The realities of procedure deviance: A qualitative examination of divergent work-as-done and work-as-imagined perspectives

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ABSTRACT

The differences between 'work as imagined' (WAI) and 'work as done' (WAD) reflect theoretically pervasive and well-known barriers to the examination of human performance at work. Due to the dynamic and situational nature of the workplace, the idealized performance reflected in procedures is not always done as prescribed, and thus provides an excellent opportunity for examining divergence between WAI and WAD. The identification and examination of this gap and the nature of these deviations are imperative for high-risk industries to understand how workers' tools—in this case procedures—can be effectively designed and maintained. The present study used thematic analysis to compare procedure administrator and management performance expectations (representing WAI) to the realities of user performance (representing WAD) through interviews collected at several large, international chemical corporation sites. Direct comparisons of these perspectives revealed divergent expectations of how procedures are used and when they are most useful: Users reported deviating more often than administrators perceived the users deviate; users reported that tasks were the cause of the deviations more than administrators; and administrators thought that users may deviate from the procedures unintentionally while users did not report this. For a procedural system to perform optimally, these differences and the underlying processes that perpetuate them must be identified and further examined. To this end, relevant findings and theories from the human factors, ergonomics, and psychology literatures are identified and future directions are proposed.

1. Introduction

In high-risk industrial organizations, operating procedures are used to support tasks being conducted safely, effectively, and efficiently at each level of an organization, and the effects of deviating from these procedures are potentially catastrophic (Hale and Borys, 2013b). For example, the Deepwater Horizon oil drilling rig explosion that resulted in the release of over 4 million barrels of oil in the Gulf of Mexico and the death of 11 people (CSB, 2016) has been linked to several failures in procedural systems (e.g., not having needed procedures and not following existing ones; Graham et al., 2011). More extensively, an

international survey of operators revealed a direct correlation between deviations and incidents/near-misses (Hendricks and Peres, 2021).

Previous research across aviation, nuclear, and petrochemical industries has revealed that there are commonly cited antecedents to deviation among procedure users. Jamieson and Miller's (2000) interviews with procedure users revealed that procedures were often out of date or contained inaccuracies. There were also many organizational barriers (e.g., cost and time) that interfered with procedure maintenance and generated mistrust among users as well as user-based reasons for deviation (e.g., incorrect procedure application; Bullemer and Hajdukiewicz, 2004). More recently, contextual features of the workplace and the

practice of initiating procedure changes only after a major incident or near miss were identified as contributors to deviation and general dissatisfaction with procedures (Sasangohar et al., 2018). Hendricks and Peres (2021) confirmed that these issues (e.g., procedure and change process quality) were significant precursors to deviation frequency. Still other differences may be due to the procedures often being developed without input from the users of the procedures, creating a disconnect between those who write or manage procedures and those who use them (Hollnagel, 2017a; Sasangohar et al., 2018). For instance, if a procedure writer has little experience actually performing a task, they may assume that every step of the procedure has to be done in a specific order, while the person performing the task may know (or assume) that some steps can be done in different orders. Hendricks and Peres (2021) found empirical support for this position via an observed, direct relationship between experience and procedure deviations.

Decker posited that procedural deviations represent a gap between what is written in the procedures and what is practiced (and practical) when doing the task (Dekker, 2003). Indeed, those organizations that monitor and look to reduce this gap have the characteristics of high reliability organizations (Rochlin, 1999; Rochlin et al., 1987; Weick, 1990; see also Hale and Borys, 2013a, b).

One of the theoretical lenses through which such deviations can be studied is the comparison of 'work-as-done' (WAD), an account of how workers actually perform tasks, with 'work-as-imagined' (WAI), or the expectations of how work should be done (Hollnagel, 2013). In the WAI/WAD context, procedures may more accurately reflect WAI than WAD and thus, workers' deviations from the procedure when they perform the task represent a difference between WAI and WAD. Procedures are often used to relay important safety information to the end user, including communicating potential safety hazards, specifying required personal protective equipment, and prescribing uniform behaviors and standards of performance that reduce human factor risks (e. g., Amalberti et al., 2006; Westbrook et al., 2011). Thus, any disconnect between WAI and WAD can result in risk mitigation methods (integrated into the procedures) not being fully utilized, increasing risk and the likelihood of incidents.

