

HOW TECHNOLOGY-AFFORDED PRACTICES AT THE MICRO-LEVEL CAN GENERATE CHANGE AT THE FIELD LEVEL: THEORIZING THE RECURSIVE MECHANISM ACTUALIZED IN SWEDISH RHEUMATOLOGY 2000–2014

Anna Essén

House of Innovation, Stockholm School of Economics,
Box 6501, SE-113 83 Stockholm, SWEDEN {anna.essen@hhs.se}

Sara Winterstorm Värlander

Center for Advanced Studies in Leadership, Stockholm School of Economics,
Box 6501, SE-113 83 Stockholm, SWEDEN {sara.winterstorm.varlander@hhs.se}

Appendix A

Literature Review of Recursiveness Studies

Table A1. Summary of Recursiveness Literature Review

Level of Analysis	Study				
	Barley (1986)	Barley (1990)	Orlikowski (1992)	Orlikowski et al. (1995)	Barrett and Walsham (1999)
Institutional/ Field			Mentions environmental pressures such as government regulation, competitive forces, state of knowledge about technology etc., but does not illuminate how these may change over time.		Highlights field-level change (e.g., how IT serves as a disembedding mechanism requiring the development of new trust systems).
Organizational	Highlights change; a more decentralized structure at both sites, although to different degrees.	Articulates how skills, tasks, and activities affect organization's and occupation's structure.	Highlights change. A new tool becomes institutionalized and part of the firm's structure of signification, legitimation, and domination.	Introduces notion of meta-structuring (actors outside a specific project in which a tool is introduced influence project members' variable technology use).	Refers to organizational aspects in terms of how tasks of brokers and underwriters risk disembedding.

Table A1. Summary of Recursiveness Literature Review (Continued)					
	Study				
Level of Analysis	Barley (1986)	Barley (1990)	Orlikowski (1992)	Orlikowski et al. (1995)	Barrett and Walsham (1999)
Individual	Highlights variability across sites.	Variability in day-to-day practices of radiologists and technologists. Does not account for individual variability in enactment of technology.	Mostly a static view on the use of technology among consultants, but acknowledges that a few used interpretive flexibility and workarounds.		Highlights some variability in self-identity within the group regarding concerns for de-skilling/existential anxiety and empowerment/re-skilling.
	Study				
Level of Analysis	Orlikowski (2000)	Boudreau and Robey (2005)	Orlikowski (2007)	Cho et al. (2007)	Davidson and Chismar (2007)
Institutional/ Field		Refers to institutional context in terms of the characteristics of the public organization implementing the technology; contexts seen as stable.	Institutional conditions seen as stable.	Current regulations and conflicts at inter- and intra-organizational levels negatively influenced adoption and diffusion of the new technology.	Highlight institutional triggers for change processes. Institutions remain stable.
Organizational				Conflicts between IT innovation/infrastructure and between emerging work practices and systems-imposed diffusion of the new technology.	Highlights changes in organizational networks emerging from institutions and technology use.
Interactional				New technology contributed to more interdepartmental communication and coordination, but conflicts between new and old practices were not resolved, which led to slow diffusion of new interaction patterns.	Highlights how technology design was influenced by professional roles. At the same time, technology altered roles through a shift in order management tasks.
Individual	Highlights variability at individual level in why, where, and how members interact with a new technology.	Users initially rejected the technology, but then reinvented it in ways that allowed them to accomplish their work.	Highlights variability in use of technology. Users initially rejected the technology, but then reinvented it.		Highlights variability between roles in terms of changes triggered by technology.

Table A1. Summary of Recursiveness Literature Review (Continued)

