PREVENT, REDESIGN, ADOPT OR IGNORE: IMPROVING HEALTHCARE USING KNOWLEDGE OF WORKAROUNDS

Research paper

Beerepoot, Iris, ICTZ and Vrije Universiteit Amsterdam, The Netherlands, i.m.beerepoot@vu.nl

van de Weerd, Inge, Vrije Universiteit Amsterdam, The Netherlands, i.vande.weerd@vu.nl

Abstract

The complex and variable nature of healthcare work makes alignment of health information systems to healthcare processes a challenge, causing the emergence of workarounds. We developed three artifacts to use knowledge of workarounds to address this misalignment and enable the improvement of work systems. (1) The Workaround Snapshot, in which the necessary social and technical information about a workaround is captured, such as motivation, impact on the work system, and possible actions that can be taken. (2) The Workaround Action Impact Matrix, which illustrates the possible decisions that can be made. (3) The Workaround Snapshot Approach, a socio-technical approach that uses the previous artifacts to enable continuous improvement. Following the principles of design science, the artifacts are demonstrated and evaluated through a case study at a Dutch hospital, where we identified and examined twelve workarounds. The approach has proven to enable the organization to make well-informed decisions on actions to be taken, which at times result in direct improvement of the work system. We contribute to existing research in moving past the identification and categorization of workarounds, towards utilizing explicit knowledge of workarounds to improve the work system.

Keywords: Workarounds, Work System, Process Improvement, Health Information Systems.

1 Introduction

In healthcare organizations, working around the prescribed procedures is the norm, rather than an exception (Koppel et al., 2008; 2015). An example of such a workaround in healthcare is a nurse writing information about patients on a piece of paper, instead of using the portable Computer on Wheels (COW). After doing their rounds, they enter the patient checks in the Health Information System (HIS). Yang et al. (2012) define such workarounds as "alternative procedures employed by users to accomplish a task in response to a misfit between computer-based and existing work processes". In healthcare, this misfit between computer-based and existing work processes is especially evident (Kobayashi et al., 2005; Nadrah & Michell, 2013; Safadi & Faraj, 2010; Vogelsmeier et al., 2008). A possible reason for this is the complex and variable nature of healthcare work (Ash et al., 2004; Cresswell et al., 2016; Kobayashi et al., 2005; Koppel et al., 2008), which makes alignment of HISs to healthcare processes a major challenge (Lenz & Kuhn, 2004). Although information systems (IS) are a key factor in providing healthcare professionals access to the needed information and thereby improving the quality of healthcare, the existence of IT-related workarounds may have a negative effect on patient safety and security (Koppel et al., 2008; Röder et al., 2015; Vogelsmeier et al., 2008).

To make managing them even more complex, healthcare processes are subject to change because of new technologies and changing responsibilities, leading to a need for healthcare work systems to continuously adapt to new conditions (Berg, 1999; Lenz & Kuhn, 2004). Knowledge of workarounds potentially offers a means to do so. Whereas workarounds can have negative effects (Ash et al., 2004; Azad & King, 2008; Outmazgin & Soffer, 2013; Patterson et al., 2006) and are often used as a form of resistance towards a system (Ferneley et al., 2004, Pollock, 2005), their existence can also be viewed positively

(Halbesleben et al., 2008). Knowledge of workarounds can signal important issues in process alignment, can help mitigate risks and may even offer a blueprint for identifying misfits that need to be resolved (Petrides et al., 2004; Safadi & Faraj, 2010; Vogelsmeier et al., 2008). According to Safadi and Faraj (2010), "workarounds are knowledge about the IS but in the context of work needs". However, to derive these work needs, tacit knowledge about the requirements of IS users should be transformed into explicit knowledge that enables improvements to IS and work processes.

As workarounds exist at the intersection of technology and its use by human actors (Cabitza & Simone, 2013), gathering explicit knowledge about them requires attention to both the social and technical aspects of the environment. Therefore, we take a socio-technical perspective on healthcare processes, where we recognize the recursive shaping of work processes and information systems (Leonardi, 2012). In this socio-technical perspective, it is useful to think of the healthcare environment as a work system: "a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products/services for specific internal and/or external customers" (Alter, 2013). To discover how analyzing workarounds and translating them into work needs can aid healthcare organizations in improving their work systems, we ask the following research question: how can explicit knowledge of workarounds in healthcare processes enable the improvement of work systems? We start by sketching the theoretical background, after which we discuss the methodology. Then, we present and evaluate our artifacts and conclude with a discussion and conclusion.

2 Literature Review

2.1 A Socio-Technical Perspective

First, it is important to distinguish workarounds as behavioral activities from the actual tweaking or hacking of a technology (Cabitza & Simone, 2013). We focus specifically on the first, on the behavioral activities that emerge when a technology is implemented and being used by social actors in an organization. Especially in terms of compliance, these workaround activities have often been viewed as negative phenomena (Röder et al., 2014a). However, they are also seen as potentially beneficial activities (Cabitza & Simone, 2013; Cresswell et al., 2016; Nadrah & Michell, 2013; Röder et al., 2014a; Safadi & Faraj, 2010). They are believed to enable the identification of gaps between work processes and their representation in the information system (Petrides et al., 2004) and draw attention to things that need fixing (Lalley & Malloch, 2010). Being aware of how processes are worked around, allows for the redesign of these processes such that gaps can be resolved (Cresswell et al., 2016).

Attention to workarounds also allows for the bottom-up involvement of process participants (Azad & King, 2011). They contain information about behavior of users, thus acting as a feedback resource that may be used to improve the system (Cresswell et al., 2016). Several scholars believe the involvement of users is crucial in developing an information system that fits the work processes (Ciborra, 2004; Helfert, 2009; Lalley & Malloch, 2010; Safadi & Faraj, 2010). As such, users can take ownership in shaping the features of the information system (Bednar & Welch, 2009). Involving caregivers in the design of healthcare systems and integrating the entire socio-technical system "is especially helpful for health care", because of the complex characteristics of the environment and high demands regarding the care of patients (Ackerman, 2016).

