- Many systems are developed in an incremental manner with each increment organized as an individual project. It may be difficult to devise relevant effects for individual projects, especially early projects that primarily provide the infrastructural foundation for subsequent, more application oriented projects.

Conclusion

Many, if not most, IT projects do not produce the effects customers are aiming to achieve. From the customer's point of view such projects are full or partial failures, but the vendors may have successfully fulfilled their contract by delivering the specified system functionality. Evidence-based IT development is a research-in-progress project based on the idea that contracts should specify the effects to be achieved by the developed system when used by intended users. By linking contract fulfillment to evidence of the actual effects of system use, vendor and customer will share risks as well as an interest in producing systems that lead to measurable improvements in users' ways of working. Our initial analyses indicate that measurable effects are not necessarily difficult to specify. The question is how to measure effects, how to link effects to overall strategic and political goals, and how to manage the vendor-customer partnership based on measurable effects. The project aims at developing and evaluating a new commercial contract model for such strategic partnerships based on agreed-upon measurable effects of using the system. Ultimately such a contract model may lead to state-of-the-art systems financed by the cost savings that have been defined as a primary effect of introducing the system.

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