Workarounds: The Path from Detection to Improvement

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1. Introduction

Over a period of only a few decades, hospitals have experienced major developments in Health Information Systems (HISs). These HISs have caused a shift from paper-based to computer-based information processing, and from departmental to global coordination [1]. Systems that were traditionally used by caregivers now also give access to patients as users. Where the focus used to be on patient care, present-day HISs offer additional modules targeted at healthcare planning and clinical research. Not all developments have been immediate successes, nor were they always enthusiastically welcomed by healthcare professionals. To illustrate the frustrations that emerge once a new HIS has been implemented, let me draw on this excerpt from a junior doctor:

> *Tuesday, 20 June 2006*. Our computer system has been upgraded and, as happens eleven times out of ten when the hospital tries to make life easier, they've made everything much more complicated. It certainly looks much whizzier (and less like an MS-DOS program from school), but they've not actually fixed any of the massive clunking problems with the software, they've just slapped an interface on top of it. It's the equivalent of treating skin cancer by putting make-up over the lesion. (…)
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> The blood tests now all live in a drop-down menu, and to order one involves scrolling down an alphabetical list of every test any doctor has ever ordered in the history of humanity. To get down to 'Vitamin B12' takes 3 minutes [and] 17 seconds. And if you press the letter 'V' rather than wading down there manually, then the system crashes so badly you have to turn the computer off at the wall and all but use a soldering iron to get it working again. Ninety-nine per cent of the time we order the same dozen tests and yet, rather than prioritizing those at the top of the list (even the easyJet website knows to put the UK above Albania and Azerbaijan), they're scattered throughout a billion tests I've never heard of or requested. Who knew there were three different lab tests for serum selenium?
>
> As a result, there's a very narrow window of anaemic patients I will now order Vitamin B12 levels for. If you're only mildly anaemic I'm not wasting the day with my finger pressing on the down arrow for three minutes. And if you're severely anaemic, I won't order it because you'll probably be dead by the time I've done so.

From: Kay, A. (2017). This is going to hurt: secret diaries of a junior doctor. Pan Macmillan.

This humorous but realistic excerpt symbolises the design-reality gap concept that is often used to evaluate HIS success or failure [2]. The redesigned system includes a modern interface that is assumed to help healthcare professionals in their work, but in practice, it is a step back from the perspective of the doctor. Because of the complexity of healthcare work and the wide span of HIS implementations [3], reducing the gap between design and practical use is no easy task.

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The illustration also demonstrates how healthcare professionals consciously change their behaviour in response to the design-reality gap. Within the information systems research field, we refer to the concept of a workaround when a user intentionally makes changes to the designed way of working in response to a perceived blockage [4]. In the example, the designed path for the doctor would be to order Vitamin B12 for anaemic patients, whether mild, normal or severe. However, the doctor perceives a blockage in his path: scrolling down the menu takes too long and may even cause the system to crash. Therefore, he chooses not to order the medication for certain groups of patients. Although this example is put jokingly, such changes in behaviour can have severe consequences in healthcare contexts. Workarounds used by physicians as well as nurses can seriously compromise patient care [5]. On the other hand, they may just as well offer those working in healthcare the ability to continue providing the needed patient care despite obstacles [6].

This PhD thesis sets out from the conviction that both beneficial and detrimental workarounds indicate misalignments between designed work practices and the actual work practices of healthcare professionals. It lies at the intersection of two fields of study, that of Information Systems (IS) and Business Process Management (BPM). In the former, workarounds have been studied intensively, but none of them have focused on systematically detecting and analysing workarounds with the aim of improving healthcare processes. In the field of Business Process Management (BPM), researchers have developed methods and techniques for analysing business processes and recommending improvements, but these have not been applied in the context of workarounds, let alone with the intention of using such behaviour to an organisation's advantage.

This thesis aims to fill the gap of analysing and addressing misalignments between designed and actual work practices. Specifically, we aim to contribute solutions to the challenge of detecting and analysing health information systems workarounds and consequently improving healthcare processes. By drawing on methods and techniques from both IS and BPM, we contribute to existing literature and practice by providing methodological guidance for the detection of workarounds, as well as for translating knowledge about workarounds into actionable improvement ideas. Additionally, we provide insights into the factors involved in the emergence of workarounds and the appropriate way of addressing different types of workarounds. In the following sections, we position this research within the two fields of study.

2. Workarounds in Research

The first empirical studies on workarounds, defined as such, are discussed in two papers by Les Gasser [7] and Gerson and Star [8]. Both studies discuss processes in the workplace, and how they evolve as a result of changing circumstances. Because of these changing circumstances, the authors recognise that designing a perfect system is an impossibility, and in response, people start engaging in 'articulation work'. Although these first studies on workarounds emerged in general IS work settings, interest in the concept became especially widespread within the field of Medical Informatics from 2004 onwards. From that time we find a number of seminal papers published predominantly in the Journal of the American Medical Informatics Association. In this period, published papers were particularly concerned with antecedents and effects of workarounds in healthcare organisations, where the phenomenon was typically related to unintended and unexpected consequences of the introduction of technology in organisations [9–11]. Outside of healthcare, workarounds have been analysed in the service and public industry [12] and the transport industry [13], among others. However, the majority of workarounds research to date is still conducted in healthcare settings.