2.2 Continuous Monitoring of Workarounds

Not only do workarounds signal misfits between work processes and IS and provide feedback of users; they are also "tangible behaviors" that can be observed, which makes them suitable for identification and analysis (Safadi & Faraj, 2010). However, they will only surface when the information system is in active use (Ash et al., 2004). According to Ciborra (2004), it is highly important in the IS discipline to pay attention to the usage of technology in everyday life. This means studying the matching "between plasticity of the artefact and the multiform practices of the actors involved" (Ciborra, 2004). Therefore, analysis of workarounds is only possible in the post-implementation phase of an information system,

when users start interacting with the technology and enact a technology-in-practice (Orlikowski, 2000). Important to recognize is that, as social context continuously changes, so does the interaction of users with the technology. As work processes change, new requirements will surface and thus new workarounds will emerge. Existing ones will evolve and stabilize because of their evolutionary characteristics (Cabitza & Simone, 2013). Gaps between the work process and the information system will always remain present (Petrides et al., 2004). Hence, the fit between work processes and information systems must be evaluated continuously (Koppel et al., 2008). Constant vigilance is crucial here (Ash et al., 2004). Only when the work system is continuously monitored can underlying problems be addressed and resolved (Koppel et al., 2008; Vogelsmeier et al., 2008).

2.3 Addressing Workarounds

Up until now, research related to workarounds has focused on how and why people work around. In what ways knowledge of workarounds can lead to improvement of work systems, is still unclear. However, it is believed that by addressing them, it has the potential to do so. To move from knowing that people work around and how they do it, towards using this knowledge to improve the work system, well-informed decisions need to be made. In previous work, researchers have discussed several actions that can be taken regarding workarounds. For example, ignoring them is often harmful (Alter, 2015), while formalizing or institutionalizing is believed to be advantageous (Azad & King, 2011; Cresswell et al., 2016; Koppel et al., 2008; Yang et al., 2012).

The different types of actions mentioned in literature can be clustered into four groups (Table 1). In this research, these four action groups are key. We aim to find out whether knowledge about workarounds can be made explicit in such a way that this knowledge enables an organization to make a well-informed decision on any of the four actions, and by doing so, to enable the organization to improve its work system.

Action	**Definition**	**Examples of synonyms used in literature**
Prevent workaround (Nadrah & Michell, 2013)	Developing countermeasures to prevent a workaround from happening.	Prohibit (Röder et al., 2014b), eliminate (Vogelsmeier et al., 2008), demonize (Cresswell et al., 2016), modify IT (McGann & Lyytinen, 2008)
Adopt workaround (Nadrah & Michell, 2013)	Transforming a workaround into a formal process.	Formalize (Cresswell et al., 2016), institutionalize (Azad & King, 2011), 'Pave the cowpath' (Cabitza & Simone, 2013)
Redesign process (Dumas et al., 2013)	Reorganizing processes to resolve the misfit that resulted in workarounds.	Fit (Gasser, 1986), embellish process (McGann & Lyytinen, 2008)
Ignore workaround (Alter, 2015)	Not taking any action regarding the workaround.	Tolerate (Röder et al., 2014b)

Table 1. Possible Actions Regarding Workarounds.

3 Research Approach

Our research follows a design science research approach. Hevner et al. (2004, p. 75) describe that in the design science paradigm, artifacts are built and applied in order to achieve "knowledge and understanding of a problem domain and its solution". In this study, our goal is to develop artifacts that make knowledge about workarounds explicit and thereby enable improvement of work systems, in particular in the healthcare domain. We follow the Design Science Research Methodology of Peffers et al. (2007), as illustrated in Figure 1.

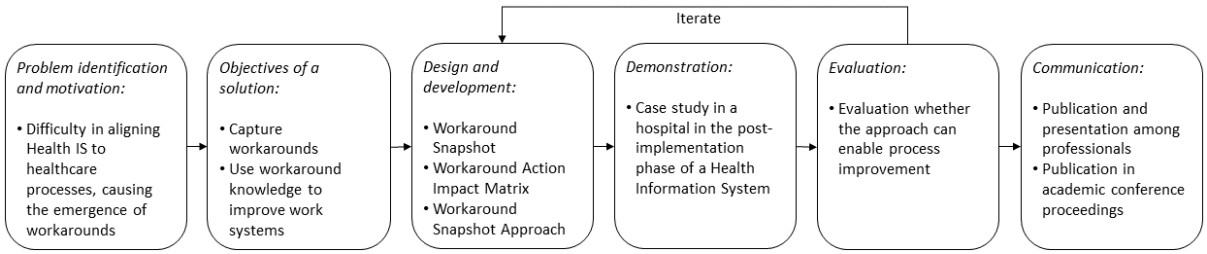

Figure 1. Design Science Research Methodology (following Peffers et al., 2007)

We first identified the problem: the challenging alignment of Health Information Systems to healthcare processes. If they are not well-aligned, workarounds emerge, which may have negative effects on the work system.

We then defined our objectives for a solution to the identified problem. Our solution should be able to capture workarounds in a structured and meaningful way, and use this knowledge to improve work systems. Workarounds should be captured as enactment of ´technologies-in-practice' (Orlikowski, 2000), with a focus on how the health information system is engaged and interacted with in everyday practice and how this enacts structures of technology. By integrating a 'practice lens' in our approach, we focus specifically on how people use the health information system, how they interact with it, and how they enact the technology-in-practice by working around the system.

In the design and development phase, we developed three artifacts: the Workaround Snapshot to capture workarounds, the Workaround Action Impact Matrix to evaluate and decide on action, and the Workaround Snapshot Approach that uses the previous two artifacts to identify, evaluate and monitor workarounds in order to enable improvement of work systems. Our approach is a socio-technical approach that focuses on human agency and how users of a HIS enact and construct the technology.

