

2-25-2014

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Recommended Citation

Strong, Diane M.; Volkoff, Olga; Johnson, Sharon A.; Pelletier, Lori R.; Tulu, Bengisu; Bar-On, Isa; Trudel, John; and Garber, Lawrence (2014) "A Theory of Organization-EHR Affordance Actualization," *Journal of the Association for Information Systems*, 15(2), .

DOI: 10.17705/1jais.00353

Available at: <https://aisel.aisnet.org/jais/vol15/iss2/2>

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Journal of the Association for Information Systems

JAIS 

Research Article

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Abstract

While organizations implement information technology (IT) to effect change, current theories of IT-associated organizational change pay insufficient attention to the change goals, the role of IT in organizational change, and the multilevel nature of change processes. We take a fresh look at IT-associated organizational change using grounded theory methods. Our longitudinal study of an electronic health record (EHR) system implementation in a multi-site medical group found user behaviors that did not fit well with existing theories. Instead, we found that they fit better with the concept of affordances from ecological psychology. In developing our affordance-based theory of IT-associated organizational change from our field data, we discovered three gaps in the affordance literature; namely, the lack of theory for (1) the process of actualizing an affordance's potential, (2) affordances in an organizational context, and (3) bundles of interrelated affordances. This paper extends the theory of affordances to handle these three gaps and, in doing so, develops a mid-range theory for EHR-associated organizational change in a healthcare organization. While the resulting theory is specific to EHR implementations, it offers a template for other mid-range affordance-actualization theories and a more general affordance-actualization lens. Our affordance-actualization lens considers the materiality of the IT artifact, the non-deterministic process by which IT leads to organizational effects, the multilevel nature of IT-associated change processes, and the intentionality of managers and users as agents of change, and thus addresses important criteria for theories of IT effects in organizations. The paper also provides practical guidance for implementing EHR systems and other organizational systems.

Keywords: *Affordance, Actualization, Grounded theory, Healthcare, Electronic Health Records, EHR, IT-associated Organizational Change.*

* Michael Barrett was the accepting senior editor. This article was submitted on 31st March 2010 and went through three revisions.

Volume 15 Issue 2, pp. 53-85, February 2014

1. Introduction

Information technology (IT) has been identified as a key element for effecting needed changes in healthcare organizations (Bates, Ebell, Gotlieb, Zapp, & Mullins, 2003; Berwick 2002; President's Council on Advisors on Science and Technology, 2010; Reid, Compton, Grossman, & Fanjiang, 2005). Until the IT-associated change process is better understood, however, achieving the desired outcomes (e.g., better quality care, higher efficiency/productivity, reduced costs, and greater patient and provider satisfaction) from such changes is uncertain. Not surprisingly, many major IT investments made by governments and healthcare organizations around the world with such goals in mind (Abraham et al., 2010; Wilson & Tulu, 2010) have often not or only partially achieved those goals (Lau, Kuziemy, Price, & Gardner, 2010; Linder, Ma, Bates, Middleton, & Stafford, 2007). IT researchers need to develop theories that explain IT-associated organizational change processes in a way that provides actionable recommendations. IT-associated change theories that acknowledge the distinct roles played by IT and the actors involved in the changes it effects enable us to make such recommendations. As such, we confronted this challenge by developing a mid-range theory of the organizational change process associated with implementing electronic health records (EHRs) in healthcare organizations. We then used this theory to identify points of leverage for managers in order to improve the record of reaching desired goals from EHR investments.

To develop our theory, we embarked on a longitudinal study of an EHR implementation in a multi-site group medical practice. Using grounded theory methodology, we interviewed clinical and non-clinical employees before, during, and after implementation. We asked them to describe their jobs and what happened to their work practices once the EHR was implemented. They framed their answers in terms of what they were trying to accomplish and how the EHR either enabled or constrained them. Because they tended not to speak in terms of EHR features, standard constructivist theories framing the process as technology adoption, adaptation, or appropriation did not capture the process we observed. Instead, what they said fit best with the concept of "affordances" from ecological psychology. As described in recent IS literature, affordances are the possibilities for goal-directed action provided by an object in relation to a goal-oriented actor (Markus & Silver, 2008; Zammuto, Griffith, Majchrzak, Dougherty, & Faraj, 2007). Our interviewees were talking about the possibilities afforded to them for accomplishing their goals. Thus, our mid-range theory of EHR-associated organizational change is affordance based.

In this paper, we contribute to theory about affordances and IT-associated organizational change. As we developed theory from our data, we discovered key gaps in affordance theory. Thus, our contributions extend the affordances concept to accommodate IT artifacts in organizations. First, our data clearly distinguish between affordances as potentials for action (in which form they have a degree of durability) and actualization as actions taken by individuals to realize those potentials. This contrasts with Bloomfield, Latham, and Vurdubakis (2010), who argue that affordances are inextricably bound with specific, historically situated actions. The actualization process explicated in our theory is an alternative to other theories of IT-associated change (e.g., the concept of appropriation) that focus on technology but ignore goals. Second, we extend the definition of affordances to address an organizational context, and explain how the affordance concept applies across organizational levels, from individuals to groups and the organization as a whole. Third, we identified multiple, interdependent affordances arising during the EHR implementation, and developed an approach (namely, affordance dependency diagrams) to clarify those relationships.

We based the development of our mid-range theory of EHR-associated organizational change on our extensions to affordance theory. Because affordances are technology and user specific, our contribution is a mid-range theory applying to a specific technology (an EHR) and its users (healthcare professionals), rather than a grand theory. For practitioners and researchers, such a theory may be more useful. It helps practitioners develop specific recommendations for identifying and addressing EHR-related challenges, and, for researchers, it addresses two theoretical voids in the literature that have limited our ability to study how technology and social actors interact (Leonardi & Barley, 2010). First, we can be specific about the technical artifact rather than minimizing its

influence as in recent research. Second, we can focus on both micro-level (individual user) processes and the macro-level institutions in which they are embedded (e.g., managers, organizational goals, and the healthcare context), rather than excluding macro-level institutions in social constructivist lenses as is common in the literature.

Beyond its contribution to research and practice and its specific examples of affordances and their actualization, our specific mid-range theory also provides a template for other mid-range theories of IT-associated organizational change. More generally, this template offers guidance to researchers in conducting empirical studies using an affordance-actualization lens. We believe this lens offers valuable insights about IT-associated organizational change processes and provides the foundation for research studies that are better able to develop theories to explain such change processes.

2. Background Literature

Following grounded theory methods, we did not go into the field with specific theories in mind beyond our intent to study EHR-associated change in a healthcare organization. The mid-range theory developed from our data (and presented in Section 5) includes affordances and collective constructs—concepts with some history in the literature. While this literature was folded into the emerging theory only after analysis of the data, we briefly review it here together with the IT-associated organizational change literature that initially motivated our study for the reader's convenience.

2.1. Affordances

Gibson (1986), an ecological psychologist, developed the concept of affordances in his study of animals' perception of their surroundings. The concept reflected his belief that animals do not perceive the many minute details of an object and then mentally compute the collective utility of those details, but directly and holistically perceive what the object will enable them to do. According to Gibson's original definition, an affordance is what is offered, provided, or furnished to someone or something by an object (Gibson, 1986). Since Gibson's groundbreaking work, other ecological psychologists have further developed and refined the concept of affordances (c.f., Chemero, 2003; Hutchby, 2001; Michaels, 2000; Stoffregen, 2000; Turvey, 1992).

We explicitly incorporate several important conclusions from ecological psychology into our affordance-based theory of IT-associated organizational change. First, affordances are relational (Hutchby, 2001; Stoffregen, 2003); they are not properties of the object nor the animal, but rather are "relations between the abilities of [animals] and features of the environment" (Chemero, 2003). Second, affordances are "possibilities for action" (Stoffregen, 2003). It is not necessary for a user to have realized or actualized the affordance for it to exist, but some user who could actualize it must exist (Chemero, 2003). Third, the possibilities for action are not infinite—certain possibilities are made available, but others are not. In that sense, affordances are not only enabling, but also constraining (Hutchby, 2001). Finally, the potential behaviors of an actor are goal directed. Thus, in our mid-range theory, we specify the technology features and actor characteristics giving rise to a particular affordance, the type of actor that might be involved, how affordances are both enabling and constraining, and the associated goals.

Several recent papers in the IT literature embrace the affordance concept. Markus and Silver (2008) use the term "functional affordances" to refer to IT-related affordances and define them as "the possibilities for goal-oriented action afforded to specified user groups by technical objects" (p. 622). Zammuto et al. (2007) stress that affordances emerge from the intersection of IT and organizational systems. Both papers are theoretical expositions on the affordance concept, and are not grounded in data from any particular IT or organization. Zammuto et al. (2007) do, however, identify five possible affordances, expressed as capabilities organizational actors will have when using some system. While both papers provide some adaptations of the affordances concept to IT research, neither provides the theoretical extensions needed to develop an affordance-based theory of IT-associated organizational change. Leonardi (2011) folds the concept of affordances into his "imbrications" view of human and material agency associated with technology use. He does provide an empirical example

and identifies several affordances, such as standardizing and coordinating, but he does not reflect on the extensions necessary to the traditional definition of affordances because that is not his focus.

2.2. The Characteristics of Collective Constructs

Because affordances in an organizational context cross organizational levels, the literature on collective constructs provides insights that are useful for presenting our mid-range theory. Collective constructs emerge from the aggregation of many individual actions (Kozlowski & Klein, 2000); for example, collective system usage emerges from the actions of individual users (Burton-Jones & Gallivan, 2007). In addition, the collective constructs literature distinguishes between the “structure” of constructs (the actions and interactions among individuals that generate the collective phenomenon), which may differ across individuals or across levels, and the “functions” of constructs (the effects or outputs of the phenomenon), which are the same across levels (Burton-Jones & Gallivan, 2007; Morgeson & Hofmann, 1999). For example, the “structure” of individual memory (which arises from various neurological processes and which may be visual, aural, or spatial) differs from the “structure” of organizational memory (which arises from the actions and interactions of individuals and which resides in processes, systems, etc). In contrast to these differing structures, the “function” of memory at all levels can be defined as “the store of things learned and retained” (Memory, Merriam-Webster.com) or “the perpetuated knowledge or recollection of something” (Memory, OED Online).

2.3. The Role of Actors and Structures in IT-Associated Organizational Change

Research on IT-associated organizational change has struggled with how to characterize the respective roles of IT and organizational actors in the change process. Various perspectives have emerged that try to balance the roles of actors and the structures (technical or otherwise) with which they interact, but most approaches end up focusing too much on one side or the other (Bloomfield et al., 2010). Most recent work embraces a social constructivist perspective, which tends to privilege the social and often loses sight of the technology (Leonardi & Barley, 2010). Researchers have studied various aspects of technology, including its adoption (viewed as a process of perception), its use (viewed as a process of technology interpretation, appropriation, or enactment) and its adaptation (viewed as a process of alignment) (Leonardi & Barley, 2010). In these approaches, technology is often generalized, which suggests that technology specifics are not relevant. Many such approaches also downplay the existence of goals. Instead, they focus on attitudes, actions, or practices of the moment. While social constructivists broadly agree that organizational (and technical) change emerges as social actors interact with the technology, there is less agreement on how best to characterize those interactions.

Early work employed Giddens' (1984) structuration theory (ST), which privileges human action over structures. Giddens does not explicitly address technology—organizational structures exist only at the moment of instantiation in human action, and more durable resources have no effect except when employed in those actions. Adaptive structuration theory (AST) (DeSanctis & Poole, 1994) modifies ST to explicitly incorporate IT. AST models the relationship between the social structures inherent in IT and the interaction processes of IT use. Specifically, IT offers features (rules and resources or capabilities) and embodies a spirit (a general intent with regard to values and goals). During social interaction where IT is applied, new structures emerge. The form of those new structures depends on the process of “appropriation”—the immediate, visible actions of applying an IT-based rule or resource in a specific context at a specific time.

While AST explicitly incorporates technology, it is also problematic. As Orlikowski (2000) notes, technology is neither static (it evolves after implementation) nor are its features unambiguously and objectively defined (individuals interpret them during use). She recommends moving from the concept of “appropriation of embedded structure” to a practice-based view of “enactment of emergent structure”. Doing so, however, returns to Giddens' (1984) notion of humans constituting structures during technology use, thus conflating IT as “artifact” and IT “in use”.