	Study				
Level of Analysis	Chu and Robey (2008)	Lim et al. (2011)	Azad and King (2012)	Barrett et al. (2013)	Seidel and Berente (2013)
Institutional/ Field	Professional norms among users influenced usage patterns. Show how these norms were reinforced.	Social structures shape different stakeholders' risk accounts, attenuating some and amplifying others. Does not show change in social structures.	Focuses on non-compliant uses of technology due to different social and historical contexts. Contexts seen as stable.	Highlights recursiveness. Rhetorical devices of discourse developed in the institutional context shape IT diffusion, and new competing frames of discourse may challenge dominant frames.	Highlights how different institutional logics enable different technology enactments. Logics remain unaffected by technology implementation at field level.
Organizational		Project organization influences risk accounts and their diffusion.	Computer workarounds can become institutionalized at organizational level and part of everyday routines and practices.		Highlights variability in different practice scripts in the same organization across projects and between levels depending on the logics invoked.
Interactional	Highlights variability over time and across occupational groups. All users had positive expectations of technology's potential to improve learning. All groups used the system initially but decreased usage over time.		Highlights variability between groups and disconnect between policy and practice. Work ethos, discretion to decouple, and material constraints are antecedents to workarounds.		Highlights variability in different practice scripts in groups depending on the logics invoked.
Individual		Individuals enact different frames and construct risk in IT projects differently. A dominant risk account emerges from negotiations.		Highlights variability. Through recombining and mobilizing existing arguments and logics, actors reinterpreting the world can be actively and creatively involved in constructing new arguments.	Highlights variability in different practice scripts depending on the logics individuals invoke. Affordances are embedded in broader institutional contexts.
	Study				
Level of Analysis	Leonardi (2013)	Hultin and Mähring (2014)	Bartelt and Dennis (2014)	Su (2015)	Scarborough et al. (2015)
Institutional/ Field		Institutional logics, variably enacted in socio-material practices, shape affordances and individual attention. Does not show bottom-up reshaping of logics at field level.	Shows how multiple social structures (genre rules), affect how teams perform. Does not show changes in genre rules.	Multiple cultural frames, which in turn affect how employees interact with clients. Argues that frames are fragmented, dynamic, and enacted differently by individuals. Does not map any changes in frames at field level.	Highlights recursiveness as field level diffusion and organizational level implementation interact.

Table A1. Summary of Recursiveness Literature Review (Continued)					
Level of Analysis	Study				
	Leonardi (2013)	Hultin and Mähring (2014)	Bartelt and Dennis (2014)	Su (2015)	Scarborough et al. (2015)
Interactional	Shows how two groups enacted a technology differently: one group developed a shared affordance and the other did not.			The enactment of different frames in turn affects client interactions.	
Individual	Shows how engineers enact individualized affordances.	While the staff constituted visual artefacts through their interpretation of it, the visual artefacts also constitute the staff by forming their intentions and understanding what the prescribed practices mean.		Develops a micro-foundational view on cultural sense-making where individuals enact cultural frames in different ways.	

Note: Areas in gray highlight the studies that capture recursiveness and subsequent change at the institutional/field level.

Appendix B

Assumptions Underlying the CR Approach

Critical realism conceives reality as stratified in three nested domains. The *real domain* consists of physical and social objects (such as technological and social structures) and the causal powers inherent in them. Objects in the real domain create capacities for behavior called mechanisms. If activated, mechanisms generate events and experiences in the *actual domain*. The third layer, the *empirical domain*, is a subset of the actual and includes events and experiences that may be observed through perception or measurement (Archer 1995; Sayer 2000). A key feature of CR is to explain the mechanisms (capacities) that generate a certain event that has been empirically observed.

CR Principles for Data Analysis

In the following, we describe how we executed the five principles characterizing well-executed CR studies as outlined by Wynn and Williams (2012).

Explication of Events

Using the interview transcripts, observational notes, and documents, we determined key events in the empirical domain (e.g., the initial introduction of the PER, stages of PER development and adoption, physician and patient PER-usage patterns, or changes in values). We deployed bracketing (Pozzebon and Pinsonneault 2005) to note the main events on a time line and to detect qualitatively the different phases across the period. The phases were different in terms of the rheumatologist's view and adoption of the PER, which in turn reflected a different constellation of logics at the field level when comparing Phase 1 with Phase 3. (This is shown in more detail in Appendix C.) In Phase 1 (2000–2004), a majority of rheumatologists rejected the PER, and our material pointed at a competitive relationship between logics at the field level. In Phase 2 (2005–2008), diffusion of the PER took off, and the number of rheumatologists who used the PER for multiple purposes increased. The field-level constellation of logics was shifting in this period according to our data. Variable enactments rather than one agreed upon, established field-level constellation of logic were visible. We conceptualize this as a transition period where logics were in flux. In Phase 3 (2009–2014), a majority of rheumatologist clinics had implemented the PER for multiple purposes, and it was no longer seen as controversial, reflecting an additive constellation of logics at the field level.

