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WORKING AROUND HEALTH INFORMATION SYSTEMS: TO ACCEPT OR NOT TO ACCEPT?

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Research paper

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Abstract

Many healthcare processes are complex and variable, which makes it difficult to align them with rigid information systems. To cope with the resulting misalignment, caregivers invent alternatives, also known as workarounds. Workarounds with negative consequences, such as those that affect the safety of patients, need to be prevented. However, those with positive consequences may be adopted by the organisation. In this study, we set out to discover which workarounds are generally acceptable and which ones should be rejected. We have discovered ten different workarounds in a Dutch hospital and analysed these in terms of three characteristics associated with healthcare processes. We found that workarounds existing in knowledge-intensive processes and/or where a patient is involved are generally considered unacceptable. In contrast, workarounds in processes with a high degree of collaboration are likely to be accepted, provided that little knowledge is required and that no patient is involved. We contribute to the current literature on addressing workarounds in healthcare settings by providing insights into the factors influencing the organisational decision to accept or reject workarounds. In addition, we provide healthcare organisations with the tools to evaluate which workarounds are attractive to be established as proper work practices.

Keywords: workarounds, health information systems, information systems, qualitative comparative analysis.

1 Introduction

Since the start of the century, health information systems (HISs) have been widely implemented in hospitals throughout the world. Commonly introduced as a promise to achieve better healthcare, many of these implementations were in hindsight judged as failures (Littlejohns, Wyatt and Garvican, n.d.; Heeks, 2006). One of the reasons HISs are less successful than other information systems is because healthcare processes are more complex than other processes (Wager, Lee and Glaser, 2009; Winter et al., 2010). The technologies in healthcare organizations are tasked with supporting the day-to-day processes of caregivers, processes which are inherently variable.

The difficulty of aligning technologies with user needs leads to a 'design-reality gap' (Heeks, 2006). The difference between "where the HIS wants to get us" and "where we are now" is evident. The larger this difference, the more a HIS is considered a failure. What has become clear in multiple studies in healthcare is that we see 'workarounds' emerge when such a gap exists between design and reality; or between policy and practice (Debono, Greenfield, Black and Braithwaite, 2010; Yang, Ng, Kankanhalli and Luen Yip, 2012; Debono et al., 2013). Such workarounds can be seen as deviations from the designed policies, which can be viewed both negatively and positively: negatively in terms of

security incompliance and positively in terms of ingenious solutions (Safadi and Faraj, 2010; Cabitza and Simone, 2013; Nadhrah and Michell, 2014; Röder, Wiesche, Schermann and Krcmar, 2014).

In general, there is agreement that workarounds with negative consequences need to be prevented and those with positive consequences may be adopted organization-wide. However, evaluating workarounds as either positive or negative is a difficult task, since a single workaround may have both positive and negative consequences. What may offer an entirely new perspective on the decision to accept or reject workarounds is to assess them on the basis of the type of processes they are related to. In this study, we ask the research question: *which characteristics are associated with healthcare processes and under which conditions should a workaround be accepted or rejected?* In doing so, we attempt to discover which workarounds are generally considered acceptable and which factors influence this decision. We thereby contribute to current literature discussing how to address workarounds in healthcare settings. Moreover, the outcomes may help healthcare organizations to evaluate workarounds and successfully act on them.

2 Related work

Traditional information systems focus on the support of repetitive and predictable processes (Combi, Pozzi and Veltri, 2017). These processes are designed prior to their execution in terms of formal protocols that describe how the information system is to be used. However, in contrast to repetitive and predictable processes, healthcare processes are often dynamic and unpredictable (Lenz and Reichert, 2007; Dhieb and Barkaoui, 2011; Combi, Pozzi and Veltri, 2017). Some healthcare processes consist of relatively predictable procedures defined by law, like handling single medical orders or examinations. Other healthcare processes, such as those related to patient treatment, are inherently unpredictable (Reichert and Pryss, 2017). Processes in healthcare are therefore characterized by both well-defined procedures and the need for flexibility (Van der Aalst, Weske and Grünbauer, 2005).

The unpredictability of some healthcare processes and the difficulty of developing information systems that support these processes may explain the major focus on healthcare organizations in studies on workarounds (Kobayashi, Fussell, Xiao and Seagull, 2005; Azad and King, 2008b; Ali, Cornford and Klecun, 2010; Halbesleben, Savage, Wakefield and Wakefield, 2010; Safadi and Faraj, 2010; Zhou, Ackerman and Zheng, 2011; Yang et al., 2012; Ilie, 2013; Koppel, Smith, Blythe and Kothari, 2015; Reiz and Gewald, 2016). The term 'workaround' itself has been defined differently throughout these studies. Based on many of these definitions, Alter proposed the following definition, which we adopt:

"*A workaround is a goal-driven adaptation, improvisation, or other change to one or more aspects of an existing work system in order to overcome, bypass, or minimize the impact of obstacles, exceptions, anomalies, mishaps, established practices, management expectations, or structural constraints that are perceived as preventing that work system or its participants from achieving a desired level of efficiency, effectiveness, or other organizational or personal goals*" (2014, p. 1044).

This definition allows us to include examples of improvisation and bricolage, loose coupling, bypasses and technology adaptation, but exclude activities that result from "inattention, accidents, or mistakes" (Alter, 2014). Important in this definition is the idea of temporality. As Safadi & Faraj (2010) note, workarounds emerge and evolve over time. The workaround reaches the end of its lifecycle when it is used repetitively and becomes established practice. When the workaround has become established practice, we no longer consider it as a workaround.