Actor network theory (ANT) gives technology its due by assuming a general symmetry between the technical and the social (Latour, 1991). Actors and technology (actants) exist in a network of aligned

interests, and are equally engaged in trying to enroll allies into the network by translating their interests so they will all be aligned. The literature has debated the extent to which symmetry between human actors and technology can be assumed (specifically because actors have intentionality, while objects do not) and has proposed various re-interpretations of ANT (McMaster & Wastell, 2005; Rose, Jones, & Truex, 2005).

Recently, the literature has turned to sociomateriality (Orlikowski, 2007; Orlikowski & Scott, 2008), building on the “mangle of practice” concept (Pickering, 1995); that is, on the constitutive entanglement of the social and the material. Orlikowski (2007, p. 1437) states that “there is no social that is not also material, and no material that is not also social”. Objects and people exist only in relation to each other, have no inherent properties, and have only the form, attributes, and capabilities acquired through mutual interpenetration. As Law (2004, p. 83) states: “[Materials] do not exist in and of themselves”. Sociomateriality explicitly includes IT, but also asserts that IT has no properties to study separately from its entanglement with developers/users.

Our challenge is to develop theory about change that acknowledges the impact of individual practices without losing the IT artifact itself and that simultaneously accommodates individual level actions and the effects of organizational structures on the change process. We argue that affordance theory, extended to address an organizational context, addresses these issues.

3. Method

3.1. Grounded Theory

We applied grounded theory (GT) methods, which are explicitly designed for generating both grand and mid-range theories based on interviews or observations of actions (Glaser, 1978; Glaser & Strauss, 1967; Locke, 2001; Urquhart, 2007). Using GT methods allowed us to focus on both the daily realities of organizations and the interpretations of those realities by participants (Suddaby, 2006) to uncover underlying social processes. Our use of GT methods in the course of a longitudinal case study of an EHR implementation enabled us to generate mid-range theory about how the combination of technology and organizational structures generates organizational change.

3.2. Field Site and Data Collection

Our field site was a multi-site group medical practice located in the northeastern US, with about 250 physicians and 1,500 other employees. It served 200,000 patients and had over one million patient visits per year. Each of its 25 clinic locations was responsible for its own performance and operated semi-independently, but a strong central administration provided policy guidelines and promoted communication and coordination across clinics. This group practice implemented a well-respected EHR package across its clinic sites in several phases. The phase we observed implemented computers in exam rooms, where providers enter data into a patient’s electronic health record and generate orders for prescriptions and lab tests.

We collected data in three interview rounds. First, we conducted baseline interviews shortly before the EHR went live in the exam room. These interviews focused on what work (tasks) individuals performed in a typical day and their initial impressions of how the EHR would affect their work. Second, we conducted interviews about six weeks after the EHR was in the exam rooms. We asked interviewees about the EHR features they used, what they liked most and least about the EHR, and how the EHR changed the way they did their work. At this time, users were highly aware of how the EHR was changing how they worked. Finally, we conducted interviews one year after go-live, a point when users were likely to be proficient with the EHR. Two researchers were present at each interview. We recorded and transcribed all interviews.

For each round, we interviewed primary care physicians and the associated staff (a practice manager, nurse, medical assistant, and non-clinical support person); that is, five interviews for each participating physician. Physicians were selected jointly by the clinic and the researchers to cover

large and small locations, established and newer physician practices, three primary care medical areas (internal medicine, family medicine, and pediatrics), and EHR supporters and doubters. For rounds one (R1) and two (R2), six physicians participated, each from a different practice site. For round three (R3), we expanded our data collection to include four additional physicians and their staff from four additional practice sites. We added these sites (at which individuals had begun to use the EHR in unexpected ways) in the course of “theoretical sampling” (Glaser & Strauss, 1967) to ensure that we explored the full spectrum of possibilities with respect to the emerging core categories (e.g., process changes). Interviewees received a small stipend for round three. With few exceptions, we interviewed the same individuals each round. Our findings are primarily from these 110 interviews (30 from R1, 30 from R2, and 50 from R3). We also interviewed the regional managers (four in R1, three in R3), attended training classes, observed pre-go-live dress rehearsals, and met several times with the CIO and IT members to discuss the implementation. We also met bi-monthly with two physicians who served as the project coordinators and provided information about the group practice.

3.3. Data Analysis and Theory Building

We conducted data analysis in accordance with grounded theory methods (Strauss & Corbin, 1998). Specifically, we coded interview transcripts as we collected data and used NVivo to support our coding and analysis. The research team met weekly to review emerging codes and ensure consistent coding. Two coders coded the early interviews. After establishing consistency, one researcher who was present at the interview coded each interview to ensure good understanding of what the interviewee was conveying. When the data revealed interesting themes, we wrote memos about them.

During open coding, we used codes the data suggested to identify broad themes (e.g., computer effects, information availability, standardization, and workload). When few new open codes emerged (i.e., when we reached saturation), we began axial coding to reveal dimensions of concepts and relationships among concepts for the major interesting themes that had emerged. For example, the key dimensions of the standardization theme included what was being standardized (data, tasks), who made standardization decisions (physicians, management), and what affected the extent of standardization achieved (system features enabling standardization, organizational goals). While we generally followed Strauss and Corbin’s (1998) coding recommendations, we took heed of Glaser’s concerns about the Straussian approach (Locke, 2001; Urquhart, 2007) and treated axial coding as a method through which to discover relationships in the data, rather than as a restrictive set of rules.

As axial coding progressed in each data collection round, we initiated selective coding to identify theoretical patterns by constantly comparing similarly coded passages across interviews. For example, we compared how interviewees talked about the EHR in terms of what they could now do (enablers or new opportunities) and what became harder to do (constraints). We also examined the literature to assess how the emerging concepts related to existing literature.

We did not go into the field with pre-existing theoretical concepts, but rather with a broad interest in understanding IT-associated organizational change due to EHRs. As we compared coded passages during selective coding, we noticed that different sites and providers used EHR features in different ways, and that use of particular features did not necessarily provide similar outcomes. We also began comparing our emerging concepts about individual journeys and goal-directed change to the IT-associated change literature. In particular, the concept of affordances seemed to fit how our interviewees talked about the EHR in terms of what it enabled or restricted them from doing, and the opportunities they had for working differently.

As we developed our theory, we began to investigate and label as affordances what our interviewees identified as the opportunities, enablers, and constraints provided through EHR use. For example, they talked about information availability and standardization opportunities. In comparing these empirical affordances to the affordance literature, we found commonalities, differences, and ways in which the emerging theory from our data extended the literature. Because the theory emerging from our data differed significantly from the literature, we continued with theory building from our data, which led to a revised affordance definition and three extensions to the concept of affordances. These

results form a mid-range theory about organization-EHR affordances, which is reported in Section 5 and summarized in Table 1.

4. EHR Implementation and Use Case

4.1. Organizational Environment

The case study organization had a strong centralized administrative and medical structure, which drove organizational goals and policies. The employees we interviewed described the organization as unique because it was a “one-stop” shop, where patients can see primary care and specialty physicians, have tests performed, and fill prescriptions. Physicians described the importance of the organization as being historically physician run and led:

Well, I think it is one of the best multi-disciplinary medical groups around... [W]e communicate well so I think we are probably part of the cutting edge of medical groups around the country... I think it is a good place to practice. (Physician, Site F, R1)¹

Nurses, medical assistants (MAs), and staff appreciated the good working relationships in their sites, which they felt also distinguished them from other healthcare clinics. For example:

We have a real tight closeness with all the workers. You can be on your dying bed and you don't want to call in sick because you know that it's going to affect the person that you work beside because the load is going to be doubled. So we have a real tight knit family. (MA, Site J, R1)

At each clinic location, providers and staff were measured on efficiency, quality, and patient satisfaction. The organization actively balanced and realigned these metrics as it and the competition changed. For example, at the time of our study, the organization's emphasis on efficiency and clinical quality was shifting to also emphasize patient satisfaction through a more personal approach:

We pride ourselves on efficiency. We are really efficient in what we do, but we don't have a lot of personal interactions with you. What I have tried to do a lot since I have been here is a lot of coaching and mentoring about how we can be personal. (Regional manager, R1)

At all sites, physicians highlighted time pressure as a critical issue; nurses and practice managers were also stressed by the tradeoff between workload and satisfying patients. Disruptions (e.g., missing charts and late patients) were obstacles affecting productivity.

Changes in clinics were often driven by centralized policies. For example, just prior to the second phase rollout (electronic messaging functionality), the entire organization moved away from a primary nurse for each physician. For larger clinics in particular, this involved setting up call centers staffed by nurses who triaged patients, and creating nursing and MA groups that worked with several physicians rather than in one-to-one relationships. While central policies guided decision-making, each site maintained autonomy to adjust policies to fit their practice, which resulted in significant variation among sites in terms of staffing and work practices.

[The two clinics,] they're two completely different models because of their size... Who does it and how it gets done, it can be completely different based on your mix, the competency of the staff, and the level of provider expectations of the staff. So there is a big difference. (Practice manager, Site A, R3)

¹ Each quote from our data is identified by the (1) role of the person speaking, labeled as regional manager, practice manager, physician, nurse, medical assistant (MA), or support staff (non-clinical support staff, usually patient check-in or check-out staff who also performed secretarial functions), (2) site at which they worked unless they were part of IT or the management team, labeled as Site A through Site J, and (3) the interview round labeled as R1, R2, or R3.

4.2. Decision to Implement the EHR, Phase 1, and Phase 2 Rollouts

The case organization chose its EHR system using approximately 100 parameters it defined to evaluate “goodness of fit”, the likelihood the vendor would stay in business, and pricing. Overall, its goals in implementing an EHR were, in order of priority, to improve clinical quality, reduce costs, improve patient satisfaction, and improve staff and physician productivity (from a meeting that included the CIO). The system was purchased in January 2005, and the practice management module went live in April 2006. EHR functionality was implemented in three phases starting in spring 2006. Phase 1 provided view-only access, followed quickly by Phase 2, the telephone messaging functionality. Phase 3 rollout, with physicians using the EHR in the exam room, began in March 2007. Phases 2 and 3 were each implemented site-by-site over six to nine months.

We conducted our first interviews approximately six months after Phase 2 was implemented. Overall, the implementation and management of Phase 2 was viewed positively.

It is a really good product. [Names deleted] are doing a phenomenal job... They're so on top of everything ... to make sure that we really learn the most of this system and really make it the best for everyone... Nothing's perfect. You still hear some people griping in meetings, and ... they're all afraid of the next [phase]. But when I hear there are other companies that a year or two into it are still having major problems, one of the major differences was that we have a very structured support team and everything is kind of baby steps. (Practice manager, Site J, R1)

While practices struggled initially with the messaging module (Phase 2), at the time of the interviews, interviewees across different roles generally liked the system:

The first two phases were tough in the beginning... [P]hase one affected mostly the secretaries. Phase 2 was a lot tougher. It was the nurses that it affected the most. I really had a lot of [distress] with the nurses. I mean, people crying every day. I had people that didn't come in for a couple of days because they were so stressed out. It probably took a good three to four weeks before everyone calmed down. When they did it's worked well. (Practice manager, Site A, R1)

It's on the plus side. It has made very explicit what needs to be done, but probably the biggest single change is that when the messages come it's very clear on the screen that you have prescriptions to fill. You have patient calls to answer. You know exactly what you have to do and whether it has been accomplished. (Physician, Site A, R1)

4.3. Expectations and Preparation for Phase 3

Going into Phase 3, the expectations of the physicians and staff were mostly favorable, based in part on their experience in Phase 2. Phase 3 was generally expected to affect physicians the most, but they saw considerable promise in the system:

[In] theory I could see a patient this morning, send him over to ENT for a 3 o'clock visit and they'd have all the information. There's no way to do that on paper right now. (Physician, Site G, R1)

It's going to decrease our malpractice liability because if you accomplish the goals and you have these reminder registries, ticklers, so that you told that patient to get a mammogram. They didn't show up for it. We know about it... And then, also the pharmacy interactions, medication duplications, medication errors, things like that, it's going to be a very positive thing for the organization. (Physician, Site A, R1)

Other care providers also viewed the system as creating new opportunities, particularly in terms of process changes and interactions:

The other big change is going to be process improvements to make the doctors' life easier and better and to continue with efficiencies with the rest of the staff. The staff that is now doing chart prep aren't going to need to do chart prep any more...so what we need to find are things that they can be doing to offload the doctors and many of those things will be process things. (Practice manager, Site C, R1)

We're all going to work together because we'll be routing a lot of things to each other. So I'm pretty sure the doctor's going to be doing more, and the nurses, but I think we'll be working together because if I have a question to the doctor regarding that script and I'll route that over to the doctor, and then the doctor will either send it back to me or to the nurse. (MA, Site F, R1)

Physicians did have concerns about patient interaction and data entry. Not surprisingly, their concerns were based in part on their own familiarity with a computer.

