Resource-Oriented Workaround Analysis: A Case Study

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Abstract. Workarounds can show how workers solve local issues in designed processes and may therefore be used for general process improvements. Recent advances into workaround mining have shown data-driven approaches can both help discover workarounds and analyze them over long periods. However, earlier studies on workarounds have neglected the resource perspective. In this work, we use information about resource roles to find additional perspectives on workarounds. With a detailed analysis of a single workaround during a case study at an Emergency Room, we find clear differences in how various resource roles adopt it. We interview domain experts to further understand the motivations behind the use of the workaround. Following organizational theory, we find that the hierarchical power of their role is important in how resources approach workarounds, resulting in strongly different adoption speeds. We propose future work to enhance the research technique and suggest directions that may lead to new insights about workarounds.

Keywords: Workarounds · Resources · Healthcare · Business Processs Management · Routine Dynamics.

1 Introduction

Workarounds are creative ways to handle unforeseen obstacles during work [2,27]. Although workers typically have good intentions when using workarounds [26], there may be unforeseen negative consequences at a later time [4]. As such, the management of workarounds is important for organizations. In a previous study, we investigated how workarounds change over a period of years [26]. By measuring how often workarounds occurred compared to the normative process, we discovered that workarounds, and the underlying process, could change drastically after organizational and system changes. However, even when there are no discernible changes, workers may increase their use of the workaround, potentially changing an incidental workaround into a common part of the process.

Our previous study also revealed that analyzing only the control-flow of the process was not always sufficient to understand the evolution of a workaround. For example, a workaround where activities were performed after discharge looked stable, with only a temporary increase in how often it was used after a Hospital Information System (HIS) update. However, when zooming in on the

change, we found that initially nurses were involved but especially secretaries applied the workaround after.

In the field of Business Process Management (BPM), workarounds are commonly studied from a data perspective [27,28]. Where BPM is able to use historical data to study long term changes, there is little work studying the effect of resources, even though this perspective is considered important [19]. On the other hand, with their high granularity through detailed interviews and observations, routine dynamics often studies differences between individuals [20,24] but struggles to study long term change. In this work, we aim to bridge the gap and investigate how workarounds change over time, considering resource roles.

In a case study at an Emergency Room (ER) we analyze one workaround in detail. By adding information about resource roles to an existing data analysis technique, we investigate changes in workarounds. Then, we conduct interviews to investigate the motivations and considerations for the workaround. By focusing on the resource perspective of workarounds during this case study, we gain a better understanding of how we can find differences between resource roles and how these influence their way of working. Practically, such differences between these roles can help tailor the management of workarounds better to roles.

In Section 2, we start with an overview of the current state of the art for the adoption of workarounds and how information about resource roles is currently used in BPM and routine dynamics. We then explain our technique in Section 3 and show the results of our case study in Section 4. We discuss our findings and limitations in Section 5 before concluding our study in Section 6.

2 Related Work

We start this section with an overview of how workarounds get adopted. As we are inspired by both BPM and routine dynamics, we will discuss how resource roles are used in these fields outside of workarounds. We will primarily use BPM terminology in this work. That is, we use *resource* to refer to a human resource or worker. However, to describe their designed job function, we use *role*, largely following one definition according to Organizational Role Theory [6].

2.1 Workarounds

There has been limited research into the adoption of workarounds. In general, workarounds seem to originate as temporary improvisations, adopted by various resources, and, once one has grown enough, it is formally accepted or rejected [2,23,28]. There are various ideas about how they spread over time. One theory suggests that sharing is initiated by anyone who knows of the workaround [23], while another states that workarounds are shared through teams [2,28]. In both cases, once new people learn about the workaround, they will start using it. However, recent work has shown that sharing may not be the leading cause of the spread of workarounds; instead the use of a workaround may only grow if more workers feel the need to work around obstacles [26].

2.2 The resource perspective in BPM

If we take a broader look at the field of BPM, we note multiple calls for resource-oriented research. It is generally accepted that information about resources is relevant for BPM [8]. To further understand process dynamics, their behavior is even considered crucial [14]. Further highlighting both the potential value and the limited research into resource-oriented research, a large Delphi study [18] notes "Analyzing business processes from the resource perspective" as an opportunity rated as extremely relevant by many international experts.