Several researchers have mentioned actions that organizations can take to address workarounds (Beerepoot and Van De Weerd, 2018; Van de Weerd, Vollers, Beerepoot and Fantinato, 2019). Some of these actions mentioned relate to accepting workarounds – e.g. tolerating (Röder et al., 2014), formalizing (Cresswell et al., 2017), or institutionalizing (Azad and King, 2012) these. Others are related to rejecting workarounds – e.g. prohibiting (Röder et al., 2014), eliminating (Vogelsmeier, Halbesleben and Scott-Cawiezell, 2008), or demonizing (Cresswell et al., 2017) workarounds. Deciding on which workarounds to accept and which ones to reject is a complex task. Röder et al. (2014)

shed some light on the willingness of managers to accept workarounds. They determined three factors that have an effect on a manager's willingness to accept a workaround, namely:

- Expected efficiency gains: positive effect on willingness to accept
- Exposure to compliance risks: negative effect on willingness to accept
- Perceived process weaknesses: mediating effect on exposure to compliance risk

The study by Röder et al. (Röder et al., 2014) gives important insights into how managers evaluate workarounds. However, this approach relies on managers' views on workarounds and their consequences. We aim to contribute to this work and others by taking a different perspective, focusing on the basic characteristics of healthcare processes that can be objectively determined.

In the following section, we describe the methodology of this study. Then, we present the results and discuss our findings in more detail. We close with some concluding remarks.

3 Methodology

Our study can be divided into three phases: characteristics discovery, process discovery, and qualitative comparative analysis. We will explain our activities and the goals of the individual phases in more detail below.

3.1 Phase one: characteristics discovery

The goal of phase one has been to discover the characteristics that are associated with healthcare processes and that can be used to determine which workarounds should be accepted or rejected. The characteristics discovery phase has been performed by the second author in the form of a literature review. This review has resulted in nine characteristics.

3.2 Phase two: workarounds discovery

In phase 2, authors one and two have set out to discover a set of processes with workarounds in a Dutch hospital. We have done this qualitatively, through observations and semi-structured interviews. The data have been collected at two wards of the hospital between May and June 2018. Both authors one and two had full access to the two wards and were allowed to speak to all healthcare professionals present on the ward at the time of our study. We captured all the important information around workarounds in 'workaround snapshots', as proposed by Beerepoot and Van de Weerd (Beerepoot and Van De Weerd, 2018). Table 1 presents an overview of the data collection.

Researcher	Ward	Method	Participant(s)	Duration
2	Inpatient	Observations	7 nurses	8.5 hrs
2	Inpatient	Observations	Clinical secretary	1 hr
2	Inpatient	Observations	2 front office members	30 minutes
1	Outpatient	Observations	2 back office members	3 hrs
1	Outpatient	Observations	2 urologists	8 hrs
2	Inpatient	Observations	Physician assistant	2.5 hrs
1	Outpatient	Interview	Team lead outpatient care	1.5 hrs
2	Inpatient	Interview	Team lead inpatient care	1.5 hrs
1+2	N.a.	Interview	Coordinator application management	1 hr

Table 1. Overview of observations and interviews phase two

3.3 Phase three: qualitative comparative analysis

The goal of phase three has been to analyse the discovered healthcare processes of phase two, according to the characteristics found in the literature review of phase one. For this purpose, we conducted a Qualitative Comparative Analysis (QCA). QCA is an approach for "systematic cross-case comparisons while at the same time giving justice to within-case complexity, particularly in small- and intermediate-N research design" (Ragin and Rihoux, 2009). It is a research method in comparative case-oriented research that makes it possible to investigate a small number of cases where a specific outcome has occurred, compared to those where the outcome did not occur. QCA uses qualitative data derived from a case study to identify conditions for an outcome. Thus, this method discovers combinations of factors (in this study, characteristics) that explain a certain outcome (Schulze-Bentrop, 2013). In this study, the outcome is the acceptance or rejection of a workaround.

QCA can be carried out in different ways. We used QCA based on Boolean algebra and on examining the minimum combination of variables that may result in either the absence or presence of the outcome (Ragin and Rihoux, 2009). The method identifies different logical combinations of factors, using the AND or the OR expressions, that might be necessary and/or sufficient to produce the outcome. The results of this analysis help to discover combinations of factors that explain a certain outcome (Schulze-Bentrop, 2013).

We organized a workshop with five domain experts to determine for each process whether the characteristic was present: assigning a score of 1 when present and a score of 0 when absent. Additionally, we determined for each process whether the workaround should be accepted or rejected. The domain experts were all employees of the company that implemented the HISs in the five case organizations. They have a combined experience of 74 years of working with HIS in hospital settings, either in an advisory or project management role. Together they have worked in 30 unique hospitals in the Netherlands and Belgium. Additionally, they often have a background as caregivers (education and work experience). Table 2 provides a summary of the workshop participants.

Participant	Occupation	Years of experience in healthcare	Former occupation
1	Senior Business Consultant & team lead	27	Nurse and senior IT advisor in hospital
2	Senior Business Consultant	28	Nurse and manager IT in hospital
3	Senior Business Consultant	14	IT developer in hospital
4	Business Consultant	4	General IT employee in hospital
5	Junior Business consultant	1	Not applicable

Table 2. Overview of workshop participants

Based on the workshop with domain experts we constructed a truth table and analysed the relationships among the factors. To find and understand the patterns, the truth table was minimized (Ragin, 1994). Finally, based on the found patterns, a descriptive explanation of how the characteristics might influence the outcome is presented.

4 Results

4.1 Discovered characteristics

The literature review performed in phase one resulted in nine characteristics of processes that might play a role in determining which workarounds to accept or reject. In Table 3, we include exemplary references for each of the nine characteristics. We also give our definition of the characteristic and describe what we mean by a presence or absence of the characteristic.