What I fear is that it's going to tie me up more by looking at that screen and not necessarily doing things that somebody else would do and do better than I do. (Physician, Site C, R1)

The downside is going to be data entry. Unless you are very fast with typing, or unless there is some very creative drop downs, then there's going to be a problem. (Physician, Site A, R1)

A week prior to Phase 3 go-live at each site, physicians, nurses, MAs, and staff were sent to training classes, that were customized by job role. The night before go-live at a site, a dress rehearsal was held to demonstrate coordination between roles as patients moved from being roomed by the MA, seen by a provider, and checking out. Trainers were on-site for 1-2 weeks after go-live, when physicians saw half as many patients as normal.

4.4. Post Go-Live Experience

Our second set of interviews (about six weeks after Phase 3 go-live) found common benefits and concerns across roles and sites, but also significant differences in users' experiences.

4.4.1. Common Benefits and Concerns

Across sites and roles, the most significant benefit was the availability of information, and the opportunities that having the information enabled. Better-quality information in some cases also reduced disruptions, particularly in communications between individuals.

I can do things on a daily basis that I could only do once a month before, which makes my job easier. Those reports that I had to do at the end of the month, I can really keep an eye on them all the time now because everything is right online. (Practice manager, Site B, R2)

Not a question anymore about what the doctor wants because [s/he] has to put it in the system. (Support staff, Site C, R2)

Interviewees also described several common struggles with using the system. From a physician perspective, loss of productivity and an increase in documentation tasks were critical.

I don't see that the system will enhance productivity for a year. The only way I could stay productive is to spend more time here. So that's what I'll have to do for a while. (Physician, Site G, R2)

I feel that we're spending an awful lot of time looking at that computer, setting up dates of return and labs and things, and I'm not doing the patient care. (Physician, Site C, R2)

Contributing to this issue, aspects of the system were still unfamiliar or difficult to use, which affected both physicians and nurses:

Just the non-user friendly... I just wish it could be a little simpler so we could understand it and do it without having to refer to a paper four or five times, for each injection we give. (Nurse, Site A, R2)

Absolutely the worst thing about it is the order entry. The order entry is not intuitive. Something as simple as an ANA anti-nuclear antibody is not in the dictionary... You have to sit down and think, what might the programmer have thought about? How might they have labeled this? (Physician, Site A, R2)

While the organization spent considerable time and effort to ensure at least two years of history was automatically included in each patient record (so the electronic record would not begin “blank”), the history required some effort to correct:

The hope was that we could review charts and put data in [the EHR] when we saw patients. That's not possible with a busy schedule... I'm trying to clean up medication lists, first time around. The second time around I'm going to try and do problem lists and past medical history. But even with that goal I'm not going to be able to keep up. (Physician, Site G, R2)

Physicians also found the system easier to use for patients with single, well-defined problems, but struggled to use it when patients presented more complex issues.

Most of my patients are old and multi-problem. So, [templates] don't work very well... If there's a weakness in the system, that's it. It's very well adapted to the relatively healthy 45 year old with one or two issues. It is not well adapted to the elderly patients with multiple issues. (Physician, Site A, R2)

4.4.2. Individual Differences

The level of use and issues encountered varied significantly across individuals. For example, while some physicians at least partially typed their notes, others continued to dictate.

I have always loathed dictating. I got to get rid of that? I was very happy. (Physician, Site A, R2)

I've cut my dictations in half so I'm not going back and reviewing and signing dictations, so that helps. (Physician, Site G, R2)

I think most physicians including myself still do an awful lot of dictation because ... I haven't established a flow as of yet. So it's still uncomfortable. (Physician, Site C, R2)

The various reasons given for individual differences included individual goals (e.g., a desire to no longer dictate), continuing discomfort with using the system, and typing experience.

Significant variation existed in the extent to which physicians and nurses used templates and shortcut phrases, which were EHR features. IT staff developed templates for physicians, providers, and staff. Physicians also had permission to develop their own templates. The templates developed before go-live primarily provided shortcuts for physicians to enter data, place orders, or produce visit notes (i.e., they were efficiency tools). Nurses had templates and shortcut phrases to support phone triage, and had the option to use them or not and to request modifications. Reasons for not using these productivity tools varied, including difficulties with standardized templates that did not fit all patients, a loss of professionalism, and time.

Everybody is an individual. I have 10 providers in internal medicine. They think differently from one another. To say that you can go in and you can do a [shortcut

phrase] *this and* a [shortcut phrase] *that, they feel like the documentation they're doing...is very canned... Some of them feel like that is not how you practice medicine.* (Practice manager, Site A, R2)

When am I going to have time to set up filters and do all that kind of stuff? I don't have time to set all that stuff up because there I am supposed to be seeing patients. (Physician, Site B, R2)

Interviewees also discussed experience and practice style to explain individual differences.

I have one doc, two, that are relatively new. Their transition and acceptance is much higher because they're not unlearning old systems or relearning old processes and ways of doing things that they've done for 20 years plus. So they took to the new system much quicker. (Practice manager, Site J, R2)

People that are very, very organized and somewhat anal retentive, this has really thrown a wrench in their gears, because they had a whole system of how they did things. They're not adjusting as well. People that have been disorganized in the past, it somewhat organized them. (Practice manager, Site A, R2)

4.5. System Use After One Year

Our third set of interviews occurred after the EHR had been in use at a site for at least one year. There was a sense that the organization would no longer operate "the old way", and there had been positive impact on both quality of care and patient satisfaction.

It's unquestionably improved quality of care. I would be very unambiguous about that. Because the information about the patient and the process of care for the patient is available, legible, retrievable, sharable. ...Being able to see what was done, what tests were done, what results were there, what drugs were prescribed, were they picked up, laboratory results and things like that [improved care]. (Physician, Site A, R3)

Patient acceptance of it is great. They love being able to look at their information right there in the room. It's like a third person in the room. They like being able to see all their data. (Physician, Site F, R3)

In addition, nurses, MAs, and secretaries expressed great satisfaction in the system:

It's wonderful because everything I need is right there. I don't have to leave [the] exam room. I don't have to go call for charts. I can find what I'm looking for from appointments to when their last EKG was six years ago. So it is such a huge, huge difference. (Nurse, Site C, R3)

Now with all the letters and everything done through the computer, it's a lot easier that way. I like everything about it. (MA, Site J, R3)

4.5.1. Ongoing Implementation Issues

Many concerns initially raised about the system had been resolved one year after implementation. For example, while some medical records still needed updating, it was not the constant effort encountered just after implementation. Similarly, while physicians and staff noted they needed occasional help navigating the system, most expressed comfort with its organization in supporting their work, but some exceptions existed.

Sometimes I get stuck, and I'm so frustrated, I want to order something and it won't let me order, or am I not putting the right diagnosis...so I'm five minutes like going back and forth... (Physician, Site J, R3)

We're trained to think with certain language and terminology, and sometimes you're forced out of that, and it takes 30 to 45 seconds to realize I better not use my medical terms, I should go back to plain everyday English, to find what I'm looking for to enter a term or a problem. So that's a little frustrating for us, and doesn't sound like a lot but it is. (Physician, Site D, R3)

One issue that arose was developing workflows around how best to communicate between care providers. After EHR implementation, care providers communicated frequently through messaging, rather than in person. While this was often a benefit (e.g., because nurses were not constantly interrupted trying to track down physicians), it sometimes required additional work or raised concerns about the timeliness of responses.

I don't think staff realizes I'm not constantly sitting on my computer and reading my messages. If I'm doing a physical for half an hour, and then I come out and I see that the patient is in [the] other room, I'm just walking in there to see the patient. So it could be 45 minutes, and this message could say, patient's going to be there for the next 15 minutes, or if she doesn't get a call she's going to ER. Before my nurse would walk over to me... Now there's a little red, little message in my inbox somewhere... So how often am I supposed to go back to my office and look at my messages? (Physician, Site J, R3)

Practice managers worked with staff to resolve such issues, in part by recognizing and adapting to physician flow. For example, some physicians might have specific times when they answered messages while others checked messages between each patient. They also emphasized that face-to-face communication had not been replaced.

It's definitely made communication a lot better between staff. I don't want to take away the one-on-one communication either. And I do emphasize that with the staff, you know, just because we are electronic doesn't mean you can't talk to somebody. When I first started doing training classes and going out live into the sites, I think people were so afraid to talk to each other. [LAUGHTER] It was just so comical because it would be, I've got to put that in the computer. If you have a question you can still verbally walk up to a provider and ask them. It was just kind of a funny balance in the beginning. But I think everybody definitely does well with it now. (Practice manager, Site H, R3)

The most critical issue remained managing physician workload effects, which received significant organizational attention. Workload increased because typing was typically slower than dictating notes and because computers in the exam room generated additional physician tasks. Recognizing that physicians could not, and would not, continue to work an extra hour or more each day on top of their already long days, management convened a physician workload task force. Individually, physicians also developed various ways of adjusting to the EHR.

The task force examined whether some physician tasks could be performed (legally and to the same level of quality) by someone else. Features in the EHR could often support shifting tasks to nurses (for telephone encounters) or to MAs (for office visits) because information visibility made it possible for the physician to ensure proper care had been provided:

Unfortunately, the doctors feel like they're now doing the ordering that used to be done by [support staff]. But what we've tried to do is put processes in place where we're taking other clerical things off their plate, like opening and sorting their mail, taking care of prescriptions, [and so on]. (Practice manager, Site J, R3)

One nurse described an innovation in her practice to ease physician workload.

Each doctor has their own way of treating patients. So usually what I'll do is whatever the doctor routinely orders for phone treatment I have my [shortcut] for it... I taught a few other nurses about it. I said when you get the chance, you do these because I'm

telling you, they're a life saver when you're doing patient education particular to one physician's desires... We [have templates] already for general easy things like conjunctivitis and respiratory, upper respiratory. So this way everything is set into the computer so the doctor can just sign it off. (Nurse, Site D, R3)

To ease data entry, management tried assigning an MA as a scribe to physicians having typing difficulties. While it was ultimately decided that scribes were not a good general solution, scribes did work well for a few physicians, who continued to use them when interacting with the EHR. Management also encouraged the use of templates and shortcut phrases tailored to individual physicians to reduce the typing required. As a result, tools were gradually developed to support the more common issues physicians encountered, particularly when physicians developed templates that they shared with others.

I see a lot of chronic disease, so I have actually learned how to bend the system to that type of patient. So for example, if you come to see me and it's just a simple high blood pressure... I now have my notes that I have formatted for that visit, so there's a few questions I have to answer, a few things I have to change. So that makes things very, very easy. (Physician, Site D, R3)

Individual differences in the use of templates, however, were still significant.

They don't tell you that in the beginning. I'm here for the back pain, so you put [in] back pain, you open the [template] for back pain, and you do the back pain thing. And then [they] say, and what about my rash? And remember my heartburn, and you know my migraines are really not getting that better anymore...so then you have like 20 [templates] and although you can open only one [template] at a time... So it takes you longer. And I don't like the progress note still, because the progress note for the back pain will take me a much longer time because they have to have all the categories of back pain...so I'm better off dictating, so I'm still dictating. (Physician, Site J, R3)

Greater use of templates also resulted in an unintended consequence, where notes seemed canned and not as informative as dictated notes.

If they use the [templates], it is very difficult to go through those. Because they are using a [template] for each thing and so it is hard to necessarily pick apart things if they've used umpteen [templates]. If somebody is dictating, I think it's much easier to figure out what they're doing. If they're using the language of [templates], sometimes it makes no sense...because they're doing [a] paper cutter type of thing, and you're saying, did they punch that in because it was just one of the things to punch in or was that important for them... It varies from individual to individual as to how they do it. (Physician, Site C, R3)

Notes were particularly problematic for complex patients who required several templates. These patients took up extra time for most physicians and resulted in less-succinct notes. Management searched for a solution and purchased software that converts voice to text. Physicians could still dictate notes. The software converted them to a text form rather than sending them to a medical transcription service. Both managers and many physicians found this to be an acceptable solution.