Two sub-fields of BPM take the resource perspective into account by design: Human Resource Mining and Resource Allocation. The former aims to leverage event logs to identify aspects of individual resources to suggest how teams of resources may work together better[18]. One of the more straightforward resource aspects in this field is their role within the organization [9]. Also, in the Resource Allocation field, the formal role is an important consideration [5,22].

While many conformance checking models include control-flow and data perspectives, the resource perspective is often suggested as future work [1,7,12]. When this perspective is used, the role is often only used to approximate permissions [17]. For example, physicians and nurses may record patient tests, while secretaries are generally not allowed to do so. Instead of direct conformance, another angle is to investigate differences between resource roles. One such approach found that different roles can have vastly different ways to execute the same process, based on experience and training differences between them [13].

2.3 The resource perspective in routine dynamics

Where BPM starts from the managerial side of the process, routine dynamics tends to approach the same topic from individuals. In this way, tensions between individuals are observed to change the underlying process [20,24]. Further information, such as role and power dynamics about individuals in specific contexts can further help with understanding processes [24]. Variances in resource roles often result in differences within the same process. On a process design level, this can be seen as organizations tend to only formally alter processes once resources with high power express that they consider it needs to change [21].

However, even on a lower level these differences are clear. Given the same process, resource aspects such as gender and role strongly affect how and if workers vocalize experienced mistreatment through a designed "remedial voice mechanism" [15]. Besides the higher comfort expressing their frustrations, workers with more power also tend to be more open to altering their process executions creatively without fear of rejection by other, more powerful, colleagues [10]. Similarly, the notion of role-routine ecologies describes that in complex scenarios, similar routines often emerge within resources with the same role [16].

To summarize, we find a broadly supported interest in the resource roles in both fields. Where BPM finds differences between roles, routine dynamics focuses on the similarities within them. In our work we will continue this focus to find how various resource roles behave when performing the same process.

3 Approach

To investigate how different resource roles use workarounds, we adopt a case study approach. Case studies are particularly suitable for how and why questions about complex, real-world phenomena [29]. In our study, we aim to understand both the variation in workaround behavior across roles and the underlying reasons for such differences. This case study consists of two parts: a quantitative analysis of event data and a qualitative analysis of semi-structured interviews with domain experts. Our goal is to identify and understand differences in how resource roles engage with workarounds.

3.1 Context

The case study was conducted at the Emergency Room (ER) of the University Medical Center Utrecht (UMCU). This academic teaching hospital employs 12.000 people and provides care to over 220.000 patients annually. The ER consists of 19 treatment rooms and treats around 18.000 patients per year. The hospital uses HiX[1] as its Hospital Information System (HIS). This study was approved by the Medical Research Ethics Committee (MREC) NedMec (research protocol number 22/1055).

3.2 Data collection and preparation

For our data analysis, we use an event log enriched with resource role information. We classify each trace as either workaround or normative, based on prior, expert defined rules [26,27]. To analyze the process, we view the process from three different resource-oriented angles to explore a single workaround.

Process Execution To determine how to measure the relevant resource for all traces, we find which event would be considered the workaround event. For example, if experts consider a late discharge of a patient a workaround, the discharge is labeled as the workaround event. We then generate an overview of all process executions, including both workarounds and normative traces, by calculating the proportion of traces in which each resource role performs the event. This enables us to find general changes in resource behavior.

Workaround Execution Next, we create a similar overview for traces marked as workarounds. This, again, allows us to find changes in resource behavior, but from a different perspective: Comparing this with the process execution plot reveals which resource roles approach workarounds differently. The plots also provide a complete overview of the roles relevant to investigate the workaround.

Workaround Ratio To sharpen our resource perspective, we calculate the ratio of workaround to normative process executions for each resource role. This allows us to determine precise changes in workaround behavior, extending the approach introduced in [26] by explicitly accounting for differences in resource roles.

[1] https://www.chipsoft.com/en

4 Case Study

4.1 Background

The workaround we investigate in this study concerns the registration of pain scores during visits to the ER. To ensure that treatment is effective, patients should be asked about their pain levels at least twice: once during triage at the start of the process and once again at discharge. This process is embedded in the HIS, which evaluates pain score registration before discharge.

This workaround was discovered in a previous study using the Semi-automated WORkaround Detection (SWORD) framework [27] and later further analyzed [26]. In the present study we build on these findings by conducting a more detailed analysis of how the workaround changes over time, with a focus on the roles of the resources. We specifically selected this workaround because the HIS enforces the use of pain scores, which can only be circumvented manually. In other words, any deviation from the normative process must be a conscious choice, removing any accidental, non-workaround deviations from the data.