As an important part of design science entails the demonstration and evaluation of an artefact, we demonstrate and evaluate our artifacts in a case study. Performing a case study allows us to carry out a detailed and intensive analysis of the case (Bryman, 2015), examining the complex environment a healthcare organization often is. The case type is representative (Yin, 2013): a hospital that is amid a digital transformation, representing many other hospitals and hospital departments in the post-implementation phase of a HIS. The first results of this study have been presented to a professional audience. In this paper, we will present our full study and evaluation results.

The remainder of this paper is structured as follows: we start with the artifact descriptions (section 4), followed by the evaluation of the artifacts through the case study (section 5), and finish with a discussion (section 6) and conclusion (section 7).

4 Artifact Descriptions

4.1 Artifact 1: The Workaround Snapshot

Alter (2015) proposed a method to capture knowledge of a work system in the form of a 'work system snapshot': a summary of different elements of a work system, such as customers, products, major activities and technologies. Inspired by this, we propose the creation of 'workaround snapshots' to make knowledge about workarounds explicit. A workaround snapshot contains the essential information about the social and technical aspects of the deviation and forces the creator to keep the information concise, so that it allows for quick analysis.

The structure of the snapshots is shown in Table 2. Included in the snapshot is the creation date, a list of the types of workers involved, and a concise textual description of the workaround, which is to be readable by someone without extensive knowledge of IT and/or healthcare. It also contains a process model of the workaround to illustrate both the activities of the prescribed model and the deviations. A description of the impact of the workaround on the work system is included as well, as a workaround can

simultaneously have a positive effect on one factor and a negative effect on another (Andrade et al., 2016; Röder et al., 2014b). To illustrate this trade-off, the snapshot includes a devil's quadrangle of impacts (Dumas et al., 2013).

The last two components of the snapshot include a description of the motivation of the worker to work around (e.g. whether it is intentional or unintentional) and an inventory of possible actions to be taken, based on the four actions mentioned in Table 1. Actions belonging to the *prevent* cluster are actions where a decision is made to actively prevent the workaround from happening. Actions belonging to the *adopt* cluster are actions where the workaround is considered the best available way of performing a task and this alternative is actively distributed. The *redesign* cluster includes actions that redesign the work process, resulting in the prescribed process being altered. The last cluster, *ignore*, includes actions that leave everything as-is.

Snapshot Component	**Content**
Date of snapshot	Date the snapshot was created.
Workers	Roles that are involved in the workaround.
Description	Concise textual description of the workaround.
Process model	Process model.
Impact	Impact of the workaround in terms of the devil's quadrangle.
Motivation	Description of the worker's motivation to work around.
Possible actions	Inventory of actions that can be taken: prevent, adopt, redesign, or ignore.

Table 2. The Workaround Snapshot structure.

By creating workaround snapshots, we aim to transform tacit knowledge about the needs of healthcare users, into explicit knowledge that can be utilized to improve the work system.

4.2 Artifact 2: The Workaround Action Matrix

To represent the possible actions, we propose the Workaround Action Matrix in Figure 2. *Ignoring* a deviation requires low management effort and no changes to the prescribed process. *Prevention* of a workaround, on the other hand, requires high management effort, but does not require changes to the prescribed process either. It may, however, entail changes in the information system, in order to prevent users from circumventing the system. The *redesign* cluster of actions differs from *prevention* in the sense that the prescribed process is altered, and therefore requires a high management effort. Lastly, *adoption* of a workaround does require changes to the prescribed process, but does not require as much effort from management as the *redesign* and *prevent* cluster, as it is already in use and its value to achieve a goal is already recognized by users.

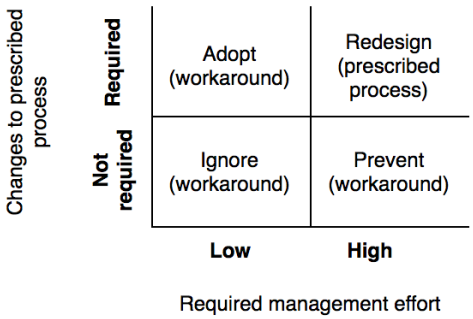

Figure 2. The Workaround Action Impact Matrix

By subdividing the possible actions into the different boxes, a decision-maker can easily determine what the required effort is for a certain action and whether changes to the prescribed process are necessary if that action is chosen.

4.3 Artifact 3: The Workaround Snapshot Approach

The snapshot and the action matrix are core elements of our approach, but it is not sufficient to develop snapshots alone. To enable continuous improvement, there needs to be a continuous workflow of evaluating and addressing workarounds. The technology-in-practice and how it is enacted by users should be monitored continuously, to allow the organization to recursively shape the work system based on the needs of its users. At the start of this workflow is the identification of the deviation: the trigger. A deviation is identified when workaround activities are spotted in an observation or interview. A snapshot is subsequently created for this workaround, which is iteratively improved through discussions with all those involved. When all components of the snapshot are filled in, a well-informed decision can be made on an action to be taken. The chosen action is recorded, after which the process is monitored for the agreed time frame. At the end of this period, the workaround is evaluated. The snapshot is adjusted accordingly, and a decision is made whether the action needs to be changed. The workaround is again monitored, evaluated, etc., resulting in the model illustrated in Figure 3.

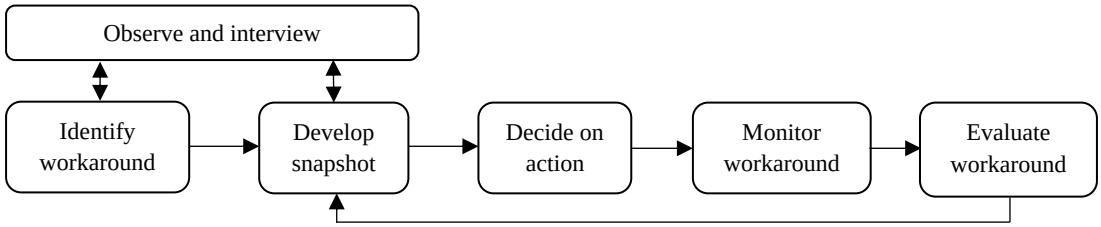

Figure 3. The Workaround Snapshot Approach.