4.5.2. Continuous Improvement

The organization sought to develop new policies and programs supported or enabled by EHR capabilities. For example, many practice managers worked on standardizing interactions among team members, and found the EHR helpful in supporting that effort.

As the MA puts in [data for a patient with a cough], there's certain things that they have to [do] to make sure that it's either the pulse ox or the inhaler to make sure that their peak flow is good. All those same things are standardized... So that piece, I think, is better. (Practice manager, Site E, R3)

We were trying to get more standardized so that when a provider sees a note they know, OK, no matter who wrote it, it's in the same type of format and that's where a lot of the staff members were free texting. (Practice manager, Site H, R3)

New workflows were also implemented, with a particular emphasis on the interaction between the MAs who roomed the patients and the physicians. Innovative ideas that were generated and implemented were conveyed through emails and webinars.

Lately, we've been doing more background. It's a brand-new process. We didn't before have to look at previous Pap smears or previous biopsies or the history, and now we do. (MA, Site A, R3)

Each month something else comes out and we are able to do something more. It's getting easier I should say. (Support staff, Site I, R3)

Sites and individuals also came up with ideas for new processes to address issues they found problematic. For example, the implementation of the EHR allowed clinics to maintain worklists for no-shows, referrals, and outstanding orders. Working from generated reports, staff worked through these lists to ensure the tasks on them had been completed. Staff often viewed this as cumbersome and contributed ideas about how to streamline the process.

You have to go in and look at the report and then go back and see if it was done, if somebody just forgot to remove the order or what the circumstances are that that is still in the computer. And some of it is a good way to make sure that people don't fall through the cracks, but the opposite side of that is that...we have to go in and make sure that people's labs have been done. And if they haven't, we have to update it, go to the doctor, send out letters. There's a big process there that's extremely time-consuming that I feel, if they instituted a letter that went out, if that patient didn't show up within an X amount of days the computer knew enough to say, OK, Mrs. Smith didn't come in for her thyroid test, let's send her a letter and let's let the doctor know that we did it, rather than have one person spend the whole day doing this. I think that would be a good process. (Support staff, Site J, R3)

Partly as a result of such innovations enabled by the EHR, a year after implementation, each site's use of the system to support its work varied somewhat. These variations in use affected organizational structures such as staffing. For example, one site experimented with a model that brought back a form of primary nursing, while seeking to maintain the flexibility of pooling MA and nursing resources.

We have more MAs because the physicians felt they needed [them]. The MAs do a lot of work. They [physicians] felt that they needed to be more consistent. If I have this certain physician, I'm going to know exactly what they want, how they want things done,...working with a specific physician is good. So now we know all the other physicians, but we only have to do ours on a consistent basis. (MA, Site J, R3)

Best practices were shared between sites through organization-wide meetings involving practice managers and physicians, but there was some sense that it might be beneficial to the organization as a whole to more actively manage site variations.

5. Extending the Concept of Affordances

Once our analysis revealed affordances as a core theme, we categorized what our respondents said into associated concepts, and created a table to summarize the results (see Table 1). As we constructed this table and compared our results to the literature, we encountered three theoretical problems; namely, that the affordance literature has not developed theory for (1) the process of actualizing an affordance's potential, (2) affordances in an organizational context, and (3) affordances that arise in the form of a bundle of interrelated affordances. The implementation we observed suggested how the concept of affordances could be extended to address these theoretical gaps and

so provide the foundation for our mid-range theory about how implementing an EHR in a healthcare organization leads to organizational change.

In Section 5.1, we present the affordances we observed and define key terms. Then, in Sections 5.2 to 5.4, we present our three extensions to the theory of affordances. In each of these three sections, we first discuss the theoretical problem we encountered with evidence from our data, and then present the theory we developed from our data. Together, Table 1 and the theory of affordances with our extensions form our mid-range organization-EHR theory of EHR-associated organizational change in a healthcare organization.

5.1. Observed Organizational Affordances and Related Definitions

We identified eight affordances (see Table 1) arising from the relation between the EHR and the healthcare organization, which captured most of what our respondents told us. These eight affordances are central to analyzing how the use of an EHR results in organizational change. Each affordance is named as a gerund associated with the actions that would be taken to actualize that affordance:

- 1) Capturing and archiving digital data about patients
- 2) Accessing and using patient information anytime from anywhere
- 3) Coordinating patient care across sites, facilities, and providers
- 4) Standardizing data, processes, and roles
- 5) Monitoring organizational operations
- 6) Substituting healthcare professionals for each other
- 7) Incorporating rich information into clinical decision making, and
- 8) Shifting work across roles.

The five columns in Table 1 are the affordance-related categories that axial coding identified in our data. Columns 1 and 2, which follow directly from Markus and Silver's (2008) affordance definition, specify the features of the technical object (in our case the EHR) and the characteristics of the actors who might engage with that object. The relation between these elements gives rise to the affordance (shown in the gray shaded row) as a potential for actions by these actors. As with existing affordance definitions, the potential actors are goal oriented (see goals in column 5), but we extend existing definitions because these actors are embedded in an organizational context (also in column 5) that affects their goals and their actions. The goals reported in our data and in Table 1 are those of our respondents' professional roles and their organization. While they certainly have and strive to achieve individual goals, individual level affordances are not the primary focus of our study. When individuals talked about the effects of the EHR, they mentioned organizational goals, but focused on more-immediate outcomes (column 3). These outcomes were evident in the data in all rounds, including round 1 before the EHR was implemented. Column 4 lists the specific actions individuals take to actualize the affordance.

Table 1. Organization—EHR Affordances

Elements giving rise to an affordance:		3. Example immediate concrete outcome from our data	4. Goal-directed actions needed to actualize an affordance	5. Applicable goals and organizational context
1. EHR features	2. Characteristics of actors			
Affordance 1. Capturing and archiving digital data about patients		Actualization		
Common database for storing patient information Structured data entry forms	Individuals can type and know how to add and update patient data Physicians have the skills for creating electronic notes without using a transcription service	"The biggest thing for nurses is to be able to document every vaccine, every shot and all that info." (Nurse, Site A, R1)	Individuals record all appropriate data about patients and interactions with them in the EHR, including provider notes	Goals: Avoid legal liabilities; Provide high quality and safe patient care; Maximize revenue stream; Reduce costs Organizational context: Culture supports patient data as a clinic resource, rather than belonging to individuals
Affordance 2. Accessing and using patient information anytime from anywhere		Actualization		
Common database filled with patient information Technical infrastructure for anytime, anywhere access	Providers know where and how to quickly find needed data about patients, and for patient care, in the EHR	"If I'm at a different site, seeing somebody else's patient, on a weekend, whatever, everything's there." (Physician, Site B, R1)	Individuals retrieve all relevant and available data pertaining to each patient encounter	Goals: Provide high quality care based on complete data; Provide timely care; Reduce costs by avoiding duplication of tests Organizational context: Culture supports informed clinical decision making
Affordance 3. Coordinating patient care across sites, facilities, and providers		Actualization		
Messaging features Patient information stored and available real-time anywhere	Individuals know how, when, and why to use the EHR's coordination features (e.g., its messaging features)	"It's definitely easier for us physician colleagues to talk to each other. It's easier to get a note to the urgent care nurses to please follow up on this kid. Instead of having to call, and wait on hold." (Physician, Site E, R3)	Individuals involved in coordinating care use the EHR's coordination features, rather than phones, for communication and coordination about patients and their care	Goals: Provide high quality, safe and timely care to patients; Ensure efficient use of resources; Avoid legal liabilities Organizational context: Culture supports documentation of, and open access to, care coordination activities
Affordance 4. Standardizing data, processes, and roles		Actualization		
Standard data entry forms Stored protocols and procedures for each role Restricted access to EHR features by role	Individuals know the applicable standards and have the skills to follow them	"Messages from nurses are better. It has forced them to ask standardized questions, with responses taken down in an order." (Physician, Site A, R1)	Individuals create and use templates in the EHR Individuals follow standard procedures for data, tasks, and roles, and participate in setting standards as needed	Goals: Provide consistently high-quality and safe patient care; Reduce costs through efficient operations Organizational context: Standards exist for what and how data is gathered, how tasks should be performed, and what each role is allowed to do

Table 1. Organization—EHR Affordances (cont.)

Elements giving rise to an affordance:		3. Example immediate concrete outcome from our data	4. Goal-directed actions needed to actualize an affordance	5. Applicable goals and organizational context
1. EHR features	2. Characteristics of actors			
Affordance 5. Monitoring organizational operations			Actualization	
Audit trail of what was done, by whom, and when Lists of tasks to do, by role and the current status of each	Individuals know which audit trail items and task lists are their responsibility Individuals have the skills and authority to take actions based on the status information	"I can sit in my office and manage, I can see who's on phones, who's doing what, who is working in-basket, who last touched a message, ..." (Practice manager, Site I, R3)	Individuals regularly check the EHR and take actions to ensure smooth operations and completion of their own or others' workloads	Goals: Ensure patients receive the treatment ordered; Ensure smooth, high quality operations; Recognize opportunities for operational improvements Organizational context: Culture supports accountability and traceability of the actions of individuals
Affordance 6. Substituting healthcare professionals for each other			Actualization	
Standardized data & functionality Audit trail Features for defining pools (e.g., the nursing pool) Message forwarding & messaging to pools	Individuals know when and why messages to role-based pools are best vs. messages to individuals	"It's in the pool, any nurse that receives that call, can pick up and find out what the patient requires." (Nurse, Site D, R3)	Individuals communicate work requests to message pools Individuals use standardized data formats in patient records	Goals: Efficiently use expensive human resources; Ensure work is completed regardless of whether or not a particular individual is available at a given time Organizational context: Standardized roles and role-based EHR pools exist; Culture supports not delaying work waiting for a particular individual
Affordance 7. Incorporating rich information into clinical decision making			Actualization	
Decision support features (e.g., medication alerts based on patient data) Easy access to online clinical references	Providers know how to use medical alerts to augment their expertise without being overwhelmed	"It's giving you the pertaining tests which are needed for this diagnosis." (Physician, Site H, R3)	Individuals consult the EHR's alerts and recommendations as part of their decision making process	Goals: Provide high quality care; Reduce liability for medical mistakes; Reduce costs through better medication choices Organizational context: Culture supports providing the best care possible and information supporting such care
Affordance 8. Shifting work across roles			Actualization	
Templates that can capture the decision rules of one role for use by another role	Individuals know how to use templates and when to contact someone in the appropriate role for assistance	"no longer do they [physicians] have to see a UTI patient. We take care of that issue. All they have to do is sign it, and send it once we get the information" (Nurse, Site I, R3).	Individuals use templates with embedded rules for performing a task, and do not deviate from the standardized rules without first checking with someone in the appropriate role	Goals: Provide timely, safe, high quality care; Make efficient use of expensive human resources Organizational context: Standardized, well-defined procedures exist for performing a task, which can be embedded into an EHR template

The affordance-related concepts in our data (shown in Table 1) led to our extended definition of an affordance to accommodate the nature of affordances in an organization; namely, we define an **affordance** as "the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors". In our study, the "artifact" is an EHR system, and the "goal-oriented actor(s)" are individuals or groups of individuals engaging purposefully in professional tasks in the healthcare organization.

Actualizing the potential captured in the concept of an affordance is very important in our data. We define **actualization** as “the actions taken by actors as they take advantage of one or more affordances through their use of the technology to achieve immediate concrete outcomes in support of organizational goals”. Figure 1 shows the affordance actualization process. This process is iterative because the actualization actions of individuals generate outcomes, and these immediate concrete outcomes, in turn, provide feedback for adjusting (as needed) those individual actions as well as adjusting the elements giving rise to the affordance.