Characteristic	Description
Knowledge (Silvestro, Fitzgerald, Johnston and Voss, 1992; Davenport, Jarvenpaa and Beers, 1996; Schafermeyer, Grgecic and Rosenkranz, 2010; Davenport, 2015; Di Ciccio, Marrella and Russo, 2015)	The knowledge characteristic refers to whether the knowledge required within the process is simple and mainly explicit, or complex. An example of simple knowledge is step-by-step instructions that can be provided for completing a task within the process. Complex knowledge is when the process requires human knowledge-based decision making.
Patient involvement (Lee and Park, 2009; Schafermeyer et al., 2010; Kemsley, 2011; Trkman, Mertens, Viaene and Gemmel, 2015)	The role of the patient can range from completely passive to highly active. In the most passive form, the patient is not present during the execution of the process and only expects the output from the process. In the more active forms, the patient can determine the order or even actively participate in the fulfilment of the process.
Healthcare professional (Karsh, Holden, Alper and Or, 2006; Zwarenstein, Goldman and Reeves, 2009)	The role of the healthcare professional refers to the person delivering care to the patient, e.g. a doctor or nurse. A process can be executed completely automatically, meaning that no healthcare professional is involved. It can also be fully performed by the healthcare professional, with no involvement of the system, meaning that the role of the healthcare professional is highest.
Collaboration (Marjanovic, Skaf-Molli, Molli and Godart, 2007)	The collaboration characteristic refers to the presence or absence of collaboration between healthcare professionals. This can range from no collaboration to a highly collaborative process.
Structure (Helfert, 2009; Felin, Foss, Heimeriks and Madsen, 2012)	The structure characteristic relates to the structures in place to support the process. An example of a highly structured process would be one that is strongly formalised in a workflow management system. An informally developed process would be an example of the opposite of a highly structured process.
Repeatability (Isik, den Bergh and Mertens, 2012)	The repeatability characteristic refers to the extent to which the process can be repeated in a similar way. On the one hand of the spectrum would be a process that is never repeated. On the other hand of the spectrum processes are continuously repeated.
Laws and regulations (Ramezani, Fahland, van der Werf and Mattheis, 2011)	The laws and regulations characteristic refers to the extent to which the execution of a process is constrained by the laws and regulations the organisation has to comply with. In healthcare especially, some medication processes are highly regulated, whereas others are not at all regulated.
Complexity (Cardoso, Mendling, Neumann and Reijers, 2006; Martinho, Rijo and Nunes, 2015)	The complexity characteristic refers to how complex the process is. For example, a process can be highly complex in terms of number of activities, decision points and different participants involved, or it can be very simple.
Predictability (Benner and Tushman, 2003; Lockamy III and McCormack, 2004)	The predictability characteristic refers mostly to the outcome of the process; e.g. whether it achieves the predicted performance outcomes. When the outcome is always the same, it pertains a highly predictable process.

Table 3. Characteristics with definitions.

In the next section, we present the results of phase two: the workaround discovery phase.

4.2 Discovered Workarounds

During the observations and interviews in the hospital, we observed a total of ten healthcare processes with workarounds. We will describe these workarounds one by one here.

1. Physicians having patients carry medical images

During patient-physician consultations, a physician uses medical imaging devices to discover a patient's physical status. Instead of digitally sending the images directly to the HIS, the physician prints

them out. He prefers having the image on paper and considers finding the image in the system too time-consuming. He asks the patient to take the paper to the front desk to have it digitised.

2. Nurses bypassing the verification of a second nurse during medication administration

When a nurse administers medication to patients, the system requests a verification by a second nurse, to ensure four eyes confirm that the right medication is giving to the right patient. It is time consuming for two nurses to go to each patient together and check the medication that is administered, and the nurses have found a way to bypass the verification box, allowing them to circumvent the verification step.

3. Physicians sending themselves a reminder to write a letter to a patient's general practitioner

At the end of patient-physician consultations, physicians send a letter to the patient's general practitioner. In this letter they describe what was discussed, which examinations were performed and which medication the patient is currently taking. Instead of writing the letter at the end of the consultation, the physician chooses to postpone it to another time because of time shortage. He creates a communication order - intended to communicate with other caregivers - and sends it to himself as a reminder to write the letter afterwards.

4. Nurses registering a patient's treatment plan next to that of the physician

Physicians visit patients together with nurses, to discuss the patient's recovery and establish a treatment plan. Physicians register the treatment plan in their part of the system. Nurses are only permitted to treat the patient according to the treatment plan. However, the nurses sometimes feel the plan registered by the physician is incomplete. Therefore, they register the plan themselves in a part of the system they have access to, even though their part of the system is not intended to contain this kind of information.

5. Physician assistant calling physician to update the treatment plan

Physician assistants (PAs) are engaged with treating patients up to a certain level, thereby alleviating the work load of physicians. Instead of waiting for the physician to come to them with news on a patient, PAs sometimes call physicians to review the results of a patient and establish a treatment plan. Otherwise, the patient may be left waiting unnecessarily long for news on their treatment.

6. Nurses leaving score blank and entering it differently

A system functionality nurses often use is a patient's activity plan. In the activity plan, all tasks that need to be done for that patient are listed. One of these activities is calculating a patient's Early Warning Score (EWS). Instead of entering this information directly, some nurses leave it blank, after which they enter it in another view within the information system. The reason for this is that they prefer to have the EWS in the same place as the other scores and measurements, and this way allows them to do so.

7. Nurses calculating a patient's inflow and outflow of fluids manually

Nurses keep track of a patient's inflow and outflow of fluids. The system allows them to view a history of the inflow and outflow of fluids over a period of time. However, they have discovered that this history is not always accurate, which is why they started calculating it manually on a piece of paper.