5 Case Study

The case study was executed at a Dutch peripheral hospital. The hospital is a client of the first author's employer, ICTZ, a consultancy company specialized in HISs. Data was collected at one ward during the months of April, May and June 2017. The first author received full access to the ward, which consists of around thirty clinical beds and is run by a team of nurses, caregivers and helpers. Also working on the department are surgeons, orthopedists, physicians and physiotherapists. The team lead of the ward allowed the researcher to observe everyone there and interact with both the nurses and physicians. A nursing suit was provided to not draw attention to the research being done.

5.1 Data Collection and Analysis

Data gathering mainly took the form of ethnographic observations and interviews that were carried out by the first author. Secondary data in the form of internal documents were provided by the ward's team lead. Initially, interviews with the team lead were planned to uncover the prescribed processes. Interviews and observations with nurses and physicians would follow afterwards, through which the actual process would be discovered. However, the discovery of workarounds turned out to be more of an iterative process where interviews and observations merged. To decide whether a nurse's or physician's activities were indeed workarounds, regular visits to the team lead were necessary. Interviews turned into observations when participants eagerly showed how they worked around an obstacle in the process or when a colleague asked them to perform a task. Active observations, where the researcher asked the participant to show the execution of a specific task, alternated with passive observations, where the researcher would watch the participants perform their daily work.

During six hours of interviews and a further sixteen hours of observations, data were collected from eight nurses, five physicians, one pharmacist, and the team lead. Twelve workarounds were identified and worked out in detail. One HIS consultant from ICTZ who played a large role in the previous phases of the HIS implementation and with a background in nursing was consulted during two sessions to gain additional information about the problems underlying the different workarounds and the possible actions that can be taken to improve the work system.

As soon as sufficient information was gathered on the workarounds, they were presented to the team lead. After discussing each deviation, the team lead was encouraged to answer a set of questions, with the aim of verifying the used approach. We provided the same information to a second team lead from another ward and asked her for a response, in order to verify the application of the approach and recognition of the workarounds outside the ward of the case study.

The first author recorded and transcribed the interviews and took notes during the observations. All transcripts, notes and internal documents were collected in qualitative analysis software Atlas.ti and coded there. Coding of the interview transcripts and observation notes was done deductively, on the basis of the components of the snapshot, i.e. 'workers', 'description', 'impact' and 'motivation'. The results from the interviews and observations and associated codes were regularly discussed with the second author and edited if necessary.

5.2 Identified Workarounds

Snapshots were created for all twelve workarounds identified in the case study. Table 3 lists the found workarounds and includes the sources from which the information was collected. The following sections present a few illustrative examples of the snapshot components Process model, Impact, Motivation, and Possible Actions. The content of the snapshots is based on the assessment of the participants, not on the assessment of the authors. The last section includes an overall evaluation of the applicability of the approach to the case.

ID	Workaround description	Source
WA1	No or partial entering of medication (a) and calling for missing medication (b)	N1, N3, N8, P4, T
WA2	Entering patient checks on paper instead of Computer on Wheels (COW)	N1, N2, T
WA3	Logging in with someone else's user account	P3
WA4	Using the activity plan alternatively	N1, N3, T
WA5	Executing dismissal checklist only partially, not at all or not in time	N1, N3, N4, N5, T
WA6	Not adequately performing the second check during administering medication	N1, N3, T
WA7	Performing an extra visual check during printing of home medication	P1, P2, P3
WA8	Walking away from the computer without locking	Several Ps and Ns
WA9	Irregular check of rush orders	N1, N3
WA10	Checking of occupancy other departments than their own	N3, T
WA11	Not sending home medication to pharmacy (in time)	N1, Pha, P3, P5, T
WA12	Entering medication in activity plan instead of administration register	N3, N4, T

Table 3. Identified workarounds (N=Nurse, P=Physician, Pha=Pharmacist, T=Team lead).

5.3 Process Model

The first workaround, WA1, involves incomplete information about medication of a patient that has returned from the operating room. As the team lead explains: *"The physician is responsible for settling everything related to medications, but they don't, causing the nurses to constantly be confronted with questions about pills, things that are incomplete, so they need to call after it. And then the physician says: I just got my hands covered in blood, so it will take half an hour"*.

Figure 5 shows the process model for WA1. The physician responsible for entering this information, does not do so sufficiently, forcing the nurse responsible for administering the medication to call the physician for more information and subsequently entering the information ad-hoc. The first difference between the prescribed activities and the workaround activities is that in the latter, the physician does not enter the medication information correctly. This affects the activities later in the stream, as the nurse notices the information is not present. Because of this, the nurse needs to ask for the information, an activity that is not necessary in the prescribed process. The physician is then interrupted in his work,

which would not happen if the information was entered correctly. Lastly, the nurse needs to perform another activity: entering information ad-hoc. Therefore, by working around the entering of information at the start, new activities are added later in the stream. This relates to the *cascading effect* of workarounds as referred to by Kobayashi et al. (2005), who found that one workaround may initiate further deviations down the line.