It was not clear from the outset how the events in the timeline should most adequately be abstracted, as this depends on the theoretical lens chosen (Wynn and Williams 2012). Initially, it was also unclear which events should be considered to constitute the outcome to be explained. Drawing on institutional logics, we realized that the outcome was broader than local changes in routines and actually implied a field-level shift in the ways in which rheumatologists perceived and exercised their profession. That is, we theorized the change in expressed values noted in 2014 as reflecting a change in the institutional logics existing in the domain of the real.

Explication of Structure and Context

We identified the components of the social and physical structure, the contextual environment, and the relationships between them (Bygstad et al. 2016). As noted by Wynn and Williams, the context could be described infinitely, in detail and complexity; hence, trade-offs need to be made. We left out those social and material components that were only anecdotally evident in our empirical material. We acknowledged that the change observed encompassed a larger context than any one single organization. Rather, the change was enacted by rheumatologists all over Sweden. Drawing on institutional theory, we conceptualized Swedish rheumatology as a “field” (Scott and Davis 2007) separate from (but related to) other fields. The rheumatology field was hypothesized as a structure consisting of several interrelated (real) social and material components, including immaterial ideals, material structures, and human actors. We used institutional logics theory and CR to place these components and their capacities into a theoretical perspective (as suggested by Wynn and Williams). For instance, we described field-level norms as several different logics (Thornton et al. 2012) capable of shaping and being shaped by human action; rheumatologists as human actors, capable of shaping and being shaped by logics, technology, and the situational context; and technology as a temporarily stable structure capable of affording and being shaped by human action. All these capacities were related.

Retroduction

The challenge in our longitudinal data was to theorize how the components had caused a majority of rheumatologists to perceive the logic of science, care, and business as additive rather than competing. This outcome was neither intended by any of the actors nor the result of any single event. Rather, it emerged successively during the course of 10 years as a result of several interacting processes which we attempted to detangle and abstract into more general, albeit directly unobservable, mechanisms. In search for these, we coded the data in several rounds. After numerous rounds of recoding, clustering, and abstracting of the micro-level activities observed (see Figure 4 and Appendix D for our coding), the analysis pointed at three processes present in all three phases of our time line, and which together constituted the “recursive” mechanism at play. None of the practices could explain the outcomes alone but, taken together, they exhibited the capacity to drive institutional change. Thus, the recursive mechanism builds on the *combined* theorized capacity of material and social structures (the PER and logics) to shape and be shaped by (afford but not determine) human action, and human actors’ capacity to not only reproduce but also transform such structures. These capacities are indeed the essence of the components and what makes the field of rheumatology what it is (conceptually, mechanisms are “nothing other than the ways of acting of things”; Bhaskar 1998, p. 38). Mechanisms are inherent to physical and social structures, enabling or limiting what can happen within a given context (Sayer 2000; Smith 2006). We found three contextual conditions that enabled the realization of the three micro-level practices: resources for user-driven technology development, decentralized decision-making, and a strong professional community. We identified the contextual conditions by analyzing the relationship between key events and attributes of the field in all three bracketed phases identified. The contextual conditions were present through all phases, and the empirical examples of the three practices could be traced to the conditions through interview transcripts, documentation, and observations. Note that the CR assumption is that the specific outcomes observed here could be generated through other mechanisms in another context (*equifinality*). Further, the recursive mechanism identified here may generate other outcomes in another context (*multifinality*).