8. Nurses registering patient information in incorrect time slot or asking next shift to register

Nurses need to register the care activities they performed in the concerning text field in the patient's medical records. When their shift ends, they can no longer edit the text field of the ended shift. What happens is that nurses do not have the time to register until after their shift has finished, or they have forgotten something that does belong in the patient record. To solve this problem, they write the information down on paper and ask the next shift to enter it for them.

9. Physician assistants requesting informal consultation

The physician assistant calls a microbiologist to ask for advice on a patient, which typically needs to be done through the system via a formal request for consultation. However, the information system does not currently allow microbiologists to register consultations. Instead of a formal request for consultation through the information system, the consultation is performed through an informal phone

call. This way, the microbiologist can advise the physician assistant, but it cannot be formally registered.

10 Department secretaries entering a star symbol in a free text field

The secretaries are tasked with preparing the physician-patient consultations. They check whether the results from a patient's examinations are all present, to make sure they do not come to the hospital in vain. To indicate that a result is present, they enter a star in the text field behind the result. By doing so, colleagues can take over at any time and continue this preparatory work.

In the next section, we analyse each workaround in terms of their characteristics and outcomes.

4.3 Analysis of the outcomes

During the workshop with domain experts, we established the characteristics of the processes where the workarounds occurred. We then discussed whether to accept or reject the workaround. As mentioned in the related work section, accepting means formalising or institutionalising the workaround throughout the organization, or tolerating it as-is. Rejecting a workaround entails actively prohibiting, eliminating or demonising the deviation.

For each workaround and each characteristic, we assigned a Boolean 1 when the characteristic was assigned a high value by the workshop participants and a Boolean 0 when it was not. Using the resulting matrix, we evaluated which characteristics seemed to influence the decision to accept or reject a workaround. What became clear at once was that the healthcare professional was highly involved in each process, meaning that all ten cases were assigned a Boolean 1 for the healthcare professional characteristic. The same was true for repeatability, as all ten occurred daily or even hourly. Both structure and predictability were considered difficult to characterise by the participants. Therefore, we did not weigh these characteristics heavily in our analysis.

Following our analysis, we found that knowledge, patient involvement and collaboration played major roles in the determination to accept or reject a workaround. Therefore, we focus on these three characteristics in the following sections, although we include the full characterisation of accepted and rejected workarounds in the Appendix.

A Boolean 1 was assigned to a workaround for knowledge when expert knowledge is required to perform the workaround. A workaround received a 1 for patient involvement when the patient is actively involved in the process and physically present when the workaround is enacted. Lastly, workarounds received a 1 for collaboration when more than one caregiver is involved and these are affected by the workaround. Table 3 presents the characteristics and outcomes for each of the 10 workarounds.

ID	Knowledge	Patient involvement	Collaboration	Outcome
1	0	1	0	Reject
2	0	1	1	Reject
3	0	1	0	Accept
4	1	1	1	Reject
5	0	0	1	Accept
6	0	1	0	Reject
7	1	0	0	Reject
8	1	0	1	Reject
9	0	0	1	Accept
10	0	0	1	Accept

Table 3. Characteristics and outcomes of the ten observed workarounds.

To illustrate our analysis, we will explain workaround W4 in more detail. W4 relates to nurses registering a patient's treatment plan in parallel with the physician. Expert knowledge is necessary in this

process, as registering a treatment plan of a patient requires extensive medical knowledge. As the process takes place at the patient's bedside and the patient participates in conversations with the physician and nurse, patient involvement is considered high as well. Since both physicians and nurses are involved in this process and actions performed by one affect the other, collaboration is also high. Therefore, all characteristics are marked with a 1. In terms of the outcome, the domain experts considered rejection the best way to address W4. The reason for this is that the double registration of treatment plans leads to inconsistencies. It is no longer clear where the complete and correct information is stored and this may lead to nurses not administering the correct treatment to patients. The way forward would be to prevent nurses from using this workaround and to make sure physicians register the treatment plan correctly in the first place.

Table 4 presents a truth table that shows all the possible configurations of the three different characteristics that were considered to affect the decision to accept or reject the workaround. Six of the eight possible configurations are present in our data set of workarounds: B, C, D, E, F and H. The first configuration, A, has no added value, since it contains none of the three characteristics. Configuration A and G were not found in our data set.

Configuration	Knowledge	Patient involvement	Collaboration	Accepted	Rejected
A: 000	0	0	0		
B: 001	0	0	1	W5, W9, W10	
C: 010	0	1	0	W3	W1, W6
D: 011	0	1	1		W2
E: 100	1	0	0		W7
F: 101	1	0	1		W8
G: 110	1	1	0		
H: 111	1	1	1		W4

Table 4. Possible configurations of the characteristics, with relevant workarounds.

Figure 1 presents a set-theoretic representation of the data set. In this figure, processes with workarounds that were accepted are marked in grayscale, while processes with rejected workarounds are illustrated in white.