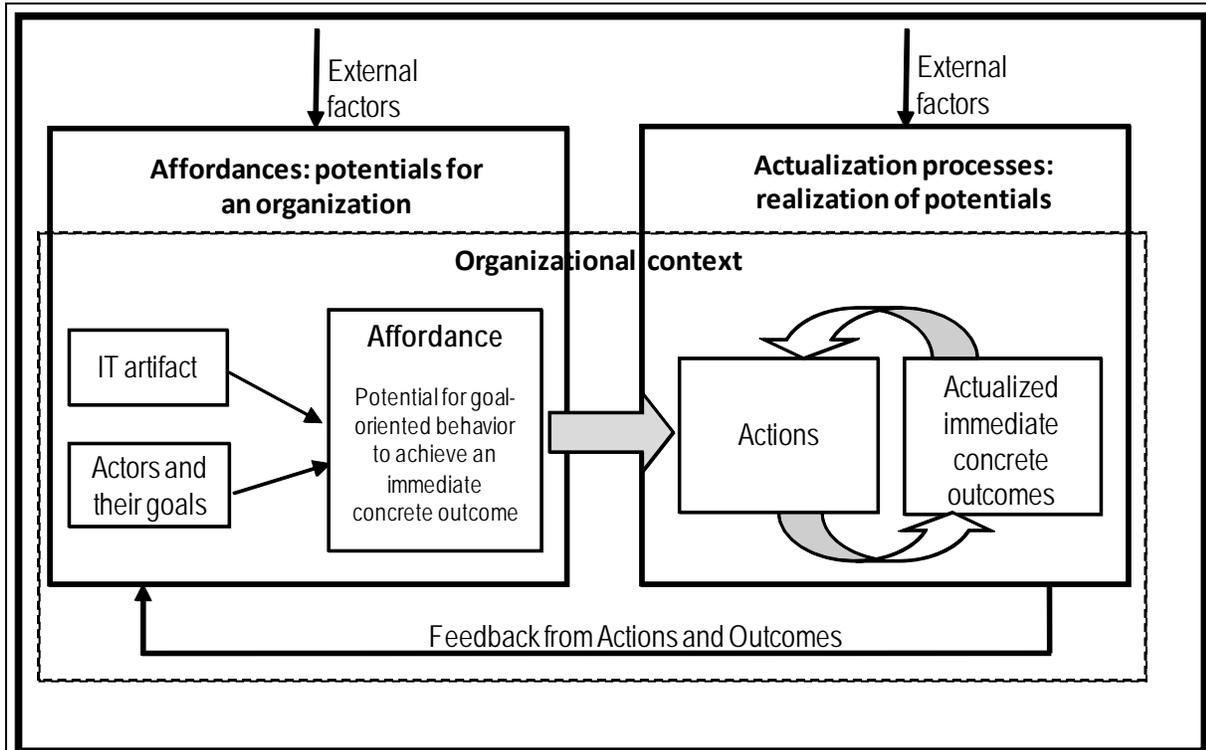
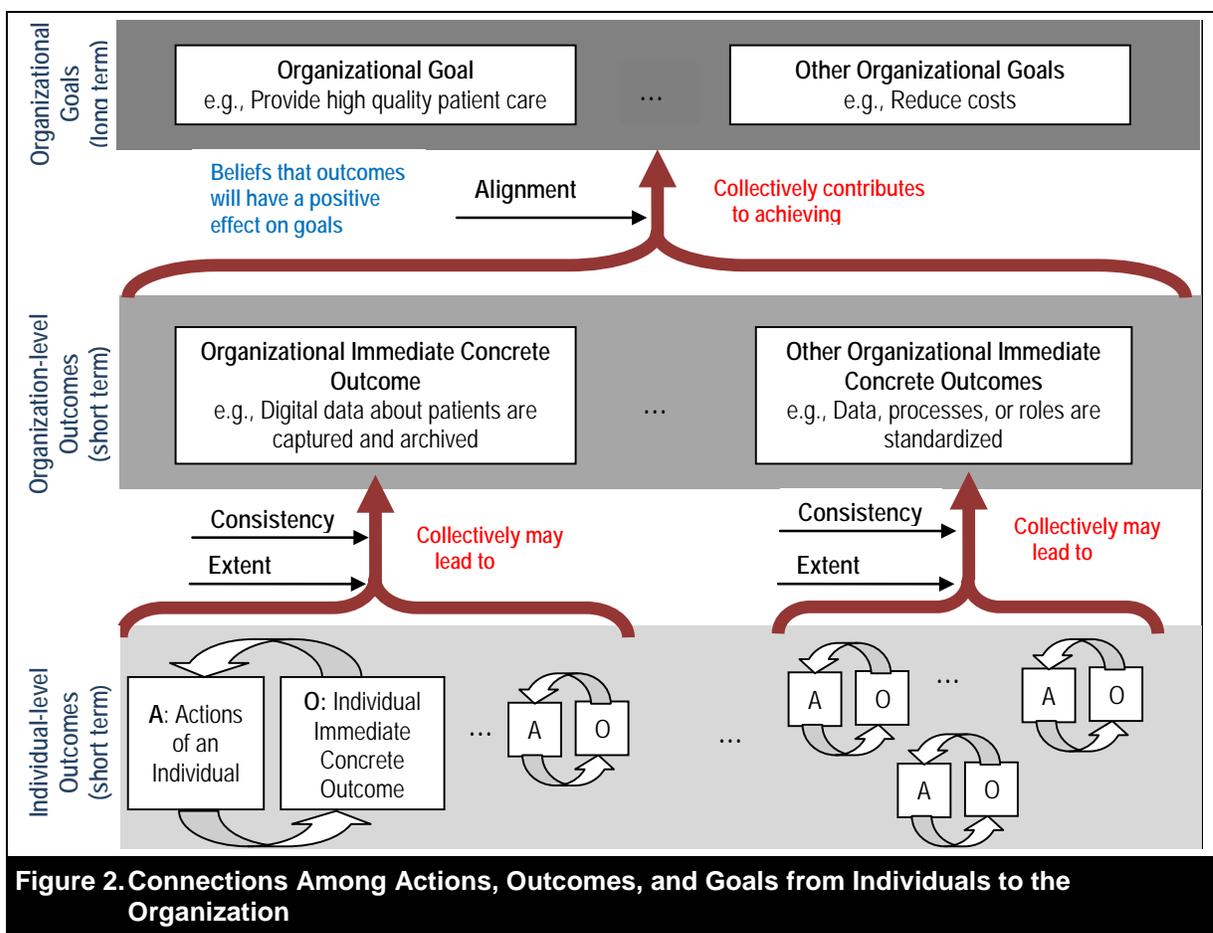


Figure 1. The Affordance-Actualization Concept from an Organizational Perspective

In the extended definition of affordances and the definition of actualization, we introduce the concept of an “immediate concrete outcome”. An **immediate concrete outcome** is a specific expected outcome from actualization, such as standardization or coordination, that is viewed as useful for realizing overarching organizational goals (e.g., higher quality care or efficient use of resources). This concept serves three purposes. First, because an immediate concrete outcome can be defined at any level (e.g., individual, group, or organizational), our extended affordance definition covers affordances at multiple levels (as discussed in Section 5.3). Second, an immediate concrete outcome spans an affordance and its actualization. The affordance identifies the potential function of the associated outcome (and, as a potential, has a common meaning across actors), whereas the structure of the outcome emerges during actualization and will differ across the individuals or groups performing each actualization (see Section 2.2). Third, an immediate concrete outcome serves as an intermediary between actualization actions and ultimate organizational goals. Figure 2 shows how individual-level immediate concrete outcomes aggregate to form organizational-level immediate concrete outcomes, which, in turn, may contribute to achieving organizational goals. The concept of immediate concrete outcomes provides a more direct way to assess whether actualization actions are contributing to organizational goals (as discussed in Section 5.2).



With this empirical and definitional background, we now discuss the three theoretical gaps in the affordance literature for which we developed theory from our data.

5.2. The Process of Actualizing Affordances

One theoretical issue we encountered is the lack of theorizing about how the potential captured by an affordance is actualized. Ecological psychologists' primary interest concerns the opportunities individuals see when they look at objects. They focus on an affordance as a potential for action (e.g., the potential for ascending provided to a person by a set of stairs) and on the characteristics of the individuals and the features of the object that give rise to that affordance. The appropriate individuals, once defined, are presumed capable of easily actualizing the affordance when they hold appropriate goals. As a result, ecological psychologists place much less emphasis on realizing potentials through goal-directed behaviours (e.g., climbing stairs one or two at a time) or on outcome achievement per se.

In contrast, identifying affordances is only a first step for understanding how introducing an EHR into an organization is implicated in organizational change. While we presume that EHR users actualizing an affordance have the potential for doing so effectively, they are engaging in a learning process and may encounter many obstacles (e.g., equivalent to having to learn how to ascend stairs rather than already knowing). There may also be missteps and redirections along the way (i.e., actualization is not a linear process, and they may not fully actualize an affordance). We thus need to also study the factors contributing to the ease or difficulty that organizational actors encounter as they act to actualize an affordance and thus effect organizational change.

To address this gap in the literature, we must theorize the process by which potentials (affordances) are realized in organizations (i.e., the **actualization process**). Actualization, a high-level category

from our data, simultaneously involves (1) a set of individual journeys occurring in a dynamic organizational context as users learn, the EHR evolves, and managers intervene, and (2) a multi-level process in which the journeys of many individuals interact and aggregate to form an organizational journey (i.e., the organizational change process).

5.2.1. Actualization as Individual Journeys in a Dynamic Organizational Context

A key theme in our data is that the process of actualizing affordances is an individual journey (i.e., an individual-level process, experienced differently by each person taking goal-oriented actions). At our case sites, individuals proceeded with the actualization process at different rates and in different ways, and did not necessarily experience the same steps and constraints, nor achieve the same outcomes. As Figure 1 notes and as is evident in our data, these journeys were far from linear, involving changes in actions and in the EHR as users and managers observe the individual-level immediate concrete outcomes of actualization actions.

As goal-directed actors, individuals began thinking (even before using the EHR) about the outcomes they would be able to achieve (e.g., for a physician, “being able to ensure that a specialist seeing my patient has all the information needed from me about why I sent the patient”) (i.e., thinking in terms of goals and affordances). They also thought about actions they would have to take (e.g., for a physician, “I must type patient data into the EHR”), and whether those actions would have desirable outcomes that contribute to goals (e.g., for a physician, “it will slow my work and distract me from paying attention to my patients”) (i.e., thinking about the actualization process). These expectations were forward looking, and were driven by individuals’ goals of delivering high-quality care (an organizational goal) because needed information would always be captured and available in the EHR, including for others seeing their patients (an affordance).

As individuals used the EHR, they encountered both supporting and restricting factors that often affected them differently. The key factors that led individuals at our site to take different actualization actions included (1) individual abilities and preferences (e.g., typing ability and work preferences), (2) the EHR’s features (e.g., its user interface and medical vocabulary), and (3) the work environment’s characteristics (e.g., variations in each clinic’s resources or norms for trying new ways of working).

Factors 1 and 2 not only formed the affordance, but also affected the process of actualization. As individuals encountered factor 1 and 2 constraints, they searched for ways to reduce or eliminate them, as shown by the feedback loops in Figure 1 and Figure 2 (bottom). For example, physicians who saw their own abilities as constraining factors requested more training on the options in the EHR to enhance their abilities. Some physicians (sometimes with IT assistance) sought to change the EHR to better fit their preferences and work styles by developing templates. Other physicians did not see developing templates as an option for themselves, and adjusted their work preferences and styles to accommodate the system. Whether physicians and nurses sought to tailor the EHR via templates and shortcuts and what they chose to tailor differed by individual based on a number of considerations, including whether they thought the time involved was worth the effort, their sense of their ability to do so, their interest in doing so, the extent to which the EHR did not match their preferences, and the potential they saw for improving the EHR. Individual actualization journeys became smoother due to the many small and larger changes to the abilities of individuals and to the EHR in response to the observed outcomes of actualization. While such adjustments are typical following go-live (e.g., Markus and Tanis’s (2000) shakedown phase), our data highlight how such adjustments need to be tailored to the differing constraints encountered by individuals.