Research in other domains has found that some of the differences between WAI and WAD likely occur due to the dynamic and complex context of the workplace (e.g., Ceja and Navarro, 2011), while other differences may be due to systemic differences between goals and expectations at different levels of organizational hierarchy. Individual preferences can also explain some of the discrepancies between WAI and WAD. Despite the promise of WAI/WAD to conceptually describe work in a socio-technical system, few studies document these differences systematically (Son et al., 2023), particularly with procedures (Ashour et al., 2021), and do not include the "how" and "why" questions of WAI/WAD gaps. This is needed before methods of mitigating any gap between WAI and WAD are developed. For instance, it could be that a user's WAD deviates from WAI most often for skill-based behaviors because the day-to-day work is tied to frequently occurring tasks that have been mastered by the user (Peres et al., 2020; Rasmussen, 1983). Explicit investigations into deviations through the lens of WAI/WAD could provide needed insight into the causes of continued occurrence of incidents related to procedures as well as a theoretical understanding.

To our knowledge, only a few attempts have documented procedure use behavior in the petrochemical field (e.g., Bullemer and Hajdukie-wicz, 2004; Jamieson and Miller, 2000; Peres et al., 2020; Sasangohar et al., 2018) and no research has directly compared and contrasted the WAI/WAD perspectives on procedure use in the petrochemical field. One notable near exception is Xu et al. (2013), where both operators and administrators were interviewed about how and why users deviate from procedures; however the results were aggregated, and thus lack the 1:1 comparison. To address this gap in the literature, we conducted interviews with workers at the sharp (doing the task) and blunt (managing the task) end of the work management cycle to identify as many reasons as possible for deviations from procedures as well as the extent of

procedural deviations at their facilities. As a result, we are providing/developing a more thorough, grounded operationalization of WAI that moves beyond the procedure alone by assessing administrator perspectives on contributing factors for deviations. The objective of this paper is to document areas of disconnect between WAI and WAD and to inform future work to unify them. Given the risk of deviations from procedures, the WAI vs WAD paradigm may better describe why and how these deviations are occurring so any deviation that increases risk can be mitigated.

2. Method

2.1. Participants

Semi-structured interviews with participants were conducted as part of a larger effort to transition standard operating procedures from paper format to a digital platform at a large, international chemical corporation. To differentiate between the two levels of interest, employees in the "sharp end" of this examination are referred to as users and "blunt-end" employees are referred to as administrators. They were all contacted via email or through word of mouth. These administrators are titled as such because they represent a collection of employees, managers, and other individuals involved in the roll-out of a digital procedure system. In total, 13 administrators were interviewed; they held the following positions: technical advisor ($n = 4$), site logistics leader ($n = 3$), health and safety technician ($n = 2$), scheduler ($n = 1$), engineer ($n = 1$), production leader ($n = 1$), and raw material coordinator, production analyst and Operating Discipline Management System (ODMS) coordinator ($n = 1$). These administrators were located across several chemical processing sites. The administrators' tasks varied from procedure review and updating to health and safety maintenance. The user in the organization was examined using interviews from 26 employees who used procedures in their everyday work. All users were located at a single chemical processing site in the southern United States. The tasks that the users typically completed consisted of machinery startup, system resets and chemical transfer. No participant dropped out or refused to participate.

2.2. Protocol

Data collection took place with users at their place of work. The interviews were conducted during the workday by graduate students (CS, AM, SD) and a PhD level scientist (SCP), all trained in interviewing, when the users had a scheduled break, lasting between 30 and 45 min. Administrators were interviewed remotely via a 1-h phone call. All participants consented to participation and agreed to be audio recorded before starting the interview. The interviewer and the participant were the only people present during the interview. There was no relationship established between the interviewers and participants prior to the study; the participants only were aware that the interviewers were conducting research to understand procedure use. No repeat interviews were conducted. The study was approved by the Texas A&M University Institutional Review Board and complied with the American Psychological Association Code of Ethics and the Declaration of Helsinki.

2.3. Measures

This study focuses on deviations from procedures by presenting parallel questions to both administrators and users of procedures to investigate three key issues: (a) how often deviations from procedures occur, (b) how and why users deviate from procedures, and c) the definition of "high quality" procedures. The administrators and users were asked: (a) "What percentage of time do you think users [you] deviate from procedures—either not using or not following the procedure exactly?", with deviation defined for both administrators and users so they had the same mental model and definition in mind when answering the question; and (b) "Can you describe some of the reasons

for such deviations?" Users were additionally asked, "Was this different for frequent/infrequent tasks?" To investigate definitions of "high quality" procedures, administrators and users were both asked, "How would you define a 'high quality' procedure?" Appendix A presents the protocol for the user interview and Appendix B presents the protocol for the administrator interview. Due to the nature of semi-structured interviews, not every question was asked and additional topics might have been introduced by participants.