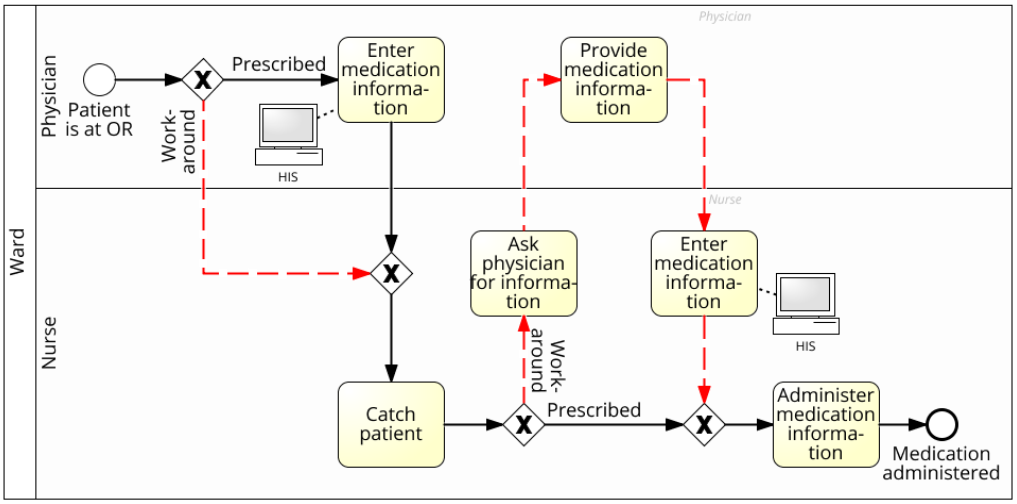

Figure 4. Process model for WA1.

5.4 Impact

An illustrative example of the impacts trade-off is WA6, illustrated in Figure 5. When one nurse administers certain medication to a patient, a second nurse is required to check whether the right medication is given to the right patient at the right time. However, it sometimes occurs that the second nurse simply gives his or her personal code, so that the order can quickly be signed off without the actual check executed. Nurse: *"It is about trusting each other. If someone needs to walk along every time until you put that pill there… we won't be able to do our jobs"*.

The impact on cost in this case is neutral, as there are no costs involved in not checking the medication, unless the hospital is caught and fined. The impact on time is clearly positive, as all activities involved in the check are omitted. The impact on the flexibility of the worker is positive as well, as the second nurse is available to do other tasks. The impact on quality is negative, as errors may not be identified in administering medication.

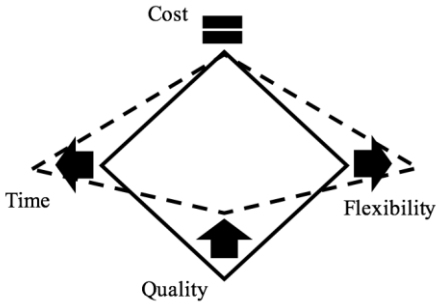

Figure 5. Devil's Quadrangle of Impacts for WA6.

5.5 Motivation

WA2 relates to the process of entering information about the regular patient check-up. Five Computers on Wheels (COWs) are present at the ward, to enable immediate entering of information at each patient's bedside. However, many nurses choose not to use the COW and write the information on a piece of paper, after which they enter it in the system one after another. Nurse: *"I need to do more things at once,*

and people ask a lot of questions during checks. So I rather perform my checks and write them down, do my stuff and when I have some time I sit down for a while and fill them in quietly".

When asked for their motivation to work around, they say they prefer to enter the data in a quiet place, as it allows them to concentrate better. Entering the data using the COW means they spend more time at a patient's bedside, resulting in other patients asking them for help.

5.6 Possible Actions

WA3 concerns a co-assistant in the last stage of his study, who consistently logs in on another physician's account. Co-assistant: *"So every morning, I log on as one of the physicians. […] Imagine I would only have that co-assistant login… Well, I wouldn't be able to do anything"*.

His own user account does not allow him to do anything other than view information and perform the most basic tasks, although he is entitled to perform other tasks for physicians because of his seniority. Four actions can be performed here. The first is to consider a new system role. This role can be attributed to all co-assistants in the last stage of their studies and equipped with the specific capabilities they need. This action is a form of *prevention*, as the aim is to prevent the co-assistant from performing the workaround (i.e. logging in with someone else's account). By creating a new system role, there is no more need to log in with the physician's account and the deviation can be prevented. In this case, the HIS is changed, but the prescribed process remains the same: i.e. using your own account and performing the work. Another *prevention* option is to prohibit the workaround, by actively monitoring and prohibiting the logging in on someone else's account. This, however, is labor-intensive, difficult to monitor and denies co-assistants the possibility of executing their work.

Another example is WA5. This concerns nurses not executing the patient dismissal checklist completely and/or in time. *Redesign* may entail the development of a new checklist. The hospital makes use of standard content, meaning that this content is supplied by the HIS provider and based on a default hospital. Therefore, the standard checklist includes tasks that are not relevant for the nurses of the ward, which results in them not following the checklist at all. It also means that the checklist cannot be edited. However, it is possible to create a new list from scratch and add just the elements that this ward needs. The workaround may also be *prevented* by organizing a meeting in which attention is paid to the checklist and the tasks that should be completed. Such a meeting may increase understanding and compliance.

5.7 The WSA as an Enabler for Process Improvement

The Workaround Snapshot Approach has been evaluated by discussing the snapshots with the team lead of the ward. Questions that were asked related to the comprehensibility and completeness of the snapshots, the team lead's awareness of the workarounds presented and his thoughts on the added value of the possible actions. Whether the actions chosen by the team lead were actually implemented, could not be verified within the time frame of this study.

According to the team lead, all snapshots were clear and understandable. Not once did he find the snapshot lacking essential information. Many snapshots provided the team lead with new information, especially regarding the possible actions that can be taken. For example, the team lead was unaware of the possibility of using the HIS on a tablet, making him consider the purchase of tablets in favor of COWs. He was also unaware of the possibility of developing an entirely new patient dismissal checklist that is tuned specifically for the ward. A last example is the possibility of facilitating the physicians in keeping track of their patients through the development of a convenient layout in the HIS.

Many workarounds caused the team lead concern, and urged him to undertake action. Regarding WA1, for instance, the team lead chose a combination of both *redesign* and *prevention*. For WA2, the team lead chose to *prevent* the use of paper in favor of COWs: *"what I prefer is that they use the COWs"*. When asked why, he said: *"I'd rather have quality of care than a small stroke of efficiency"*.