As illustrated in Figure 1, when discharging a patient, a user should drag a patient card from the room they are currently in to the Discharge field ("Ontslagen" in Dutch). This action starts the formal discharge procedure, which includes a check for pain score registration. If fewer than two pain scores have been registered during the ER visit, the system prompts to enter additional pain scores and prevents the actual discharge until this requirement is met. However, users can bypass this control by right-clicking the patient card to access a drop-down menu. From this, they can forcibly move the patient, circumventing any system checks. In doing so, they work around the pain score requirement.

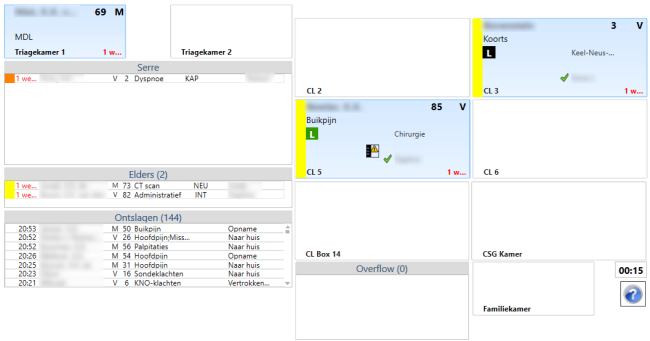

Fig. 1. Screenshot of the process in HiX. The blue cards can be dragged to move patients to various rooms (e.g., "CL 2"), or discharge ("Ontslagen").

4.2 Data Extraction

To follow patients, every ER visit is assigned a unique visit ID. We use this as a Case ID in our analysis. For each case, we also extract the pain score registrations and the discharge event. For the discharge event, we record the resource role of the employee that performed the discharge. We classify each trace as a workaround if fewer than two pain scores were registered. Otherwise, traces are labeled as normative.

4.3 Data Results

Process Execution by Resource Role As shown in Figure 2, the discharge process is primarily executed by nurses. In 2013, approximately 80% of the patients are discharged by nurses, 15% by secretaries, and 5% by physicians. In July 2014, a sharp increase occurs: the proportion of discharges completed by nurses increases to over 95%. This moment of sudden change coincides with a previously discovered HIS update, which introduced a system constraint: users could only discharge patients if enough pain scores had been registered [26].

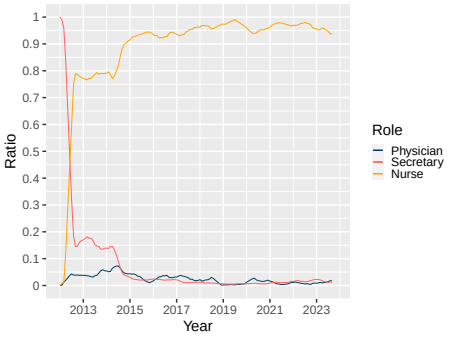

Fig. 2. Process executions per resource role

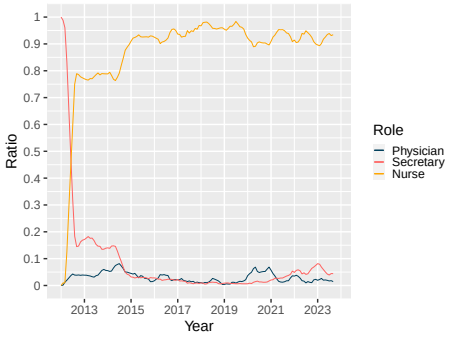

Fig. 3. Workarounds per resource role

Workaround Execution by Resource Role Figure 3 shows the distribution of resources roles for workaround cases. Before the intervention, the role distribution ratios are similar to the overall process. However, notable differences emerge after the system update in July 2014. Then, nurses still perform most of the discharges, but their share of workarounds is usually lower than their share of the discharges. This difference is especially notable after 2020, where first physicians and later secretaries perform the workaround in more than 6% of the cases, despite neither of them performing more than 3% of the overall cases. This divergence indicates that secretaries and physicians have a higher tendency to use this workaround than nurses after the HIS update.