2.4. Thematic analysis

The recorded interview sessions were transcribed to text using Otter AI (Otter ai, 2022) and then edited to correct any errors; participants did not provide feedback at this stage or further. The transcribed interviews were analyzed using thematic analysis (Guest et al., 2012). Thematic analysis is broken down into three phases: initial coding, focused coding, and thematic coding. For the administrator interviews, two coders, both graduate students (AS and JeH), created a list of initial codes and completed the coding process. Two other coders, also graduate students (AM and SL), completed the focused coding under the guidance of the most experienced coder (AS). For the user interviews, three coders (AS, AM, and SL) created the list of initial codes and completed initial and focused coding. Between each phase of coding (initial coding to focused coding and focused coding to thematic coding), the coders met to discuss the process and resolve any differences before moving forward. After the thematic coding was complete, the coders met with the authors to finalize the themes. There were some stylistic differences in coding, but no substantial differences accounted for in the analysis. The participants did not provide feedback on the final codes or findings. The results are reported through themes and subthemes as well as counts of each population that shared their thoughts. There are subdivisions of the original counts that occur to show further breakdown on topics that were discussed surrounding the original theme, but not by all participants. Due to the nature of semi-structured interviews, not every topic is covered by all participants or not all participants responded to every question, prompting some counts to be under the total number of participants.

3. Results

3.1. Frequency of procedure deviation

Deviation estimates ranged from 0% deviation to 90% deviation among both users and administrators. Fig. 1 presents comparisons of the deviation estimates provided by users and administrators. Notably, the user estimations ($M = 30.8$, $SD = 33.5$) of their own deviation were much higher than the administrator's estimates ($M = 19.8$, $SD = 24.5$).

Most administrators (12/13, 92%) acknowledged that some *deviations do occur*. However, one administrator (1/13, 8%) expected complete compliance with procedures at all times, and an additional four administrators (4/13, 31%) reported *complete compliance* was the goal. While administrators and users were not asked to provide a reference or rationale for their estimations, three of the administrators (3/13, 23%) reported deriving their deviation estimates from *internal error reports*. The estimated deviations from those who used internal error reports were noticeably lower ($M = 5\%$, $SD = 5$; Min = 0%, Max = 10%) than the other administrator responses ($M = 20\%$, SD = 26.4; Min = 0%, Max = 90%). One administrator (1/13, 8%) clarified that their estimations (5–10%) were drawn from on-site observations and the remaining administrators (9/13, 69%) did not provide a reference for their estimations.

> *"I would say, you know, 90 to 95 percent of the time, they're compliant, at least based on the data that we have."* – Administrator 01 (A01)

Users, who claimed to never deviate or deviate up to 90% of the time, clarified that their estimations reflected only their own *personal deviation* (3/26, 12%). Three users (3/26, 12%) would not provide estimations for
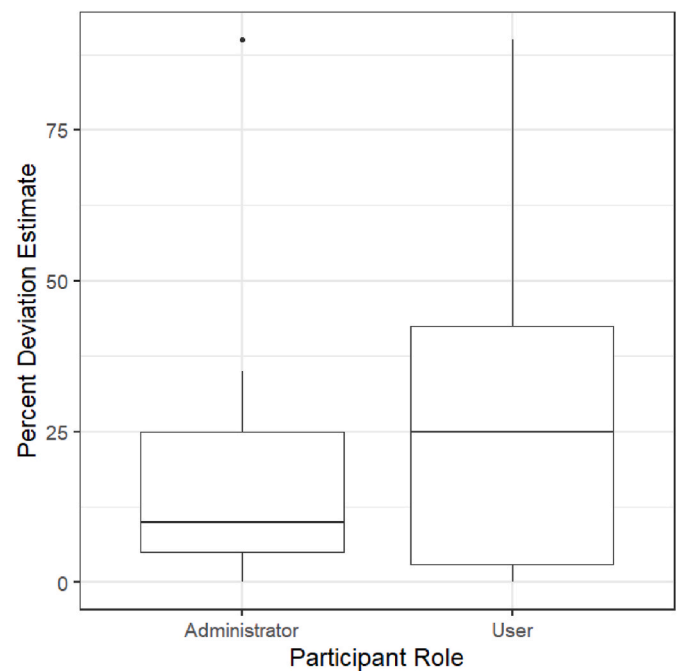