The actions chosen by the team lead are represented in the Action Impact Matrix in Figure 6. *Adopt* was not once chosen: it was most often either *prevent* or *redesign* or a combination of the two. In two cases,

the team lead said not to take action, which translates to choosing to ignore. Notable is that the two workarounds where he said not to take action, i.e. to ignore, were indeed one where flexibility was positive and quality was neutral (WA2), and one where both flexibility and quality were positive (WA10). All others had a devil's quadrangle where flexibility or quality were negatively impacted, therefore it was deemed necessary to undertake action. Although time and cost are important, the most crucial factors for the team lead in terms of impact are quality and flexibility. The team lead strongly believes the information from the snapshots enables the organization to improve the work system, and he answered positively to the question whether he sees value in a re-inventory of the workarounds after a year.

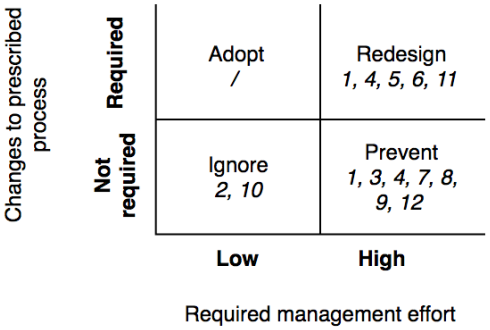

Figure 6. The team lead's intended decisions, represented in the Action Impact Matrix.

In order to get an indication of the generalizability of the approach, a second team lead was interviewed. She considered the snapshots clear and comprehensive, recognized the issues related to medication and considers them a top priority. Nurses using paper instead of COWs are not considered concerning by either team leads, especially if it helps them concentrate better. Employees logging in under another name is not unique to the one ward either, as on others it also happens that new nurses have already worked for two weeks before they get a HIS tutorial. By default, nurses do not get an account before they have had the tutorial, so they must have worked on someone else's account for the time being.

The general belief is that the creation of workaround snapshots enables the team leads to improve their work systems. Both team leads expressed interest in performing subsequent analyses after the final stage of the implementation has finished.

6 Discussion

6.1 Creating Snapshots and Using the Action Matrix and WSA

With little time on site, the Workaround Snapshot Approach enabled us to draw a comprehensive picture of the technology-in-practice and its enactment, by encouraging workers to talk about their usage of the system. The creation of the snapshots was an iterative process that required repetitive consultation of different informants to confirm the information about the workaround. In business process management studies, involving different domain experts is a standard practice, as one person is rarely aware of an entire process (Dumas et al., 2013). By developing snapshots, one gathers knowledge of different domain experts and by presenting this combined knowledge in a clear and concise manner, this holds great value for the organization. By presenting the team lead with information about deviations he was unaware of, the WSA also allows for the voices of the system's users to reach decision-makers, a feat that is often difficult to achieve in organizations (Cabitza & Simone, 2013). By listening to the voices of the HIS users and making decisions based on their needs, users start playing a role in the construction of the work system as well.

The proposed components of the snapshot have proven to be very encompassing. The Possible Actions component has turned out to be especially useful, by providing new information in terms of solutions other process participants had been unaware of. The representation of the Possible Actions through the Action Matrix enabled structured evaluation of possible decisions for the team lead. With regards to the

impact of a workaround, there is a trade-off involved, as few of them have a negative impact on all factors. On the contrary, some of them have great benefits on time, cost, quality and/or flexibility, which corresponds to the idea that workarounds can in some ways be beneficial (Cabitza & Simone, 2013; Cresswell et al., 2016; Nadrah & Michell, 2013; Röder et al., 2014a; Safadi & Faraj, 2010).

One necessity for identifying workarounds and developing snapshots, is for the participants to be willing to share this information. Lalley and Malloch (2010) proposed the development of a new culture of user involvement and sharing. Process participants in such a culture need to be encouraged to share their ways of working so that awareness can be achieved. Organizations need to be proactive in identifying workarounds and addressing them (Koppel et al., 2008), creating standard procedures for identifying, monitoring and evaluating workarounds. They hereby become more responsive so that they can react to changing needs (Lenz & Kuhn, 2004). By developing such procedures, they are on track to grow, instead of build, their work system (Atkinson & Peel, 1998). This approach also corresponds to the idea that technologies should not merely be handed to users and left there, but that they should continuously evolve and adapt to the organizational context they are part of (Cabitza, 2014).

Similar to creating a culture of user involvement for participants to share information on issues and deviations, decision-makers should also be allowed to admit that some workarounds will be tolerated. Tolerating workarounds can be beneficial (Huuskonen et al., 2013; McGann et al., 2008; Miller & Wedell-Wedellsborg, 2013). Especially when efficiency gains are expected, managers are often willing to tolerate deviations (Röder et al., 2014b). The same goes for decision-makers in healthcare. Not all issues can be solved at once: choices must be made regarding solutions to invest in. There is another trade-off here in terms of choosing the workarounds that are most in need of a solution. If using paper instead of COWs is preferred by workers, the impacts are not considered problematic, and an alternative is costly, it may be acceptable to tolerate this deviation.

One pattern found in the causes of workarounds is communication. At least one-third of the deviations identified in this study have something to do with information not being communicated correctly. This corresponds to one of the two types of unintended consequences Ash et al. (2004) have defined in the use of health information technology: issues related to the communication and coordination the system is supposed to support. Another pattern concerns the use of standard content. The vendor of the HIS aims to equip hospitals with standard content, as opposed to customizing the HIS for each and every hospital. This allows them to support hospitals more easily, but it brings side-effects with it. Although this has not been studied in depth as this was not the focus of the research, some workarounds may actually be the result of this standard content. For example, by deploying a standard patient dismissal checklist that is not tuned to a specific hospital ward, users are overwhelmed by the number of tasks and sometimes choose to dismiss the checklist altogether. By introducing standard content that does not suit the work process, this may in fact pave the way for other deviations. This "self-defeating propagation of additional computer workarounds", should be avoided (Azad & King, 2008).