Empirical Corroboration

Wynn and William’s fourth principle is important to ensure that the proposed mechanism(s) have causal power and have better explanatory power than alternatives. For example, this can be done through a comparative analysis of the candidate mechanisms to determine the one with the strongest explanatory power (Bygstad 2010). We outlined several alternative causes for the change observed; for instance, exogenous “shocks” such as political agendas or managerial incentives. However, empirical events reflecting such activities seemed temporally to result *from* and *reflect* rather than *cause* the change in rheumatologists’ practices and values. For instance, none of the interviews referred to the nationwide spread of the PER or the use of PER for multiple purposes as a *result* of new regulations, the activities of policy makers, or managerial incentives. Rather, they referred to managers and policy makers as “being clueless,” “leaving us largely alone,” and “not interfering in the process.” Hence, these candidate mechanisms did not seem to have stronger explanatory power in relation to the institutional change observed. The possibility that the shift in rheumatology was merely a result of a more overarching transformation of healthcare at a global level was also considered. This would imply that the recursive practices *reflect* rather than cause a transformation of logics. Many healthcare studies point to a change in healthcare, moving from being impregnated by one dominant logic to multiple competing ones (e.g., Reay and Hinings

2009). The specific ways in which the logics were enacted and transformed, changing the relationship of the constellation of logics from competitive to additive, however, highlighted the salient role of technology in our recursive practices. Without the practices involving the PER, the specific technology-afforded behaviors and field-level logics would have looked different in the third phase. Hence, we view the practices as a necessary condition for the specific outcomes observed. Worded differently, the general shifts at the societal level needed to be operationalized, mobilized, and translated through the technology-afforded practices in order to have an effect in the domain of the real in the field of Swedish rheumatology.

The many roles and locations of respondents further allowed us to view the outcomes from different perspectives. We capitalized on this in our attempt to empirically corroborate, for instance, the perspective of the county council employees and the rheumatologists. Both groups frequently referred to the change as driven by a collective and continuous reinvention of tools, practices, and terms. Our longitudinal analysis further revealed that the mechanism was tied to a change and a “temporal unfolding of events” (Wynn and William 2012, p. 802) not in only one but in all three phases.

Triangulation and Multimethods

Finally, the importance of using triangulation or multimethods is twofold (Wynn and William 2012). First, because CR assumes a reality composed of many types of structures, our use of different methods was required to create knowledge about them and compensate for various weaknesses in each method. For instance, we juxtaposed interviewees’ descriptions of events with the events surfacing during debates at seminars and with the events mentioned in reports and official applications. Because causal analysis lies at the core of CR, multiple sources also allow for a solid understanding of mechanisms and outcomes and provide different and complementary perspectives instead of a limited viewpoint (Mingers 2004). Being two researchers, making sense of the data individually and jointly also provides validity to the conclusions and enabled us to reduce personal biases. We also used triangulation of theories. We found similarities between the meaning systems evident in our data and the institutional logics in other healthcare studies. We also found support for some of the practices in the literature, although there was no comprehensive framework conceptualizing how together they can generate institutional change (see Figure 2).

Appendix C

Examples Illustrating Field-Level Constellation of Logics in Phase 1 and Phase 3

In the following list, each example illustrates a certain relationship between the logics at *field level*. The relationship is depicted in brackets at the end, where “≠” refers to a competitive relationship and “+” refers to an additive relationship between the logics. Note that Table C1 includes examples of relationships enacted through the practices of recursiveness in Phases 1, 2, and 3.