Fig. 1. Users' and administrators' estimations of procedural deviation.

the deviations of their peers. Those users who did provide estimations reported that their peers deviated at a *similar frequency to themselves* (12/26, 46%; $M = 29.3$, $SD = 29.7$). Further, these users often explained their peers' deviation as a *function of their experience*—"Probably like 75–80% … [for] the experienced guys." However, contrary to this theme, a correlation revealed no significant differences between the users' tenure and their deviation estimates, $r(24) = 0.25$, $p > .25$.

Deviations were also reported to occur at the team or unit level. Five users (5/26; 19%) reported that their deviations occurred in the context of a team or unit where *all users deviated in a shared manner* for common procedures.

> *"… Usually, you have a partner … [they] work one way with this partner and they kinda - … feed off each other, and …. they know each other's routine. "[You ask] hey, how you want to do this?" … and … we started getting a routine down and all that."* – User 24 (U24)

3.2. Reasons for deviation from procedures

The users and administrators mentioned several reasons for deviation at organizational, task, and individual levels. While administrators broadly framed deviations as unintentional (use errors), users mentioned intentional deviations characterized by the work group, and differences between frequent and infrequent tasks. Table 1 summarizes the frequency of shared and unique themes reported as reasons for deviations from users and administrators.

Table 1
Reasons for deviation alongside frequency counts for each theme.

Theme	Administrators		Users	
	N	%	N	%
Environmental	8	62%	4	15%
Organizational	3	23%	5	19%
Group	–	–	7	27%
Task	5	38%	18	69%
Task Frequency	–	–	17	65%
Individual	12	92%	20	77%
Unintentional	5	38%	–	–
Intentional	5	38%	12	46%

3.2.1. Environmental factors contributing to deviation

Most of the administrators (8/13; 62%) and some of the users (4/26; 15%) cited *environmental reasons* including the weather, environment, or the barriers related to the design or *layout* of the facility. This point is accentuated by the use of paper procedures and their vulnerability to the external elements like rain, dirt, or mud. Similarly, users who did find this to be an issue also cited the use of digital procedures as problematic because they could not let the tablets or computers get dirty, break or be used outside when raining. Another reason the environment caused deviations or non-use was the physical layout of the facilities, with some spaces or areas being harder to access which limited the usage of procedures.

3.2.2. Organizational factors contributing to deviation

Some administrators (3/13; 23%) and users (5/26; 19%) cited *organizational* reasons, or mandates from the company for deviating. Administrators mentioned the influence of company quotas and time pressure as the cause of deviation. Users were more focused on deviations that occur due to the disconnect between those who write the procedures and those who complete the task. As a result of this disconnect, users reported that they must deviate from what is written when there are errors in their procedures.

3.2.3. Task-related factors contributing to deviation

Some of the administrators (5/13; 38%) and most of the users (18/26; 69%) revealed that task frequency was related to the amount of deviation; *frequent and routine tasks* that were performed often were more likely to be deviated from. Of the administrators who mentioned task frequency, over half (3/5; 80%) stated that because users knew these tasks so well, especially those with lots of experience, they often made *adaptations to the task* and performed the steps in a different manner from what is described in the procedure. Similarly, the users expressed that their knowledge of the task was great enough that they had discovered ways to carry out the procedures in a more efficient and effective way.

> "*Because they are high performers and then they just want to get a lot of the pallets loaded as fast as they can.*" – A10

> "*It tells you to inspect the car at the bottom first, then open all the hatches and then go up top, open all of those hatches […] So that's kind of how the deviation is. So, I'm already down low and [I'll] take care all of that first and then I'll go up and put everything in the in the spots and get the load going.*" – U02

Users were asked to differentiate between their deviation for frequent and infrequent tasks. Almost half of the users (12/26; 46%) said that they deviate more often on frequent tasks because they *know the task well enough* to change how the procedure recommends them to approach the task. Over half of the users (14/26; 54%) said that they deviate less on infrequent tasks because they are *not as familiar* with the tasks and would like to complete them accurately. A minority of users (3/26; 12%) stated that there is *no difference* between their deviation for frequent and infrequent tasks because they always use procedures and never deviate from them. A small number of users (5/26; 19%) stated that they deviate less on procedures when the task is *hazardous* or presents more danger than tasks they are used to performing.