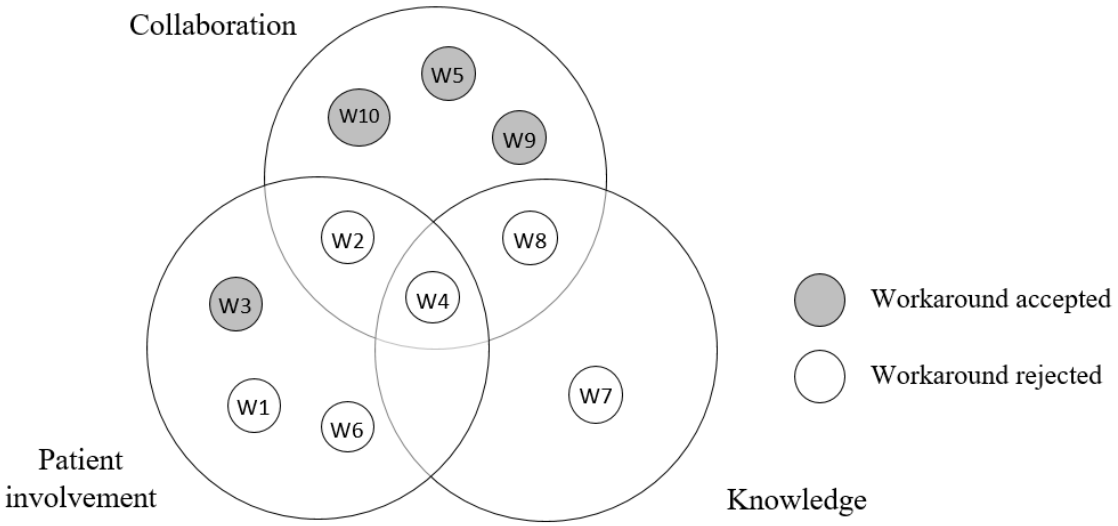

Figure 1. Set-theoretic representation of the data set.

What stands out is that most workarounds in processes that require expert knowledge and/or where the patient is highly involved (the lower circles), are rejected. Workaround W3 is the only exception. The

three workarounds occurring in highly-collaborative processes, but where the involvement of the patient is low and expert knowledge is not necessary (the upper circle), were all accepted. In the following section, we examine these findings in more detail and discuss their implications.

5 Discussion

5.1 Rejection of workarounds when expert knowledge is required

The first of the findings resulting from the analysis relates to the requirement of expert knowledge in rejecting a workaround (the lower right circle in Figure 1). The three workarounds where the required knowledge in enacting the process was considered high by the domain experts (W4, W7 and W8) were all rejected. This suggests that in processes where knowledge is an important factor and complex decision-making is involved, deviations are generally unacceptable. W7 (nurses calculating a patient's inflow and outflow of fluids manually) is an example of a rejected workaround where expert knowledge is required. Calculating a patient's inflow and outflow of fluids requires significant knowledge of the types of fluids and medical equipment such as infusion devices. Additionally, performing manual calculations is error-prone. The latter was a major reason for rejecting this workaround.

To negatively view workarounds where expert knowledge is an important factor supports findings by Unger, Leopold and Mendling (2015). In the past, several authors (Gronau and Weber, 2004; Nurcan, 2008) argued that the processes that benefit most from flexibility are knowledge-intensive processes. Unger, Leopold and Mendling rejected this viewpoint. They found that – particularly during training phase – negative deviations were more common in knowledge-intensive business processes (KIBPs) than in non-KIBPs. The cause of this seems to be that the users are not yet familiar with the complexity of the process. Several other authors have indeed noted a lack of good training as a cause for workarounds (Saleem et al., 2009; Malaurent and Avison, 2016; Van Beijsterveld and Van Groenendaal, 2016). It is to be expected that workarounds caused by a lack of knowledge of executing the task at hand, whether because of a lack of medical knowledge or knowledge of the information systems, are likely to be rejected by an organization.

What is important to note when discussing knowledge-intensity in processes is that the meaning of a KIBP is much broader than our definition of the knowledge characteristic. According to Unger, Leopold and Mendling (2015), KIBPs have nine characteristics: knowledge-prevalence, collaboration, predictability, complexity, structure, goal-orientation, event-drivenness, repeatability, and frequency and time-horizon. Our approach to the knowledge characteristic is most similar to the knowledge-prevalence characteristic. Similar to our view on collaboration as a distinctive characteristic of processes with workarounds, Unger, Leopold and Mendling consider collaboration as a characteristic of KIBPs. As W4 and W8 are both characterized as collaborative and requiring expert knowledge, they can be viewed as KIBPs in this respect and are indeed considered the more negative deviations: those that need rejecting.

5.2 Acceptance of workarounds in highly collaborative processes

Interestingly, we see from the upper circle in Figure 1 that those cases with a high level of collaboration - meaning that other participants are involved in the process affected by the workaround – are more likely to be accepted. However, this is only the case when there is no patient present and little expert knowledge is necessary to perform the tasks. In a previous study, Kobayashi et al. (2005) already pointed out the importance of collaboration when studying workarounds. They found that the effectiveness of a workaround relies on the skills, abilities, and willingness of other participants. Moreover, they argued that one workaround often triggers another, resulting in a cascading effect. Similarly, Unger, Leopold and Mendling (2015) found that process participants "did not consider possible implications for other sub-processes resulting from their deviations". Other authors speak in a similar vein of a 'downstream' effect on other participants in the process (Azad and King, 2008a; Alter, 2015; Drum et al., 2016; Reiz and Gewald, 2016). Workaround W4, which we explained in de-

tail in section 4.3 can be seen as an example of this cascading effect. Here, nurses are affected by physicians that do not register a physician's treatment plan completely. Because of this, they come up with a workaround to make sure the patient does receive the treatment they require. Kobayashi et al. (2005) also discovered that principles of fairness and favours are involved in many workarounds: I did something for you, now you will do something for me. In the context of our study, it is interesting that these kinds of cases, where one workaround affects other participants in the process, tend to be accepted. In workaround W4, this can be explained since the nurse's workaround ensures the patient receives the correct treatment. Another example of this can be found in a study by Reiz and Gewald (2016, p. 11), where they found a physician stating: "the important thing is treating the patient, that is what I am doing. If [other department] needs to clean up a bit of a mess then this is just the way it is". They found that this kind of behaviour was socially accepted in the hospital and accepted by all ranks. This suggests that even though participants in the process are affected negatively, the quality of patient care is put first in deciding whether a workaround is considered acceptable or not.