Factor 3 captured the ways in which the organizational context, acknowledged as especially important in healthcare (Cho, Mathiassen, & Nilsson, 2008; Constantinides & Barrett, 2006; Davidson & Chiasson, 2005), supported and restricted the actualization process. In an organizational context, others, especially managers, can intervene by changing the work context to provide more support and fewer constraints. Bloomfield et al. (2010) and Michael (2000) argue that the co-presence of others necessarily affects the context and thus the affordance. We argue that actualization of any affordance is most often affected, and only sometimes the affordance itself. In our case, managers intervened to remove the different constraints encountered by individuals (e.g., by providing scribes

for physicians who were poor typists). They intervened when organizational goals were not being met and when physicians requested additional resources (e.g., providing dictation-to-text software when physicians continued to dictate rather than type their notes and additional MAs to help with increased workloads). Some physicians used the dictation software while others chose not to. Another organizational context aspect was that some sites were better at exploring how best to actualize the affordances, while others seemed to accept or struggle with the EHR without changing their actions or the EHR, which is consistent with EHR adoption being higher for practices that are innovative and actively seeking to improve quality (Simon, 2007). To address this issue, management convened improvement meetings so that affordance actualization ideas emerging in one site could be shared across sites.

5.2.2. Actualization as an Organizational Journey

While successful individual journeys are necessary for achieving desired outcomes, we also need to theorize their relationship to an organizational level actualization journey. Based on the collective constructs literature, we view the organizational-level immediate concrete outcomes, which may on the surface appear to be the result of an organizational-level actualization process, as collective constructs emerging as aggregations of the immediate concrete outcomes of individuals' actions (see Figure 2). Bloomfield et al. (2010) refer to these aggregate outcomes as collective accomplishments. Thus, we theorize a combined individual-level and organizational-level lens, where the organizational actualization journey emerges dialectically as a complex aggregation of the many individual actualization journeys.

To understand whether and how individual level journeys contributed to the organizational-level journey, we turned to our data. Specifically, analysis of our data found three measures; namely, the "consistency", "extent", and "alignment" of individual actualization actions and their resulting immediate concrete outcomes (see Figure 2) that can be used to assess the emergence of organizational level outcomes.

Consistency of actualization assesses the horizontal aggregation across individual actions or outcomes (Figure 2, bottom) to capture how well the actions of individuals considered jointly serve to actualize organizational affordances. Inconsistent actions may interact with each other in ways that interfere with achieving actualization outcomes (e.g., practice managers attempt to standardize the tasks of MAs, while physicians ask MAs to tailor their work to the physician's work style, resulting in less standardization as an organizational-level immediate concrete outcome). Consistency means that the actualization outcomes are compatible and possibly reinforcing; the actions and their outcomes are not necessarily the same. For example, to achieve "capturing and archiving", physicians used different structures, e.g., scribes, typing, or dictating into voice-to-text software, but these differing actions all serve to achieve the same immediate concrete outcome of capturing data and notes digitally.

Extent of actualization assesses how far the actualization process goes toward achieving desired organizational level immediate concrete outcomes (see Figure 2, bottom). While users may actualize affordances consistently, they may not do so to the extent required to achieve organizational-level immediate concrete outcomes. For example, many physicians typed some notes, especially simple ones, but few switched entirely from dictation. As a result, the costly transcription service was still needed until the organization purchased voice-to-text software.

Alignment of actualization assesses how well the actions of individuals support achieving organizational goals. Alignment takes a vertical view by linking the immediate individual and organizational level outcomes to longer term organizational goals (see top of Figure 2). For some affordances (e.g., the capturing and archiving affordance), individual actualization activities and their outcomes are well aligned with and contribute directly to an organizational level digital archive, which, in turn, provides the data for coordinating care and providing better quality care. For other affordances, the actions taken to achieve individual-level outcomes may not contribute to achieving organizational-level outcomes and associated goals. For example, some physicians sent messages to a nurse they knew (to ensure work was done to their standards), whereas managers wanted physicians to send

messages to the nursing pool (to support substitutability and to ensure the work was done). In this example, physicians took actions to achieve a quality goal, but those actions did not contribute to actualizing the organizational substitutability affordance, which would have helped to make better use of resources.

As our data indicate, a theory of affordances is incomplete without a corresponding theory of how those affordances are actualized. Based on our data, we developed the concepts comprising affordance actualization, which explain how individual actions connect to organizational outcomes. With these concepts and the three measures, managers can identify when, where, and how to intervene to improve those outcomes and researchers can study how individual actions and their immediate concrete outcomes contribute to producing organizational-level outcomes and can build process models of how those changes emerge.

5.3. Characteristics of Organizational Affordances

The second theoretical issue we encountered is the need for theory about organizational-level affordances. In ecological psychology with its generally simple objects (e.g., stairs, and single independent actors), an affordance is an individual level concept (i.e., a potential for an independent individual actor to take actions to achieve a goal of that individual). In contrast, the affordances in our data apply to actors in organizations. Most actions taken by individuals in organizations are either performed jointly with others or are influenced by others' actions (Bloomfield et al., 2010; Fayard & Weeks, 2007), and are taken to achieve both individual and organizational goals. Extending the affordance concept to an organizational context requires that we address this collective action and multi-level intent.

We refer to an affordance as an organizational affordance to the extent that the potential actions enabled are associated with achieving organizational-level immediate concrete outcomes in support of organizational level goals. These organizational-level immediate concrete outcomes are produced by the collective actions of individuals. While the interpretations of organizational goals and the structure of actualization actions may vary across individuals, the affordance itself is not specific to an individual. The key is the distinction made earlier between structure and function. As discussed in Section 2.2, the function of a collective construct such as an organizational affordance will stay the same across different individuals and across different levels. Thus, for example, "functionally", the organizational affordance of "standardizing" means the potential for making things the same. When that affordance is actualized, "structurally", what is standardized or how it is standardized can differ across individuals. Whether the resulting organizational level outcome is standardization depends on the consistency, extent, and alignment of the collective standardizing actions of individuals. Furthermore, while the immediate concrete outcome of standardizing is functionally the same (i.e., something is standardized), the ultimate goals of the actors could be quite different (e.g., while a physician may value standardizing as a way to ensure appropriate care and/or avoid lawsuits, the organization may see standardizing as a way to reduce costs). The affordance is defined by a set of characteristics related to the nature of the immediate outcome, even though specific actualizations of that affordance exhibit variation. In the same way that no two humans are perfectly alike yet are identifiably humans, we can talk about each of our eight affordances as having a clear organizational outcome from a functional perspective, although there are many ways each can be actualized, resulting in significantly different structures.

We use the data in Table 1 to distinguish an individual from an organizational-level affordance. Five of the organizational affordances in Table 1 may also have individual-level equivalents. Specifically, individuals may produce individual-level immediate concrete outcomes that contribute to their own individual or professional goals as they enter data (aff 1), use data (aff 2), standardize their tasks (aff 4), monitor the results of their activities (aff 5), and incorporate rich data into decision-making (aff 7). If the phenomenon of interest is at an individual level (e.g., professional identity), we might be interested in studying individual-level affordances. When the phenomenon of interest is IT-associated organizational change (as in this paper), we would focus on organizational affordances. The other affordances in Table 1 are clearly not at the individual level because the outcomes apply across individuals (e.g., coordinating care (aff 3),

substituting professionals for each other (aff 6), and shifting work across roles (aff 8)). For these, the expected outcomes are for groups of individuals or organizational units as a whole.

By introducing the concept of immediate concrete outcomes and by building on the concepts of the function and structure of collective constructs, we extend the theory of affordances to also cover organizational-level affordances. As a result, IS researchers have the theoretical foundation to employ the theory of affordances, originally developed by Gibson (1986) as an individual-level theory, in the context of IT-associated organizational change.

5.4. The Bundle of Interrelated and Interacting Affordances

The third theoretical issue we encountered is that many affordances arise from the relation between a new EHR and a healthcare organization, and these affordances are interrelated and interact. In the ecological psychology literature, the focus is a single affordance and the immediate outcome that a simple object affords an individual (e.g., a chair affords a person the possibility of sitting). While a chair could afford an individual an alternative outcome (e.g., reaching an overhead object by standing on it), both opportunities are not simultaneously considered.

In contrast, in an organization, each affordance is being simultaneously actualized by many individuals engaged in their own individual journeys, but also each individual is confronted with multiple affordances (e.g., those in Table 1). These multiple affordances are likely to be interrelated in various ways, and their actualization may contribute to achieving multiple goals (see Figure 2). To understand EHR-associated organizational change, we must consider the bundle of affordances and account for the ways in which the affordances in this bundle are interrelated and how they interact.

From our data, the most obvious relationship among affordances is temporal. Affordances are not all actualized at once; rather, actualization occurs at different times. The affordance dependency diagram in Figure 3 shows the observed temporal sequence in which affordances were actualized.

In our data, during the first two months after go-live, most (but not all) providers at our site learned to routinely actualize the first two affordances; namely, “capturing and archiving” patient-related data and “accessing and using” these data. As they used the EHR to record orders for prescriptions, lab tests, and future appointments, they provided data to support the “coordinating patient care” affordance. As providers sent messages to pools and responded to messages from nurses and staff using these message pools, they provided data that enabled easier substitution of employees in roles (“substituting” affordance).

Other affordances (namely, “monitoring operations”, “standardizing data and operations”, “incorporating rich information into clinical decision making”, and “shifting work across roles”) were only actualized later. For example, practice managers started to monitor clinic operations in real time to find bottlenecks and intervene to produce smoother operations or schedule more training for those who needed it. Physicians started to check the status of patient orders to ensure that patients received the care ordered. Using the EHR to monitor operations did not occur in the first few months; it took some time before users were proficient with the basic affordances to make such uses of the EHR. Furthermore, the time varied by individual (e.g., some physicians were using the EHR to “monitor care delivery” within a few months, while others took up to a year to actualize this more-advanced affordance).

This observation that affordance actualization unfolds over time, with some affordances being actualized early after go-live and others much later, led us to analyze our data more closely to discover the underlying reasons for these time sequences. In some cases, the actualization of affordances depends on the immediate concrete outcomes from previous actualization of other affordances (i.e., actualized affordances build on one another by providing the initiating conditions for affordances that could be actualized later).

Such dependencies vary in strength as designated in Figure 3. Strong dependency occurs when the relationship between two affordances is such that actualizing an affordance requires that the preceding affordance is actualized, at least to some extent. For example, “accessing and using information” (aff 2) depends on the actualization of “capturing and archiving digital data” (aff 1). In general, to actualize an affordance that involves using data in new ways requires that those data are captured and available for use. A dependency among affordances is weaker to the extent that actualizing the preceding affordance is enabling but its absence does not completely prevent actualizing the follow-on affordance. For example, when providers consistently send messages to, and respond to messages from, pools (e.g., the nursing pool), it is much easier to actualize “substituting employees within roles” (aff 6). If providers send messages to individual nurses rather than the nursing pool, substituting one nurse for another is harder, but not impossible, although it might result in delays in accomplishing some tasks.

As Figure 3 shows, several affordances are enabled by “standardizing data, processes, or roles” (aff 4). For example, “monitoring operations” through the EHR (aff 5) requires that the necessary data be available (aff 2), but is also enabled (made easier) to the extent that “standardizing data, processes, and roles” is actualized. The “standardizing” affordance is also interesting because standardizing can be done separately from implementing an EHR (e.g., the EHR supports role standardization but role standardization can be achieved without an EHR). In addition, actualizing EHR-enabled standardization contributes to the success of the later, more-advanced affordances, but is not required for most of them.