However, we acknowledge that customization of the HIS to the organization in question is not always possible. As Safadi and Faraj (2010) note, there is always the trade-off of improving processes through customization versus the costs that are involved with customization. Different strategies in resolving misfits have advantages and disadvantages and choosing one depends on many factors, e.g. the size of the organization, whether it regards a perceived or imposed misfit, etc. (Van Beijsterveld and Van Groenendaal, 2016).

The findings in this study have several implications for practice. The Workaround Snapshot Approach not only enables an organization to make explicit how and why people work around, but to utilize this knowledge as well. Creating snapshots allows for the gathering of knowledge from different domain experts, empowering the organization to make a well-informed decision. We propose to illustrate the impact of a workaround on the work system using a devil's quadrangle, and to take action by preventing, adopting or ignoring workarounds, or redesigning the prescribed process. We thereby go beyond the design and development of the technology, and broaden our view to the entire socio-technical work system.

6.2 Limitations and future work

There are limitations to this study as well. First of all, the case study has been done on a single ward in a single hospital. We therefore consulted a second team lead to verify the findings, who recognized many deviations, although in slightly different form. The interest in a re-inventory of workarounds and the belief that awareness of deviations can lead to an improvement of the work system is shared, but application outside these wards and this hospital remains to be verified. Second, this research has not reached saturation in terms of the workarounds identified on the ward. We identified twelve deviations, but more may exist. Moreover, the interviews and observations were performed by one researcher, resulting in only one perspective on the deviations, although the approach to the development of snapshots through discussing the information with many different participants allows for multiple perspectives. The inventory of workarounds and their frequencies is not intended to be exhaustive, but intends to explore the application of the approach in an actual hospital ward.

The study presents a first step towards realizing improvement of work systems by making knowledge of workarounds explicit. Further research might validate the application of the approach on a larger scale and over the course of years. Longitudinal research would allow for the tracking of changes over time and analysis of the effect of actions taken on the work system. Future research may also focus on methods to uncover workarounds, such as the automatic detection and monitoring of workarounds through process mining (Van der Aalst, 2011). Finally, the assumption that workaround knowledge can be used for continuous improvement of work systems aligns with the work of Feldman and Pentland (2003), who state that organizational routines are not only related to stability, as assumed in the traditional understanding of organizational routines, but also "a source of flexibility and change". Moreover, Truex, Baskerville and Klein (1990) claim that systems should continuously be adjusted and adapted, similar to the organizations they serve. This opens up opportunities for future research such as investigating in which health processes workarounds are more or less likely to emerge, and under which circumstances healthcare process should be allowed a certain degree of flexibility.

7 Conclusion

In this study, we investigated how explicit knowledge of workarounds can enable the continuous improvement of work systems. We explored whether knowledge about workarounds can be made explicit and thereby enable an organization to make well-informed decisions on actions to be taken. In order to capture the knowledge needed to accomplish work system improvement, we proposed three artifacts: the Workaround Snapshot, the Workaround Action Matrix and the overarching Workaround Snapshot Approach. These socio-technical artifacts have proven to be valuable tools in analyzing deviations that emerge from the misfit between healthcare work processes and the health information system. We contribute to existing research in moving from how and why people work around, to how this knowledge can be made explicit and utilized. The creation of workaround snapshots, by capturing knowledge from different types of participants, contributes to raising awareness about workarounds in terms of impact, motivation and possible actions that can be taken. The case study shows that the approach enables an organization to make well-informed decisions, as several proposed actions bring about immediate improvement to the work system.

References

Ackerman, M., Prilla, M., Stary, C., Herrmann, T., & Goggins, S. (2017). *Designing Healthcare That Works: A Sociotechnical Approach*. Academic Press.

Alter, S. (2013). Work system theory: overview of core concepts, extensions, and challenges for the future. *Journal of the Association for Information Systems*, *14*(2), 72.

Alter, S. (2015). A workaround design system for anticipating, designing, and/or preventing workarounds. In *International Conference on Enterprise, Business-Process and Information Systems Modeling* (pp. 489-498). Springer International Publishing.

Andrade, E., van der Aa, H., Leopold, H., Alter, S., & Reijers, H. (2016). Factors Leading to Business Process Noncompliance and its Positive and Negative Effects: Empirical Insights from a Case Study. In *22nd Americas Conference on Information Systems (AMCIS 2016), San Diego, USA*.

Ash, J. S., Berg, M., & Coiera, E. (2004). Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. *Journal of the American Medical Informatics Association*, *11*(2), 104-112.

Atkinson, C. J., & Peel, V. J. (1998). Transforming a hospital through growing, not building, an electronic patient record system. *Methods of information in medicine*, *37*(3), 285-293.

Azad, B., & King, N. (2008). Enacting computer workaround practices within a medication dispensing system. *European Journal of Information Systems*, *17*(3), 264-278.

Azad, B., & King, N. (2011). Institutionalized computer workaround practices in a Mediterranean country: an examination of two organizations. *European Journal of Information Systems*, *21*(4), 358-372.

Bednar, P. M., & Welch, C. (2009). Contextual inquiry and requirements shaping. In *Information Systems Development* (pp. 225-236). Springer US.

Berg, M. (1999). Patient care information systems and health care work: a sociotechnical approach. *International journal of medical informatics*, *55*(2), 87-101.

Bryman, A. (2015). *Social research methods*. Oxford university press.

Cabitza, F., & Simone, C. (2013). "Drops Hollowing the Stone": Workarounds as Resources for Better Task-Artifact Fit. In *ECSCW 2013: Proceedings of the 13th European Conference on Computer Supported Cooperative Work*, 21-25 September 2013, Paphos, Cyprus (pp. 103-122). Springer London.

Cabitza, F. (2014). De-designing the IT artifact. Drafting small narratives for the coming of the Socio-Technical Artifact. In *ItAIS 2014, Proceedings of the 11th conference of the Italian chapter of AIS-Digital innovation and inclusive knowledge in times of change, track on design and re-design of socio-technical systems* (pp. 21-22).

Ciborra, C. (2004). Encountering information systems as a phenomenon. *The social study of information and communication technology: Innovation, actors, and contexts*, 17-37.