5.3 Acceptance of workarounds when a patient is involved

Apart from workarounds in processes where expert knowledge is required being generally rejected and those with in highly collaborative processes being generally accepted, we found that most workarounds performed when a patient is present are rejected by the domain experts. According to Debono et al. (2013), workaround behaviour by caregivers can often be traced back to image management: participants convincing their peers of their competencies. For example, nurses attempt to display competency by solving problems and, thereby, protecting patients. They justify the use of workarounds by arguing it benefits the patient. In other cases, they manage their image by *not* using workarounds, demonstrating they choose to adhere to protocol. In the context of our study, there may be a third form of image management involved: one from the organisation's point of view. The reason that many workarounds are rejected when a patient is present may be that deviating from protocol affects how patients view their caregivers and the organization in general. For example, organizations may fear that physicians having their patients carry medical images with them (W1) reduces their professional image. Workaround W3, in which physicians postpone the writing of a letter by sending themselves a reminder, is the exception. This workaround actually results in the physician being able to give the patient more attention during patient-physician consultation. Therefore, the patient may in fact develop a *better* image of the physician and the organization in general, which explains why this workaround would be accepted rather than rejected.

5.4 Quality of patient care

Apart from the influences that expert knowledge and patient involvement seem to have on rejecting workarounds and the collaboration characteristic on accepting workarounds, the benefit for the quality of patient care has become a recurring theme in our discussion on accepting or rejecting workarounds. Workaround W4 seems to be considered acceptable because it helps in giving patients the correct treatment. Workaround W1 has perhaps been rejected because it negatively affects the professional image towards the patient. Workaround W3 actually benefits the patient in the sense that the physician is left with more time to give the patient the attention he or she wants. It seems that workarounds benefiting the patient are likely to be accepted in general and, as a result, may well be adopted by a hospital. This presents an interesting area for further study, as many studies today recognize the positive side of workarounds in terms of efficiency and inventive solutions, but they are still largely considered harmful in terms of patient safety (Halbesleben et al., 2010; Holden, 2011; Middleton et al., 2013; Blandford, Furniss and Vincent, 2014; Carayon et al., 2014).

6 Conclusion

Workarounds are no longer viewed as purely negative phenomena. Many authors have proposed that workarounds with negative consequences indeed need to be prevented, but that those with positive

consequences can be exploited as improvement opportunities by adopting them. In this study, we have attempted to assess workarounds on the basis of their characteristics to discover which combinations of characteristics form a deviation that is considered acceptable. We have focused on three characteristics that are associated with healthcare processes: (1) knowledge, (2) patient involvement, and (3) collaboration. Using observations and interviews in a Dutch hospital, we discovered ten workarounds in healthcare processes. During a workshop with domain experts, we decided on the characteristics of these workarounds and whether they were considered acceptable or not. Using a qualitative comparative analysis, we analysed the characteristics and outcomes of the workarounds and arrived at three conclusions. (1) When complex decision-making is involved and expert knowledge is required by the IS user to execute the tasks in the process, workarounds are likely to be rejected. (2) When collaboration is involved and actions by one participant in the process affect others, workarounds are generally accepted. However, this only applies when no expert knowledge is required and there is low patient involvement. (3) When a patient is involved, i.e. the patient is present when the process is executed, workarounds are generally considered unacceptable. Interestingly, this does not seem to hold for situations in which patients are positively affected by the workaround. Those types of workarounds may be considered acceptable.

With this study, we contribute to the current literature on how to address workarounds in healthcare organizations. We provide insight into the characteristics associated with healthcare processes and under which combination of characteristics a workaround is considered acceptable. Healthcare organizations may use these insights to evaluate which workarounds are to be accepted. Future research could focus on the discovery and characterization of more workarounds to test our findings on a larger scale and beyond the setting of one healthcare organization. Another interesting research strand may be to include other characteristics to discover whether there are more influencing factors involved in deciding which workarounds to accept. Finally, the set-up of this study may also be applied to study which workarounds are accepted in industries other than healthcare.

References

Ali, M., T. Cornford and E. Klecun. (2010). "Exploring control in health information systems implementation." In: *MedInfo* (pp. 681–685).

Alter, S. (2015). "A workaround design system for anticipating, designing, and/or preventing workarounds." In: *Lecture Notes in Business Information Processing* (Vol. 214, pp. 489–498).

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

Azad, B. and N. King. (2008b). "Situated practices of computer workarounds in a hospital medication system: a case study." In: *Academy of Management Proceedings* (Vol. 2008, pp. 1–6).

Azad, B. and N. King. (2012). "Institutionalized computer workaround practices in a Mediterranean country: an examination of two organizations." *European Journal of Information Systems*, *21*(4), 358–372.

Beerepoot, I. and I. Van De Weerd. (2018). "Prevent, redesign, adopt or ignore: Improving healthcare using knowledge of workarounds." In: *ECIS 2018*.

Benner, M. J. and M. L. Tushman. (2003). "Exploitation, exploration, and process management: The productivity dilemma revisited." *Academy of Management Review*, *28*(2), 238–256.

Blandford, A., D. Furniss and C. Vincent. (2014). "Patient safety and interactive medical devices: realigning work as imagined and work as done." *Clinical Risk*, *20*(5), 107–110.

Cabitza, F. and C. Simone. (2013). ""Drops Hollowing the Stone ". Workarounds as Resources for Better Task-Artifact Fit." *European Conference of Computer Supported Cooperative Work*, (September 2013), 103–122.