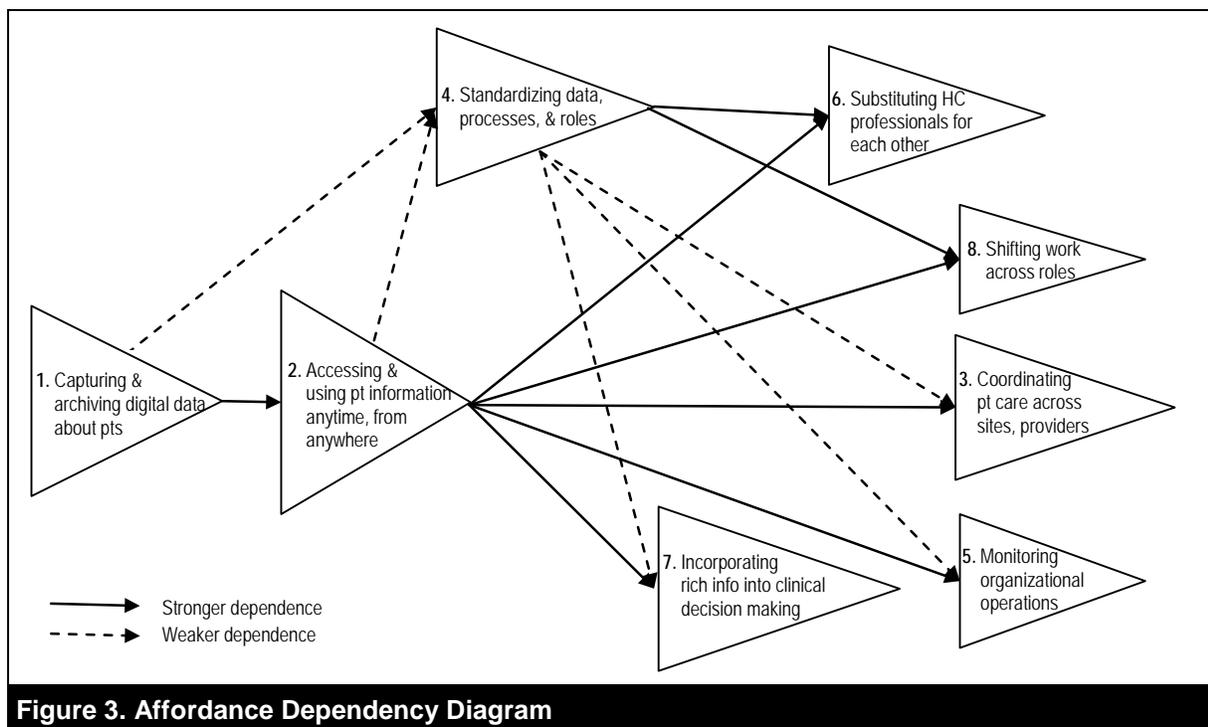


Figure 3. Affordance Dependency Diagram

A second type of dependency is related to the feedback loops in Figure 1 and the three factors (individual characteristics, EHR features, and organizational context) that can constrain individual actualization journeys. Thus, while the affordances exist as potentials, some actors, some EHR aspects, or some organizational context aspects may not be ready for actualizing them. Consider the actors. Actualizing more basic affordances can build their knowledge and skills in ways that enable them to recognize and actualize affordances they could not before. Such learning enables actors to see innovative ways to use the technology features (i.e., to recognize previously unrecognized affordances), which we illustrate with the increasing development and use of templates (a technology feature). Early templates primarily provided physicians with various shortcuts to enter data more

efficiently (aff 1). Later, physicians began to understand how the EHR worked and started to use templates for “standardizing” their own or their group’s routine tasks (aff 4). Similarly, a few nurses designed templates, each tailored to an individual physician, for the most common, routine patient symptoms, which they could invoke during patient phone calls, and which “standardized” their response to routine conditions for each physician (aff 4), but not across physicians. This also shifted some workload to nurses, “shifting work across roles” (aff 8), as they formulated routine orders for physician approval using these physician-tailored templates, and also enhanced quality of care by always using pre-approved standard care procedures (aff 4).

In this example, not only were actors enhancing their abilities, but they were also enhancing the EHR by developing templates. The organizational context was also developing to support learning and innovative uses of EHR features as managers recognized their value. Thus, we see how the three factors that enable or constrain actualization interacted and co-evolved over time.

With the concept of dependencies among affordances, we are developing theory to address Bloomfield et al.’s (2010) call for understanding how and when action possibilities emerge, which is based on Michael’s (2000) observation that affordances seem to cascade. Studying whether and to what extent the second dependency type could be reduced by training actors better, designing the EHR better, and preparing the organizational context better is an opportunity for future research. Reducing the first type (i.e., those dependencies based on the immediate concrete outcomes from actualizing other affordances) would be difficult.

In summary, in Section 5, we first present the affordances in our field data and extend the definition of affordances to cover these affordances. We then extend affordance theory to address the three gaps we encountered, and, in doing so, we develop the theoretical rationale for individual and organizational actualization processes, organizational affordances, and dependencies among affordances. Filling these gaps are contributions in themselves, but they also enabled us to develop a mid-range affordance-based theory of EHR-associated organizational change.

6. Contributions and Future Research

Our mid-range organization-EHR theory and more broadly the affordance-actualization (AA) lens, both of which depend on our extensions to affordance theory, provide significant value to researchers and practitioners, as discussed below.

6.1. Value of our Organization-EHR Affordance Actualization Theory

Our organization-EHR affordance actualization theory is defined by the organizational affordances (in Table 1), the specific individual- and organizational-level actualization processes (in Section 5.2), and the dependences among the affordances (in Figure 3). It is a mid-range theory because its theoretical concepts apply to healthcare organizations and EHRs, rather than being a grand theory applying to all organizations and all IT artifacts. Our theory differs from most current approaches to studying EHR implementation and use because it focuses on explaining, at a sufficiently detailed level, **how** and **why** outcomes occur, rather than on **what** outcomes occur and **what** the major barriers to those outcomes are.

Given that EHR systems have been advocated and funded to achieve important benefits (e.g., lower costs and higher quality care), it is not surprising that much current research on EHR implementations has focused on whether or not such benefits are achieved. Following a clinical research paradigm, the EHR is viewed as a single intervention and benefits are assessed (as objectively as possible) before and after the intervention (Chaudhry et al., 2006; Rippen, Pan, Russell, Byrne, & Swift, 2012). Alternatively, surveys are used to collect data from providers about their assessment of the value of these systems (Reardon & Davidson, 2007). On the whole, these studies have found small or no benefits, at least partially, because they treat technology as an undifferentiated whole (Rippen et al., 2012). Given the frequency of failed or inadequate EHR implementations (Rippen et al., 2012) and providers’ resistance to such implementations (Lapointe & Rivard, 2005), another common research focus is studying barriers and facilitators to EHR implementations (McGinn et al., 2011). Such studies

usually present those barriers in large buckets, such as costs, lack of financial incentives, and physician resistance (Reardon & Davidson 2007).

Our theory is distinct from these approaches in five key ways. First, our theory focuses on a range of affordances and the role of various aspects of both the technology and the organizational actors in those affordances, rather than focusing solely on the technology as an undifferentiated intervention. Second, our theory focuses on the immediate concrete outcomes of actualization and how they contribute to organizational goals, rather than solely on whether organizational goals are achieved. Third, our theory examines the multi-level dynamics of actualization, focusing on how the organizational change process and the organizational level outcomes emerge from individual actualization processes and their immediate concrete outcomes, rather than examining outcomes at a single level. Fourth, by acknowledging these individual actualization journeys, our theory treats providers and other healthcare workers as individuals, rather than as undifferentiated occupants of various roles (e.g., nurses or physicians), while acknowledging the contextual influence of such roles. Finally, our theory examines how these individual actualization processes are enabled or constrained by the dependencies among the bundle of affordances in an organizational context.

For EHR researchers and practitioners, these distinctions provide a foundation for studying and understanding how to better implement an EHR to improve quality of care and reduce costs. Our theory's more detailed view of EHR implementation in terms of eight core affordances and the dependencies among them helps managers identify the potential value and challenges associated with different actions. For example, they can consider the differential implications of substituting healthcare professionals for one another as compared to shifting work across roles. As a result, managers can make better EHR implementation decisions (e.g., deciding to promote standardization to improve the ability to use MAs interchangeably or to focus attention on shifting work from physicians to nurses).

By focusing on the dynamic process by which outcomes are achieved, as we do with our theory, researchers and managers can examine individual actualization journeys and their immediate concrete outcomes, and thus identify interventions and focus those interventions where they provide the most organizational value. At our field site, management's prompt and serious attention to complaints and requests of individuals having actualization difficulties may have made the difference between the successful implementation we observed and other EHR implementations that met serious resistance and failed (Lapointe & Rivard, 2005). Understanding that the organizational actualization journey emerges from the journeys of individuals highlights that even one individual who fails to actualize a basic affordance to a sufficient extent can interfere with the success of that organizational journey. The three measures identified (namely, consistency, extent, and alignment) can be developed to monitor how well individual journeys are contributing to the organizational journey; managers can then intervene appropriately as needed. Managers can guide actualization better because they understand the dependencies among affordances and thus the need for individuals to develop the competencies and the organization to develop the capabilities that come from actualizing the more basic affordances first. Ideally, then, they can promote a continuing actualization process that unfolds as the organization, its actors, and the EHR co-evolve, and as users gain the expertise to recognize and actualize more-advanced affordances.

6.2. Value of the Affordance-Actualization Lens

We turn now to how the AA lens, which refers to the original affordance concept augmented with our new affordance definition and our three affordance theory extensions, differs from approaches in the IS literature. Specifically, we examine the value of the AA lens in the context of studies in the IS literature that have taken an affordance approach and in several other approaches to IT-associated organization change (briefly reviewed in Section 2.3).

IS researchers have started to employ the concept of affordances to study IT in organizations (c.f. Goh, Gao, & Agarwal, 2011; Kane, Bijan, Majchrzak, & Faraj, 2011; Leonardi, 2011), but with a limited theoretical rationale for organizational affordances. Our extension of the theory of affordances to

cover organizational affordances as potentials for multi-individual teams, groups, and entire organizations provides that theoretical rationale. While Markus and Silver (2008) focus on theorizing affordances for an IS context, the AA lens goes beyond their work to highlight the importance of theorizing both affordances and the actualization process, and the organizational context of both. In conjunction with actualization and the identification of immediate concrete outcomes, our new concept of dependencies among affordances helps researchers theorize how and why IT-associated change unfolds. Identifying specific affordances (as in Table 1) serves to identify what matters about a particular IT to a particular organization, rather than assuming that specific IT features alone drive change. These affordances, along with our three measures of emergence, provide researchers with a starting point for building more theory about how individual actors using IT contribute to organizational change. Furthermore, by being specific about the nature of affordances (e.g., via Table 1), researchers can avoid slides into mistaken application of the affordance concept (e.g., implicitly associating an affordance solely with the IT rather than with the relation between the IT and actors). Overall, the theoretical foundation of the AA lens should enable IS researchers taking an affordance approach to build theoretically sound mid-range theories of IT-associated organizational change.

Because the AA lens is multilevel, researchers developing mid-range AA theories will naturally include both micro- and macro-level concepts, which is consistent with the call for more multilevel IS research (Burton-Jones & Gallivan, 2007) and the growing multilevel research in organizational and management literature. With our extensions, affordances are potentials for both individuals and organizations. In addition, our concept of immediate concrete outcomes and the emergence of organizational-level outcomes from individual-level actualization processes and their immediate concrete outcomes in an organizational context provides a multilevel approach to studying how organizational effects emerge.

As compared to AST (DeSanctis & Poole, 1994), to which Markus and Silver (2008) contrast their affordance theorizing, the AA lens shifts from AST's IT structures to affordances (i.e., replacing a concept located in the IT with a relational concept). As a result, AST's concept of how those IT structures are appropriated no longer applies. Instead, the AA lens includes goal-directed individual and organizational journeys, which fit well with affordances as potentials for goal-directed behaviors. This goal-directed characteristic of the AA lens differentiates it from AST (e.g., AST considers whether appropriation is faithful to the designers' intentions, whereas the AA lens considers whether actualization is aligned with organizational goals).

The AA lens contributes to the IS literature regarding the roles of technology and organizing in IT-associated change theories (see Section 2.3). Affordances, arising from the relation between the material (the IT artifact) and the social (actors in an organization), embrace the instrumental entanglement of the material and social in the process of actualization, while retaining the ontological separateness of the two in the definition of affordances. The AA lens is specific about the IT and its features (Monteiro & Hanseth, 1996; Leonardi & Barley, 2010), but focuses on the affordances that arise from them in concert with actors' goals as the mechanisms of organizational change, not those IT features themselves. Being specific about the mechanisms of change (e.g., about specific affordances as the key mechanisms of IT-associated organizational change) is essential for explanatory theory (Hedström & Swedberg 1998; Volkoff & Strong 2013). Actualization is, in fact, human action, but it is action related to an affordance (i.e., it is tied to the material). Because affordances intermediate between IT and actors, we have a clear view of both while acknowledging their entanglement. In addition, actualization actions are simultaneously goal-directed and emergent. This forward-looking orientation contrasts with the micro-level focus of the practice lens (Oborn, Barrett, & Davidson, 2011; Orlikowski, 2000). Gherardi (2009) distinguishes between practice theories, which focus on how conduct is enacted, and action theories, which privilege the intentions of actors. AA theories represent a re-balancing between action and practice theories by focusing on goal-directed behavior, while acknowledging the performative aspects of individual actions.