Table C1. Relationships between the Logics at the Field Level

Examples Illustrating Field-Level Logics Enacted as Competitive Phase 1 (2000–2004)
<p>“My reaction was this: The standardized questions in the PER are not the way to make patients involved. You need to create an atmosphere and put your heart into the meeting in order to achieve involved patients. No system can do that for you The PER was primarily a tool for generating data for researchers. Do you think patients care about that? Do you think they want to be left to assess and treat themselves because this saves costs?” (Rheumatologist, non-adopter, interview, 2010) [Logic of care ≠ science]</p>
<p>“We felt that we cannot reduce costs by delegating our tasks to patients, nurses, or computer systems. We [specialists] have long training, experience, which is needed to be able to wisely use evidence and guidelines. Evidence-based medicine is not just about mindlessly executing guidelines.” (Rheumatologist, non-adopter, interview, 2011) [Logic of management ≠ science]</p>
<p>“In the late 90s, a majority of rheumatologists rejected the paper-based patient registry form [predecessor to the PER] because they viewed it as a ‘patient-perspective-humbug thing,’ as being in conflict with safe, evidence-based medicine.” (Health informatics researcher, interview, 2012) [Logic of care ≠ science]</p>
<p>“When the PER was first introduced, the multiple and conflicting goals of our profession were old news and what kept many of us awake. Being a patient’s doctor, listening to the patient, taking into account the individual patient’s needs on the one hand; following the guidelines, standard time slots, being fair, on the other.” (Rheumatologist, interview, 2010) [Logic of care ≠ science]</p>
<p>“In those days [before 2000], I was thankful for being able to ignore the cost issue. Being relieved from this responsibility [thinking of how costs may be minimized] allowed me to focus on doing a good job. It was enough to systematically keep track of the patients.” (Rheumatologist, interview, 2012) [Logic of management ≠ science]</p>
<p>“Evidence-based medicine was the norm, it still is. But it was stricter then [before the PER], it was a narrower definition of evidence-based medicine, which did not include involved patients and the like. Science is one thing, care is another. Two different worlds.” (Healthcare agency employee, interview, 2014) [Logic of care ≠ science]</p>
Examples Illustrating Logics Enacted as Additive in Phase 3 (2009–2014)
<p>“I would say that the PER has contributed to making the fight between care and science outdated. It has made us realize that evidence can be a tool for patients and a tool for making processes more cost efficient. Tools like the PER turn the old view that technology simply increases costs upside down. IT shows a more mutually beneficial relationship between patients, costs, and research.” (Rheumatologist, conversation, 2012) [Logic of care + management + science]</p>
<p>“PER-like modules are now being implemented in other medical specialties too. The government assigned us the task [CUR grant] to develop generic modules that can be used and adopted to other specialties that need to involve patients in data generation and care improvement.” (PER development leader, interview, 2012) [Logic of care + science].</p>
<p>“Now it is easier for them [the PER team] to explain the PER to us policy makers and other specialties as there is an established word for it: Patient-Reported Outcome Measures (PROMs). And everybody loves PROMs! Policy makers because they provide transparency and insight into the results of care from the patient perspective, which policy makers often underline as a way to democratize care. Patient associations love them because they let patients into the formal healthcare assessment system. Managers love them because they potentially encourage patient self-management, which saves rather than consumes</p>

money and time. And, I mean, the truth is, we cannot expect patients to wait for us to develop these tools for them. They have developed their own health data-sharing solutions already! ... The PER folks are good at incorporating these movements ... in their development work, which partly explains the sustainability of the service I think.” (Funding agency employee, conversation, 2012) [Logic of care + management].

“PER data is used in combination with other data in scientific research studies.* While subjective, it is structured and comparable. Incomplete data [lacking fields, etc.] ... has been a problem, but it is improving. So, yes, the data from patients are definitely used both during the encounter in daily clinical practice and in research.” (Rheumatologist, researcher, interview, 2012) [Logic of care + science]

“PER engages patients in the daily monitoring of their health. The data complements other sources as it enables us to study the utility of different treatment alternatives, not only in medical terms but in terms of quality of life.” (Health economist, researcher, interview, 2012) [Logic of care + science]

“Using the PER has become standard almost. Not because it is a perfect technology, gosh no. Because it fits with the overall view of how healthcare should be conducted: embedding data in daily practice. The old view that documentation is for the secretary, and care for the doctor, is untenable. The PER has opened our eyes to the fact that we must base our decisions on data but we need to be smart about how we gather data. To save human labor. The PER has been a game-changer.” (Rheumatologist, interview, 2014) [Logic of management + science]

“A majority of rheumatologists now use the PER. It is nothing controversial anymore. And they use the PER for several purposes. To facilitate an evidence-based conversation with their individual and unique patients. In order to ensure that the evidence-based measures are incorporated in their encounters. In order to save time. In order to generate data for annual reports. They [rheumatologists] use it for different purposes, too; they don't use it in exactly the same way. But the PER is nothing special anymore. It contributes in several different possible ways, and everyone is fine with that. I would say that is how most view PER today.” (Course coordinator, interview, 2014) [Logic of care + management + science]

*Note: Several studies ongoing between 2009 and 2014 were published (e.g., Bremander et al. 2015).

Appendix D

Empirical Examples Illustrating the Three Practices Constituting the Recursive Mechanism

In the Table D1, each example illustrates how the micro-level practices enacted the relationship between logics as additive in all the three phases, thus diverging from the field-level competitive constellation of logics in Phase 1 and Phase 2 (in Phase 2 the field-level constellation was in flux). The relationship enacted is depicted in brackets at the end, where “+” denotes an additive relationship.