In terms of research methods, IS researchers studying workarounds typically make use of qualitative methods for data collection. In the majority of studies performed to date, researchers observed workers for a period of time, and combined this information with insights from semi-structured interviews. For example, Flanagan et al. [17] performed observations of 120 clinicians and 118 patients over 11 outpatient clinics. Two days were spent at each site. Similarly, one of the researchers in Stevenson et al. [18] spent 62 hours shadowing nurses and performing

additional semi-structured interviews. Indeed, Koppel et al. [19] stress the importance of shadowing clinicians and conducting interviews or focus groups to capture the motivations and decision processes behind the use of workarounds. As for the analysis of the collected data on workarounds, this part is often aimed at identifying different workaround types and discovering the direct causes of their emergence. As such, researchers typically identify several dozens of workarounds over a large number of processes, and categorise them based on their characteristics [10,20].

Contrary to the IS field, studies published in the BPM field have typically made use of methods such as simulations, design science or engineering, and formal proofs [21]. Recently, the dominant way for collecting and analysing process-related data has been to employ process mining techniques [16]. Process mining techniques help discover and analyse business processes using event data that are collected from information systems. Within the subfield of conformance checking in particular, process mining allows researchers to check large amounts of process executions against a predefined set of rules or constraints. In extension, it is possible to check conformance with process models over longer periods of time, pointing out changes in behaviour [22]. Although process mining requires high effort in the extraction and pre-processing stages, it does not require the researcher to spend hours on end at the organisation of study. In addition, making use of event logs may provide a more objective view on behaviour compared to the use of interviews and observations such as in typical workaround studies. However, process mining is not without limitations either. Not all behaviour is detectable in the event data, and the data cannot give insights into the reasons behind the use of workarounds [23]. Interviews and observations, on the other hand, are used to collect rich data on a phenomenon, but are very labour-intensive and require access to process participants.

3. Research Approach

To benefit from the advantages of both streams of research methods, in this thesis, we employ different approaches to detect and analyse workarounds. Table 1 provides an overview of the different research methods used throughout the thesis. Our main research approaches include a literature review, design science, case studies, and action research. Within these approaches, we have made use of observations, interviews, focus groups, interactive workshops, process mining, and qualitative comparative analysis, to collect and analyse data. The studies that make up this thesis have been applied in seven healthcare organisations. Table 2 provides an overview of the studied departments over the seven healthcare organisations involved, and the period in which the studies were undertaken. The organisations correspond with those in Table 1.

Table 1
Overview of research methods and techniques used

Method/technique ↓ Chapter →	2	3	4	5	6	7	Organisation(s)
Literature review	√						
Design science		√					*A*
Case study(s)		√	√	√	√		*A, B, C, D, E, F*
Action research						√	*F, G*
Observations		√	√	√	√		*A, B, C, D, E*
Interviews		√	√	√	√		*A, B, C, D, E*
Focus group					√		*C*
Interactive workshops						√	*F, G*
Process mining			√			√	*F, G*
Qualitative comparative analysis					√		*C*

Table 2
Overview of healthcare organisations studied

Organisation	Department	Period of study
A	Orthopaedics & surgery	April – June 2017
B	Urology & cardiology	April – June 2018
C	Urology & pulmonary	May – July 2018
D	Nursing wards, medical rehabilitation	May – July 2018
E	Therapists, medical rehabilitation	July – August 2018
F	Nursing wards	January – May 2020
G	Outpatient clinics	March 2021

4. Contributions and Implications

The contributions made in this thesis lie in developing methods and techniques for detecting and analysing workarounds and consequently improving healthcare processes. They build on and connect knowledge across disciplines, but also within different axes of those disciplines. Our contributions to the BPM field range from technical ones such as the definition of workaround patterns that are detectable using process mining, to more management-focused contributions such as approaches to support organisations in acting on workarounds. Contributions to the IS field range from methodological advancements that allow a more systematic detection and analysis of workarounds, to theoretical advancements regarding the understanding of the emergence of workarounds and their impact. In the following sections, we outline our key contributions and implications for research practice.

As a result of our design science and action research studies, we developed four artefacts. We proposed the Workaround Snapshot Approach to detect, analyse, and address workarounds. This approach includes two more artefacts: the Workaround Snapshot and Action Impact Matrix, which can be used to capture knowledge of workarounds and evaluate the impacts of decisions, respectively. The final key artefact that we proposed in this thesis is the FEI Funnel, a method for translating process mining insights to actionable improvement opportunities. The artefacts developed in the context of this thesis provide research practice with structure and rigour in studying workarounds in healthcare organisations.

By studying workarounds in seven healthcare organisations using mixed methods, we also provided empirical accounts of aspects of the phenomenon not previously covered by research. Specifically, we provided rich descriptions of the detection of workarounds from multiple perspectives using process mining techniques. In addition, we described in-depth the different power dynamics that are at play in the emergence of workarounds. Last, we provided insights into the various process characteristics relevant for the analysis of workarounds in healthcare and their influence on the managerial decision to accept or reject a workaround. Our empirical accounts may be used by research practice for generalising to theory or for developing new empirically-informed artefacts. Our rich descriptions of aspects of the phenomenon and the traces some workarounds leave in the data may be used to illustrate practices in healthcare organisations or to evaluate new data mining techniques.

Although the focus in this thesis lies more on developing artefacts for dealing with workarounds and providing rich accounts of the phenomenon than on developing new theories, we also provide a theoretical contribution in the form of an overview of the types of power that are involved in the emergence of workarounds. Not only does our overview explain what happens, it also bears value for predicting what may happen when an actor exercises their hierarchical power towards other actors or when the system is designed too restrictively. As such, our study provides research practice with opportunities for analysing and explaining observed phenomena, as well as possibly predicting the effects of changes made to processes.

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