Carayon, P., T. B. Wetterneck, A. J. Rivera-Rodriguez, A. S. Hundt, P. Hoonakker, R. Holden and A. P. Gurses. (2014). "Human factors systems approach to healthcare quality and patient safety." *Applied Ergonomics*, *45*(1), 14–25.

Cardoso, J., J. Mendling, G. Neumann and H. A. Reijers. (2006). "A discourse on complexity of

process models." In: *International Conference on Business Process Management* (pp. 117–128).
Combi, C., G. Pozzi and P. Veltri. (2017). *Process modeling and management for healthcare*. CRC Press.
Cresswell, K. M., H. Mozaffar, L. Lee, R. Williams and A. Sheikh. (2017). "Workarounds to hospital electronic prescribing systems: a qualitative study in English hospitals." *BMJ Quality & Safety*, *26*(7), 542–551.
Davenport, T. H. (2015). "Process management for knowledge work." In: *Handbook on Business Process Management 1* (pp. 17–35). Springer.
Davenport, T. H., S. L. Jarvenpaa and M. C. Beers. (1996). "Improving knowledge work processes." *Sloan Management Review*, *37*, 53–66.
Debono, Deborah SGreenfield, D., J. F. Travaglia, J. C. Long, D. Black, J. Johnson and J. Braithwaite. (2013). "Nurses' workarounds in acute healthcare settings: a scoping review." *BMC Health Services Research*, *13*.
Debono, D. S., D. Greenfield, D. Black and J. Braithwaite. (2010). "Workarounds: straddling or widening gaps in the safe delivery of healthcare." In: *Proceedings of 7th international conference in organisational behaviour in health care (OBHC)*.
Di Ciccio, C., A. Marrella and A. Russo. (2015). "Knowledge-intensive processes: characteristics, requirements and analysis of contemporary approaches." *Journal on Data Semantics*, *4*(1), 29–57.
Drum, D. M., D. M. Drum, A. J. Pernsteiner, A. J. Pernsteiner, A. Revak and A. Revak. (2016). "Walking a mile in their shoes: user workarounds in a SAP environment." *International Journal of Accounting & Information Management*, *24*(2), 185–204.
Felin, T., N. J. Foss, K. H. Heimeriks and T. L. Madsen. (2012). "Microfoundations of routines and capabilities: Individuals, processes, and structure." *Journal of Management Studies*, *49*(8), 1351–1374.
Gronau, N. and E. Weber. (2004). "Management of knowledge intensive business processes." In: *International Conference on Business Process Management* (pp. 163–178).
Halbesleben, J. R. B., G. T. Savage, D. S. Wakefield and B. J. Wakefield. (2010). "Rework and workarounds in nurse medication administration process: implications for work processes and patient safety." *Health Care Management Review*, *35*(2), 124–133.
Heeks, R. (2006). "Health information systems: Failure, success and improvisation." *International Journal of Medical Informatics*, *75*, 125–137.
Helfert, M. (2009). "Challenges of business processes management in healthcare: Experience in the Irish healthcare sector." *Business Process Management Journal*, *15*(6), 937–952.
Holden, R. J. (2011). "What stands in the way of technology-mediated patient safety improvements? A study of facilitators and barriers to physicians' use of electronic health records." *Journal of Patient Safety*, *7*(4), 193.
Ilie, V. (2013). "Psychological Reactance And User Workarounds. A Study In The Context Of Electronic Medical Records Implementations." In: *ECIS* (p. 24).
Isik, Ö., J. den Bergh and W. Mertens. (2012). "Knowledge intensive business processes: An exploratory study." In: *2012 45th Hawaii International Conference on System Sciences* (pp. 3817–3826).
Karsh, B. T., R. J. Holden, S. J. Alper and C. K. L. Or. (2006). "A human factors engineering paradigm for patient safety: designing to support the performance of the healthcare professional." *BMJ Quality & Safety*, *15*(suppl 1), i59--i65.
Kemsley, S. (2011). "The changing nature of work: from structured to unstructured, from controlled to social." In: *International Conference on Business Process Management* (p. 2).
Kobayashi, M., S. R. Fussell, Y. Xiao and F. J. Seagull. (2005). "Work coordination, workflow, and workarounds in a medical context." In: *CHI'05 Extended Abstracts on Human Factors in Computing Systems* (pp. 1561–1564).
Koppel, R., S. Smith, J. Blythe and V. Kothari. (2015). "Workarounds to Computer Access in Healthcare Organizations: You Want My Password or a Dead Patient?" In: *Studies in Health Technology and Informatics* (Vol. 208, pp. 215–220).

Lee, S. and Y. Park. (2009). "The classification and strategic management of services in e-commerce: Development of service taxonomy based on customer perception." *Expert Systems with Applications*, *36*(6), 9618–9624.

Littlejohns, P., J. C. Wyatt and L. Garvican. (n.d.). "Information in practice Evaluating computerised health information systems: hard lessons still to be learnt Development of the project."

Lockamy III, A. and K. McCormack. (2004). "The development of a supply chain management process maturity model using the concepts of business process orientation." *Supply Chain Management: An International Journal*, *9*(4), 272–278.

Malaurent, J. and D. Avison. (2016). "Reconciling global and local needs: A canonical action research project to deal with workarounds." *Information Systems Journal*, *26*(3), 227–257.

Marjanovic, O., H. Skaf-Molli, P. Molli and C. Godart. (2007). "Collaborative practice-oriented business processes Creating a new case for business process management and CSCW synergy." In: *Collaborative Computing: Networking, Applications and Worksharing, 2007. CollaborateCom 2007. International Conference on* (pp. 448–455).

Martinho, R., R. Rijo and A. Nunes. (2015). "Complexity analysis of a business process automation: case study on a healthcare organization." *Procedia Computer Science*, *64*, 1226–1231.