Workaround Ratio by Resource Role To gain a deeper understanding of role-specific behavior, we zoom in further on the resources by investigating the ratio of workarounds per role in Figure 4. Before the intervention, this ratio is close to 100% across all roles, as pain scores were rarely logged prior to being enforced by the system. Directly after the intervention in 2014, the workaround ratio sharply decreases to 15% and gradually lowers further to 10% in 2017 across all roles. We then see strong differences between the roles in how they adopt the workaround:

- Nurses only show gradual adoption of the workaround over five years up to 25%. This averages to 3%pt per year.
- Physicians start using the workaround commonly relatively early in 2018. Then they apply the workaround up to 75% of the time after four years. This averages to 16%pt per year.
- Secretaries do not strongly adopt the workaround until 2020, but they adopt it much faster than physicians and nurses. They ratio grows from 20% to 85% in two years. This averages to 32%pt per year.

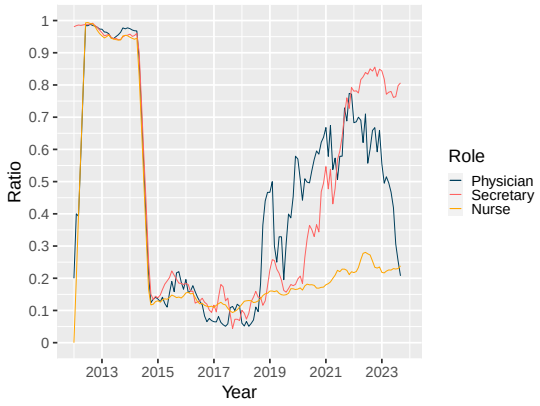

Fig. 4. The ratio of workarounds to normative process executions for each role

Note that the workaround ratios of the physicians and secretaries fluctuate more sharply than those of the nurses. This can be explained as there are months where the former discharge few patients, resulting in ratios that change stronger. Despite this variability, the general changes in workaround ratio are clear.

4.4 Interviews

To understand the motivations behind the workaround behavior observed in the data, we interviewed two domain experts: one ER physician who has worked for 12 years at the UMCU and one nurse who has worked at the ER for 20 years, the latter also serving as the product owner of the HIS for the last six years. Both experts confirmed that they have performed the workaround themselves.

Discharge responsibilities and role dynamics The interviewees confirmed the general pattern shown in Figure 2: Nurses are typically responsible for discharging a patient. While both nurses and physicians have permission to perform all tasks related to the discharge, such as registering pain scores with patients. Physicians often perform more specialized care. This makes nurses the more logical choice for these more general tasks that require a good overview of individual patients. As such, if a physician handles the discharge, the case is already exceptional.

While secretaries do not have permission to register measurements such as pain scores, they can discharge patients, typically in edge cases. For example, secretaries may discharge patients who leave the hospital against medical advice or they handle patients who were not properly discharged by anyone else. In this sense, secretaries often function as a "back-stop" and discharge remaining patients to make sure the log of patients at the ER is up to date.

Recognition of workarounds as alternative practices Both experts clearly distinguish between the normative process, where patients are discharged with pain scores during triage and discharge, and the workaround, where patients are manually discharged with fewer than two pain scores. Besides these options, both experts noted that especially nurses use other strategies to satisfy the HIS requirements. Most notably, they may register placeholder pain scores, such as "n/a" (not available), when the patient is no longer present. While this option is designed for patients who are present but not capable of reporting pain, it is also used as a workaround. Alternatively, the nurse mentioned that some colleagues consistently register two pain scores during triage so they will not run into this issue at all later, already planning ahead and solving the issue beforehand.

Motivations for using workarounds Both interviewees report the same reasons for using any workaround: If the patient has left and it is found that there were not enough pain scores, no normative option (i.e., asking the patient) is available and people need to choose a workaround. This can happen regularly as the discharge procedure may get postponed while patients get sent home during a temporary peak in patients or if there is no computer present at the time.

Physicians often choose the manual discharge workaround as it is quick. The physician noted that they were explicitly instructed not to use this workaround, but they still did so regularly due to time pressure. In contrast, the nurse noted that most nurses are unaware of the manual option and typically resolve missing data through other means. The nurses who are aware of the workaround tend to use it if multiple forms are missing and manual discharge is more efficient than addressing each issue individually. For secretaries, the manual workaround is the only available option when discharging patients with missing pain scores, as they lack the permission to register additional measurements.