6.3. Future Research

Because the AA lens is new and not fully developed, our research opens many new avenues for inquiry. A valuable next step is more exploration of the actualization of the eight affordances we identified, especially the more-advanced affordances such as standardizing, to further develop theory about how/why/when each is actualized by individuals or groups of individuals, the difficulties they encounter during actualization, the relation of these actualizations to the actualization of other affordances, and how organizational outcomes emerge from the various individual actualization journeys. Studies are also needed about the extent to which the eight affordances generalize to other technologies in other organizations.

Our concept of the emergence of organizational level actualization from individual level actualization journeys needs further research and development from both practical and theoretical perspectives. The new concept of dependencies among affordances also provides opportunities for further conceptual development. We uncovered two forms of dependencies, but there may be others to be discovered—ones not highlighted in our data. Studying dependencies also provides an opportunity for comparing dependencies across different technologies or different organizations.

In addition to developing further the various components of the AA lens, another valuable step would be building additional mid-range AA theories, both in healthcare and other contexts. Our mid-range theory provides an example and a template researchers can use to guide their development of mid-range AA theories for other technologies in organizations. Sociologists have argued that mid-range theories developed around the mechanisms of social change (in our case, affordances and their actualization) are what will help us understand such change (Hedström & Swedberg, 1998). Such studies would also provide an opportunity for comparing affordances across systems and organizations (Volkoff & Strong, 2013).

Research questions of direct practical value to managers are suggested by our results about using consistency, extent, and alignment of individual actualization journeys as direct, early indicators of the potential for organizational goal achievement and as indicators of where to intervene in individual journeys. For example, is it better to focus on rapidly increasing the extent of actualization, or to go slowly and ensure consistency? Does the answer to this question depend on the particular affordance?

More generally, the AA lens provides a theoretical perspective useful to researchers for empirically studying the material and the social separately and together (i.e., in their intertwined actualization in organizations). Such studies would contribute to understanding what it is about IT and its design, about organizations and actors, and about their relations that matters in IT-associated organizational change. With this research, practitioners will be able to identify what it is about a particular IT artifact in relation to a specific organizational context that matters so that they can appropriately intervene in actualization journeys in ways that lead to better outcomes from IT-associated organizational change.

Acknowledgements

This research was supported in part by the National Science Foundation (NSF) under Grant SES-0826842. The participation of Professor Volkoff was supported by a grant from Canada's Social Sciences and Humanities Research Council (SSHRC). Any opinions, findings, conclusions, and/or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the NSF or the SSHRC. We thank the group medical practice for willingly partnering with us and generously providing the time of its people both before and after we obtained funding for the project and during a time in which it was extremely busy with the EHR implementation and with serving its many patients. We thank the many medical professionals at the practice who willingly spoke with us during three rounds of interviews about their experiences with the EHR. We are also very appreciative of our editorial team for actively engaging in the editorial process.

References

- Abraham, C., Akiyama, M., Brown, C. V., Currie, W. L., Davidson, E., LeRouge, C., & Strong, D. M. (2010). Healthcare IT adoption under different government models: Debating the HITECH impacts. *Proceedings of the International Conference on Information Systems 2010*. Saint Louis, MO.
- Bates, D. W., Ebell, M., Gotlieb, E., Zapp, J., & Mullins, H. C. (2003). A proposal for electronic medical records in US primary care. *Journal of the American Medical Informatics Association*, 10(1), 1-10.
- Berwick, D. M. (2002). A user's manual for the IOM's 'Quality Chasm' report. *Health Affairs*, 21(3), 80-90.
- Bloomfield, B. P., Latham, Y., & Vurdubakis, T. (2010). Bodies, technologies and action possibilities: When is an affordance? *Sociology*, 44(3), 415-433.
- Burton-Jones, A., & Gallivan, M. J. (2007). Toward a deeper understanding of system usage in organizations: A multilevel perspective. *MIS Quarterly*, 31(4), 657-679.
- Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S. C., & Shekelle, P. G. (2006). Systematic review: Impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine*, 144(10), 742-752 and W168-W185.
- Chemero, A. (2003). An outline of a theory of affordances. *Ecological Psychology*, 15(2), 181-195.
- Cho, S., Mathiassen, L., & Nilsson, A. (2008). Contextual dynamics during health information systems implementation: An event-based actor-network approach. *European Journal of Information Systems*, 17(6), 614-630.
- Constantinides, P. & Barrett, M. (2006). Negotiating ICT development and use: The case of a telemedicine system in the healthcare region of Crete. *Information and Organization*, 16(1), 27-55.
- Davidson, E., & Chiasson, M. (2005). Contextual influences on technology use mediation: A comparative analysis of electronic medical record systems. *European Journal of Information Systems*, 14(1), 6-18.
- DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science*, 5(2), 121-147.
- Fayard, A. L., & Weeks, J. (2007). Photocopiers and water-coolers: The affordances of informal interaction. *Organization Studies*, 28(5), 605-634.
- Gherardi, S. (2009). Introduction: The critical power of the 'Practice Lens'. *Management Learning*, 40(2), 115.
- Gibson, J. J. (1986). *The ecological approach to visual perception*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. University of California Press.
- Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory* (Vol. 2). Mill Valley, CA: Sociology Press.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine de Gruyter.
- Goh, J. M., Gao, G., & Agarwal, R. (2011). Evolving work routines: Adaptive routinization of information technology in healthcare. *Information Systems Research*, 22(3), 565-585.
- Hedström, P., & Swedberg, R. (1998). Social mechanisms: An introductory essay. In P. Hedström & R. Swedberg (Eds.), *Social mechanisms: An analytical approach to social theory* (pp. 1-31). Cambridge, UK: Cambridge University Press.
- Hutchby, I. (2001). Technologies, texts and affordances. *Sociology*, 35(2), 441-456.
- Kane, G. C., Bijan, A., Majchrzak, A., & Faraj, S. (2011). The paradoxical influence of social media affordances on intellectual capital creation. *Academy of Management Annual Meeting*. San Antonio, TX.
- Kozlowski, S. W. J., Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (chapter 1). San Francisco: Jossey-Bass.
- Lapointe, L., & Rivard, S. (2005). A multilevel model of resistance to information technology implementation. *MIS Quarterly*, 29(3), 461-491.
- Latour, B. (1991). Technology is society made durable. In J. Law (ed.), *A sociology of monsters: Essays on power, technology and domination* (pp. 103-131). London: Routledge.
- Lau, F., Kuziemsky, C., Price, M., & Gardner, J. (2010). A review on systematic reviews of health information system studies. *Journal of the American Medical Informatics Association*, 17(6), 637.
- Law, J. (2004). *After method: Mess in social science research*. Routledge: Abingdon.

- Leonardi, P. (2011). When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. *MIS Quarterly*, 35(1), 147-167.
- Leonardi, P. M., & Barley, S. R. (2010). What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing. *The Academy of Management Annals*, 4(1), 1-51.
- Linder, J. A., Ma, J., Bates, D. W., Middleton, B., & Stafford, R. S. (2007). Electronic health record use and the quality of ambulatory care in the United States. *Archives of Internal Medicine*, 167(13), 1400-1405.
- Locke, K. D. (2001). *Grounded theory in management research*. Thousand Oaks, CA: Sage Publications Ltd.
- Markus, M. L., & Silver, M. S. (2008). A foundation for the study of IT effects: A new look at DeSanctis and Poole's concepts of structural features and spirit. *Journal of the Association for Information Systems*, 9(10/11), 609-632.
- Markus, M. L., & Tanis, C. (2000). The enterprise systems experience-from adoption to success. In R. W. Zmud (ed.), *Framing the domains of IT research: Glimpsing the future through the past* (pp. 173-207). Cincinnati: Pinnaflex Educational Resources.
- McGinn, C. A., Grenier, S., Duplantie, J., Shaw, N., Sicotte, C., Mathieu, L., Leduc, Y., Légaré, F., & Gagnon, M-P. (2011). Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: A systematic review. *BMC Medicine*, 9(46), 1-10.
- McMaster, T., & Wastell, D. (2005). The agency of hybrids: Overcoming the symmetrophobic block. *Scandinavian Journal of Information Systems*, 17(1), 175-182.
- Memory. (n.d.). *Merriam-Webster.com*. Retrieved February 10, 2014, from <http://www.merriam-webster.com/dictionary/memory>
- Memory. (2013). *OED Online*. Oxford University Press. Retrieved February 10, 2014, from <http://www.oed.com.proxy.lib.sfu.ca/view/Entry/116363?redirectedFrom=memory>
- Michael, M. (2000). These boots are made for walking...: Mundane technology, the body and human-environment relations. *Body & Society*, 6(3-4), 107-126.
- Michaels, C. F. (2000). Information, perception, and action: What should ecological psychologists learn from Milner and Goodale (1995)? *Ecological Psychology*, 12(3), 241-258.
- Monteiro, E., & Hanseth, O. (1996). Social shaping of information infrastructure: On being specific about the technology. In W. J. Orlikowski (ed.), *Information Technology and Changes in Organizational Work* (pp. 325-343). London: Champan & Hall.
- Morgeson, F. P., & Hofmann, D. A. (1999). The structure and function of collective constructs: Implications for multilevel research and theory development. *Academy of Management Review*, 24(2), 249-265.
- Oborn, E., Barrett, M., Davidson, E. (2011). Unity in diversity: Electronic patient record use in multidisciplinary practice. *Information Systems Research*, 22(3), 547-564.
- Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, 11(4), 404-428.
- Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. *Organization Studies*, 28(9), 1435-1448.
- Orlikowski, W. J., & Scott, S. V. (2008). Sociomateriality: Challenging the separation of technology, work and organization. *The Academy of Management Annals*, 2(1), 433-474.
- Pickering, A. (1995). *The mangle of practice: Time, agency, and science*: University of Chicago Press.
- President's Council of Advisors on Science and Technology (PCAST). (2010). Report to the President: Realizing the full potential of health information technology to improve healthcare for Americans: The path forward. [Washington, D.C.]: Executive Office of the President.
- Reardon, J. L. & Davidson, E. (2007). An organizational learning perspective on the assimilation of electronic medical records among small physician practices. *European Journal of Information Systems*, 16(6), 681-694.
- Reid, P. P., Compton, W. D., Grossman, J. H., & Fanjiang, G. (2005). *Building a better delivery system: a new engineering/health care partnership*. National Academy Press.
- Rippen, H. E., Pan, E. C., Russell, C., Byrne, C. M., & Swift, E. K. (2012). Organizational framework for health information technology. *International Journal of Medical Informatics*, 82(4), e1-e13.
- Rose, J., Jones, M., & Truex, D. (2005). Socio-theoretic accounts of IS: The problem of agency. *Scandinavian Journal of Information Systems*, 17(1), 133-152.

- Simon, S. R., Kaushal, R., Cleary, P. D., Jenter, C. A., Volk, L. A., Poon, E. G., Orav, E. J., Lo, H. G., Williams, D. H., & Bates, D. W. (2007). Correlates of electronic health record adoption in office practices: A statewide survey. *Journal of the American Medical Informatics Association, 14*(1), 110-117.
- Stoffregen, T. A. (2000). Affordances and events. *Ecological Psychology, 12*(1), 1-28.
- Stoffregen, T. A. (2003). Affordances as properties of the animal-environment system. *Ecological Psychology, 15*(2), 115-134.
- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oak, CA: Sage Publications.
- Suddaby, R. (2006). From the editors: What grounded theory is not. *The Academy of Management Journal, 49*(4), 633-642.
- Turvey, M. T. (1992). Affordances and prospective control: An outline of the ontology. *Ecological psychology, 4*(3), 173-187.
- Urquhart, C. (2007). The evolving nature of grounded theory method: The case of the information systems discipline. *The Sage handbook of grounded theory, 339-59*.
- Volkoff, O., & Strong, D. M. (2013). Critical realism and affordances: Theorizing IT-associated organizational change processes. *MIS Quarterly, 37*(3), 819-834.
- Wilson, E. V., & Tulu, B. (2010). The rise of a health-IT academic focus. *Communications of the ACM 53*(5), 147-150.
- Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., & Faraj, S. (2007). Information technology and the changing fabric of organization. *Organization Science 18*(5), 749-762.

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