Cresswell, K. M., Mozaffar, H., Lee, L., Williams, R., & Sheikh, A. (2016). Workarounds to hospital electronic prescribing systems: a qualitative study in English hospitals. *BMJ quality & safety*, bmjqs-2015.

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2013). *Fundamentals of business process management* (Vol. 1). Heidelberg: Springer.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative science quarterly*, *48*(1), 94-118.

Ferneley, E., Sobreperez, P., & Stevens, J. (2004). Management Information or Trompe L'Oeil? Resistance to Workplace Surveillance. *PACIS 2004 Proceedings*, *78*.

Gasser, L. (1986). The integration of computing and routine work. *ACM Transactions on Information Systems (TOIS)*, 4(3), 205-225.

Halbesleben, J. R., Wakefield, D. S., & Wakefield, B. J. (2008). Work-arounds in health care settings: Literature review and research agenda. *Health care management review*, *33*(1), 2-12.

Helfert, M. (2009). Challenges of business processes management in healthcare: Experience in the Irish healthcare sector. *Business Process Management Journal*, *15*(6), 937-952.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS quarterly*, *28*(1), 75-105.

Huuskonen, S., & Vakkari, P. (2013). "I did it my way": Social workers as secondary designers of a client information system. *Information processing & management*, *49*(1), 380-391.

Kobayashi, M., Fussell, S. R., Xiao, Y., & Seagull, F. J. (2005). Work coordination, workflow, and workarounds in a medical context. In *CHI'05 Extended Abstracts on Human Factors in Computing Systems* (pp. 1561-1564). ACM.

Koppel, R., Smith, S. W., Blythe, J., & Kothari, V. (2015). Workarounds to computer access in healthcare organizations: you want my password or a dead patient? In *ITCH* (pp. 215-220).

Koppel, R., Wetterneck, T., Telles, J. L., & Karsh, B. T. (2008). Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety. *Journal of the American Medical Informatics Association*, *15*(4), 408-423.

Lalley, C., & Malloch, K. (2010). Workarounds: the hidden pathway to excellence. *Nurse Leader*, *8*(4), 29-32.

Lenz, R., & Kuhn, K. A. (2004). Towards a continuous evolution and adaptation of information systems in healthcare. *International journal of medical informatics*, *73*(1), 75-89.

Leonardi, P. M. (2012). Materiality, Sociomateriality, and Socio-Technical Systems: What Do These Terms Mean? How Are They Related? Do We Need Them? In P. M. Leonardi, B. A. Nardi, & J. Kallinikos (Eds.), *Materiality and Organizing: Social Interaction in a Technological World* (pp. 25-48). Oxford: Oxford University Press.

McGann, S. T., & Lyytinen, K. (2008). The improvisation effect: a case study of user improvisation and its effects on information system evolution. *ICIS 2008 Proceedings*, 209.

Miller, P., & Wedell-Wedellsborg, T. (2013). The case for stealth innovation. *Harvard business review*, *91*(3), 90.

Nadrah, N., & Michell, V. (2013). A normative method to analyse workarounds in a healthcare environment: their motivations, consequences, and constraints. In *The 14th International Conference on Informatics and Semiotics in Organisations, ICISO* (pp. 195-204).

Orlikowski, W. J. (2008). Using technology and constituting structures: A practice lens for studying technology in organizations. In *Resources, co-evolution and artifacts* (pp. 255-305). Springer London.

Outmazgin, N., & Soffer, P. (2013). Business process workarounds: what can and cannot be detected by process mining. In *Enterprise, Business-Process and Information Systems Modeling* (pp. 48-62). Springer Berlin Heidelberg.

Patterson, E. S., Rogers, M. L., Chapman, R. J., & Render, M. L. (2006). Compliance with intended use of bar code medication administration in acute and long-term care: an observational study. *Human factors*, *48*(1), 15-22.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of management information systems*, *24*(3), 45-77.

Petrides, L. A., McClelland, S. I., & Nodine, T. R. (2004). Costs and benefits of the workaround: Inventive solution or costly alternative. *International Journal of Educational Management*, *18*(2), 100-108.

Pollock, N. (2005). When is a work-around? Conflict and negotiation in computer systems development. *Science, Technology, & Human Values*, *30*(4), 496-514.

Röder, N., Wiesche, M., & Schermann, M. (2014a). A situational perspective on workarounds in IT-enabled business processes: A multiple case study. *ECIS 2014 Proceedings*.

Röder, N., Wiesche, M., Schermann, M., & Krcmar, H. (2014b). Why managers tolerate workarounds–the role of information systems. *AMCIS 2014 Proceedings*.

Röder, N., Wiesche, M., Schermann, M., & Krcmar, H. (2015). Workaround Aware Business Process Modeling. In *Wirtschaftsinformatik* (pp. 482-496).

Safadi, H., & Faraj, S. (2010). The Role of workarounds during an Open Source Electronic Medical Record System Implementation. In *ICIS* (p. 47).

Truex, D. P., Baskerville, R., & Klein, H. (1999). Growing systems in emergent organizations. Communications of the ACM, 42(8), 117-123.

Van Beijsterveld, J. A., & Van Groenendaal, W. J. (2016). Solving misfits in ERP implementations by SMEs. *Information Systems Journal, 26*(4), 369-393.

Van der Aalst, W.M.P. (2011). *Process Mining: Discovery, Conformance and Enhancement of Business Processes*. Springer-Verlag, Berlin.

Vogelsmeier, A. A., Halbesleben, J. R., & Scott-Cawiezell, J. R. (2008). Technology implementation and workarounds in the nursing home. *Journal of the American Medical Informatics Association*, *15*(1), 114-119.

Yang, Z., Ng, B. Y., Kankanhalli, A., & Yip, J. W. L. (2012). Workarounds in the use of IS in healthcare: A case study of an electronic medication administration system. *International Journal of Human-Computer Studies*, *70*(1), 43-65.

Yin, R. K. (2013). *Case study research: Design and methods*. Sage publications.