Middleton, B., M. Bloomrosen, M. A. Dente, B. Hashmat, R. Koppel, J. M. Overhage, … J. Zhang. (2013). "Enhancing patient safety and quality of care by improving the usability of electronic health record systems: recommendations from AMIA." *Journal of the American Medical Informatics Association*, *20*(e1), e2--e8.

Nadhrah, N. and V. Michell. (2014). "Workarounds: risk or benevolence for patient safety." *IGI Global*.

Nurcan, S. (2008). "A survey on the flexibility requirements related to business processes and modeling artifacts." In: *Hawaii International Conference on System Sciences, Proceedings of the 41st Annual* (p. 378).

Ragin, C. C. (1994). "Introduction to qualitative comparative analysis." *The Comparative Political Economy of the Welfare State*, *299*, 300–309.

Ragin, C. C. and B. T. A.-T. T.- Rihoux. (2009). "Configurational comparative methods : qualitative comparative analysis (QCA) and related techniques." Thousand Oaks, Calif. ; SAGE.

Ramezani, E., D. Fahland, J. M. van der Werf and P. Mattheis. (2011). "Separating compliance management and business process management." In: *International Conference on Business Process Management* (pp. 459–464).

Reichert, M. and R. Pryss. (2017). "Flexible Support of Healthcare Processes." *Process Modeling and Management for Healthcare*.

Reiz, A. and H. Gewald. (2016). "Physicians' Resistance towards Information Systems in Healthcare: the Case of Workarounds." In: *PACIS* (p. 12).

Röder, N., M. Wiesche, M. Schermann and H. Krcmar. (2014). "Why Managers Tolerate Workarounds – The Role of Information Systems." *Twentieth Americas Conference on Information Systems*.

Safadi, H. and S. Faraj. (2010). "The role of workarounds during an opensource electronic medical record system implementation." In: *ICIS 2010 Proceedings*. St. Louis.

Saleem, J. J., A. L. Russ, C. F. Justice, H. Hagg, P. R. Ebright, P. A. Woodbridge and B. N. Doebbeling. (2009). "Exploring the persistence of paper with the electronic health record." *International Journal of Medical Informatics*, *78*(9), 618–628.

Schafermeyer, M., D. Grgecic and C. Rosenkranz. (2010). "Factors influencing business process standardization: A multiple case study." In: *System Sciences (HICSS), 2010 43rd Hawaii International Conference on* (pp. 1–10).

Schulze-Bentrop, C. (2013). *Qualitative comparative analysis (QCA) and configurational thinking in management studies*. Peter Lang Frankfurt am Main.

Silvestro, R., L. Fitzgerald, R. Johnston and C. Voss. (1992). "Towards a classification of service processes." *International Journal of Service Industry Management*, *3*(3), 62–75.

Trkman, P., W. Mertens, S. Viaene and P. Gemmel. (2015). "From business process management to customer process management." *Business Process Management Journal*, *21*(2), 250–266.

Unger, M., H. Leopold and J. Mendling. (2015). "How much flexibility is good for knowledge intensive business processes: A study of the effects of informal work practices." In: *System Sciences (HICSS), 2015 48th Hawaii International Conference on* (pp. 4990–4999).

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

Van de Weerd, I., P. Vollers, I. Beerepoot and M. Fantinato. (2019). "Workarounds in retail work systems: prevent, redesign, adopt or ignore?" In: *ECIS 2019*.

Van der Aalst, W. M. P., M. Weske and D. Grünbauer. (2005). "Case handling: a new paradigm for business process support." *Data & Knowledge Engineering*, *53*(2), 129–162.

Vogelsmeier, A. A., J. R. B. Halbesleben and J. R. Scott-Cawiezell. (2008). "Technology Implementation and Workarounds in the Nursing Home." *Journal of the American Medical Informatics Association*, *15*(1), 114–119.

Wager, K. A., F. W. Lee and J. P. Glaser. (2009). *Health Care Information Systems: A Practical Approach for Health Care Management*. John Wiley & Sons.

Winter, A., R. Haux, E. Ammenwerth, B. Brigl, N. Hellrung and F. Jahn. (2010). "Health information systems." In: *Health Information Systems* (pp. 33–42). Springer.

Yang, Z., B. Y. Ng, A. Kankanhalli and J. W. Luen Yip. (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.

Zhou, X., M. Ackerman and K. Zheng. (2011). "CPOE workarounds, boundary objects, and assemblages." In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 3353–3362).

Zwarenstein, M., J. Goldman and S. Reeves. (2009). "Interprofessional collaboration: effects of practice-based interventions on professional practice and healthcare outcomes." *Cochrane Database of Systematic Reviews*, (3).

Appendix

Table 5 and 6 contain the complete characterisations of rejected and accepted workarounds.

Characteristic	W1	W2	W4	W6	W7	W8
Knowledge	0	0	1	0	1	1
Patient involvement	1	1	1	1	0	0
Healthcare professional	1	1	1	1	1	1
Collaboration	0	1	1	0	0	1
Structure	0	1	0	0	1	1
Repeatability	1	1	1	1	1	1
Laws and regulations	0	1	1	0	0	1
Complexity	1	1	1	0	1	0
Predictability	0	1	0	1	0	1

Table 5. Characterisation of rejected workarounds.

Characteristic	W3	W5	W9	W10
Knowledge	0	0	0	0
Patient involvement	1	0	0	0
Healthcare professional	1	1	1	1
Collaboration	0	1	1	1
Structure	1	0	0	0
Repeatability	1	1	1	1
Laws and regulations	1	0	1	0
Complexity	1	1	0	0
Predictability	1	1	0	1

Table 6. Characterisation of accepted workarounds.