Table D1. The Recursive Mechanism: Empirical Examples Illustrating its Three Components

Material Reconstruction Practices	Emergent Usage Practices	Discursive Reconstruction Practices
<p>“[With the PER], patients with a system account could log in and enter their assessment directly into the system. Physicians had few possibilities to influence or filter what was entered [physicians could make <i>post hoc</i> changes to one field] This meant that patients became participants in the production of structured data, and so we became part of the evidence cycle.” (Patient, chair of patient association, interview, referring to Phase 2) [Logic of care + science]</p> <p>“The PER included a print button, allowing patients to print and bring their assessment on paper to their doctor. The idea was that having a paper with one’s self-reported numbers would enable patients to ensure that their voice was heard I think this was not what most people meant by patient-centeredness in early 2000, but we wanted to push the patient-centeredness movement in that direction.” (Rheumatologist, PER team, interview, referring to Phase 1) [Logic of care + science]</p> <p>“The PER enabled patients to generate evidence as it asked patients to rate the same standardized dimensions at every single meeting. Rather than the variable verbal accounts that are typically provided by patients, the PER and its restricted data format generates comparable data that can be used in research, which disturbed the prevailing deeply rooted view of evidence.” (Rheumatologist, researcher, interview, referring to Phases 1–2) [Logic of care + science]</p>	<p>“At some observational occasions, patients used their printed PER health assessment to debate the dosage of the prescribed drugs due to its severe side effects. For instance, a patient asked a physician at a meeting, ‘But what about my ability do [this and that]?’ Look at the values [as rated]; they could indeed be better.” (Field notes, Phase 3) [Logic of care + science]</p> <p>“I initially introduced the PER to a few of my patients. I however doubted their capacity, as some of them had deformed hand joints and were far from IT-savvy. But most of the patients were able to do this not everybody, but a majority ... and it made me more interested in involving patients more concretely, rather than just talking about holistic care and the like, which is unrealistic We need ways of involving patients that is useful to them <i>and</i> us. Not only do they [patients using the PER] seem to appreciate being asked <i>what they</i> perceive, they really concentrate on doing this task correctly. This improves the data!” (Rheumatologist, PER user, interview, 2012, Phase 3) [Logic of care + science]</p> <p>“We began using PER to monitor patients at a distance in ... 2010. The ones who are well [with stable values] don’t need to come in to the office. So we manage all our patients with fewer doctors. The upside is that patients like it; they don’t have to interrupt what they are doing just to visit the hospital for a routine checkup. They can decide if they need to see us. We are adjusting to their individual health status. Still, few copied this model in the beginning... rheumatologists were not used to think along these lines; they thought patients always want to see the doctor as much as possible.” (Rheumatologist, PER user, interview, referring to Phase 3) [Logic of care + management]</p>	<p>“There were anxieties early on. But I was like, why is a physician’s subjective assessment sounder evidence than a patient’s lived, experienced reporting? Come on! I was sometimes provocative at these PER discussions, but these questions need to be posed, and the PER made them come to the surface.” (Rheumatologist nurse, researcher and PER user, interview, referring to Phase 1) [Logic of care + science]</p> <p>“We [rheumatologists] keep <i>talking</i> about how to empower patients, utilize their competence The PER is a concrete tool for this, used by rheumatologists and RA patients every week, all over Sweden! ... The PER shows that patients are capable of entering this data—you nod, but I know many of us are afraid of endangering patient safety if we hand over things to patients Consider this, all the instruments in the PER are scientifically validated.” (Field notes from observation at a Swedish Health IT conference, Phase 3) [Logic of care + science]</p> <p>“The PER helps patients to think through and share with me how they are. It is easier for both of us when we see the same numbers. We use the measures as a start, then we can discuss the nonmeasured! ... It is also nice for patients to know that the data is used in research. Many patients want to contribute to healthcare. And they don’t want to ‘waste’ healthcare resources.” (Field notes from observation of discussion at political week in Sweden, Phase 3) [Logic of care + management + science]</p>

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