Perceived impact on patient care Neither expert could think of any direct negative impact on the quality of care resulting from this workaround. They are confident in the quality of care as patients are continuously monitored. They

may not always log pain scores, but if patients state that their pain is manageable, nurses and physicians understand that no further treatment is necessary. In addition, patients are usually checked at least informally before they go home.

However, the physician did highlight a broader concern: while workarounds at discharge are typically harmless, similar behavior during intake could lead to more serious consequences. For example, skipping questions about antibiotic-resistant bacteria could pose significant risks if done improperly. This contrast underscores that not all workarounds carry the same level of risk, depending on the stage of the process and the nature of the information omitted.

5 Discussion

To interpret our findings, we further discuss our work first from a theoretical angle. After this, we consider the practical contributions and finish this section by discussing the limitations of our study.

Theoretical contributions We found differences in workaround adoption among the different resource roles. One explanation could be found in existing theory: Roles with higher power adjust their process with less fear of repercussions than those with low power [11]. As such, secretaries would be hesitant to use the workaround, explaining their late adoption. However, as resources with less power are expected to align their work to those with more power [10], it makes sense that secretaries use the workaround often, as they have no other options to discharge patients without sending work back to nurses or physicians.

The way nurses work strongly follows the temporal coordination theory in complex role-routine ecologies [16]. Following this theory, nurses could either try to follow the normative sequence or optimize timing. However, trying to follow both will lead to local conflicts, such as when a patient could leave without being formally discharged. In such cases, theory suggests that nurses would solve this through role-based prioritizing: They choose based on who benefits [16]. While sequence is important to management, timing is more important for the patient, who would go home earlier, and colleagues, who would have a less crowded ER.

Practical contributions Our theoretical findings have direct practical implications related to workaround management. The case study organization was already aware of this workaround, but our data analysis has shown that their attempts to minimize its usage have not worked over time. To manage workarounds more effectively it may be important to keep the resources roles in mind. Although physicians were explicitly told not to use it, they still do so as they feel comfortable deciding for themselves due to their high power. As such, threats of repercussions would have limited effect. Instead, discussing the effects on colleagues and the organization would likely have more effect [21]. Strict instruction could have an effect on low power roles like secretaries, although they would need alternative ways to align their process with their higher power colleagues.

In March 2024, the UMCU had a large HIS update when they moved from a Custom-Built system to the Standard-Content version of the same HIS. This

new version standardizes many processes, including the intake and discharge of patients. Various questions, like pain scores, are not enforced anymore. For this workaround, the change is likely positive, given that registering pain scores is unlikely to negatively impact the process. However, during intake, questions about antibiotic-resistant bacteria may now also be skipped without a workaround, which may have potential negative effects. This emphasizes the need for ways to monitor workarounds, as their usage may change unpredictably.

Limitations The primary limitation of our work is its scope: We only inspected one workaround in a single organization and interviewed two domain experts. Investigating more workarounds and holding more interviews would broaden this study, making more generalizations possible.

In this study, we only used existing visual inspections to find differences in the workaround ratios for the various resource roles. In this case, the differences between roles are large enough to discover these without further statistical proof. However, measures such as cross-correlation [30] or change point detection [3], would provide a more rigorous way to determine such differences.

6 Conclusion

In this resource role-oriented study, we performed a case study at an ER. We looked into the discharge process of patients which should have at least two pain scores. We find that besides the designed differences in how often various roles discharge patients, physicians and secretaries adopt the workaround more quickly than nurses. The findings are in line with IS literature, stating that roles with more hierarchical power tend to alter their personal process quickly without fear of repercussions, while roles with low power may change their process to support those with higher power.

While the resource perspective has already led to novel insights, we can extend this work further in various ways: First, we could discover more about this specific workaround with a further study into the alternative pathways for this process. Batch detection [25] could discover multiple pain scores registered during triage, while rule-based detection [27] could find "not available" pain scores. In addition, a new analysis with more recent data could show new insights into how the process changed, especially given that the system requirements that enforced the number of pain scores is not present anymore.

Second, while we focused on resource roles, similar techniques could be used to find differences between individual resources. This could provide new insights into how workarounds are shared between individuals and when they are used. Combining this with additional resource characteristics, such as quality or experience [31], could help organizations manage workarounds further.

Finally, in this study, we use expert-defined rules to classify traces as workarounds or normative. While this approach manages to identify instances of a specific path, interviews showed that alternative workarounds can be missing. By repeating the cycle of data-analysis and interviews, we could get a more complete view of workaround behavior within a single process.

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