3.2.4. Individual factors contributing to deviation

Almost all of the administrators (12/13; 92%) and most of the users (20/26; 77%) mentioned that *individual differences* and motivations resulted in deviations from procedures. Administrators mentioned that users may personally choose to deviate due to complacency, confidence or motivation. Users mentioned deviating because they believe the task can be done better in their own estimation, even if it is in a different way than how the procedure lays out the task.

> "*But I think when we see errors, the biggest reason why is because they get complacent and/or overconfident just based on the, you know, the amount of times that they've done it.*" – A01

Beyond the individual reasons for deviation provided by the administrators and users, there was also a breakdown of the intentionality behind deviation between intentional and unintentional (use errors).

3.2.5. Group factors contributing to deviation

Some of the users (7/26; 27%) mentioned their *work group*, or those with whom they directly worked each day (i.e., other users, trainers, and direct supervisors) influenced their deviation behavior. One user mentioned that many deviations occurred when working with other users and having only one procedure present because everyone does things their own way and they do not all have access to the procedure at the same time. One user mentioned that their trainer instilled in them the practice of never deviating from procedures. None of the administrators mentioned the group as a factor.

> "*And then in the warehouse, you're working with somebody you have a group of people you're working with. And in that, in that sense, when you have a lot of people you have, you can have multiple people doing different things at one time … So, I think when you have more people involved in one procedure, you're gonna have deviations all over the place because like I said, everybody has their own way of doing things, right.*" – U13

> "*But the way I was trained, my trainer was, was really, really good on "wherever you go take your tablet with you" […] So, just to prevent that and cover my own tail. […] I'd just rather do it the way it's supposed to be done.*" – U24

3.3. Perceptions of "high quality" procedures

Thematic analysis revealed several characteristics of procedures that contribute to perceived quality by both administrators and users (*effectiveness, detailed, efficiency, ordered/sequenced, and considering intended audience*), as well as themes that were discussed only by administrators (*safety emphasis*) or users (*accounting for individual differences, follows regulations*).

3.3.1. Effectiveness

Almost all of the administrators (12/13; 92%) and several of the users (10/26; 38%) discussed the *effectiveness* of high-quality procedures. Both administrators and users generally agreed that high quality procedures need to help the users "get the job done". Specifically, high-quality procedures need to help users effectively complete their tasks

> "*Quality procedures are detailed enough to get the job done, useful, convenient, and thorough.*" – A03

> "*[A high quality procedure is] something that is straightforward. It gives you all the information you will need and leaves nothing to question from start to finish.*" – U04

3.3.2. Detailed

More than half of the administrators (8/13; 62%) and one-third of the users (9/26; 35%) expressed that "high-quality" procedures needed to be *detailed*. It was paramount that high-quality procedures have enough detailed information so the users of the procedure could complete the job safely and correctly. This was more heavily emphasized by administrators, compared to users.

> "*It needs to be precise. It needs to be direct and exactly what you're meaning to do for that job. You can't have any loose ends with that […] you don't want [procedures] to be watered down.*" – A09

"*A high quality procedure is [a] procedure in detail that takes you step by step, that can […] guide you to doing the job.*" – U09

3.3.3. Efficiency

Both administrators (7/13; 54%) and users (11/26; 42%) explained that high-quality procedures should be *efficient*. It is important that high-quality procedures allow procedure users to efficiently complete their job tasks.

"*It needs to be direct and exactly what you're meaning to do for that job.*" – A09

"*The best procedures are the ones that have the least amount of steps […] they take a little step, and they make it the entire page and it's just unnecessary.*" – U13

3.3.4. Ordered/sequenced

A few of the administrators (2/13; 15%) and some users (6/26; 23%) explained that high quality procedures need to be *ordered and sequenced*, so that the procedure users can follow the procedure and complete their tasks in order.

"*Define the steps as you go along, and have those steps written to where you can't proceed to the next step until that step is completed before.*" – A06

"*[High-quality procedures are] real informative and [have] steps actually in sequence.*" – U01

3.3.5. Considering intended audience

Both administrators (6/13; 46%) and users (8/26; 31%) explained that it is important to consider the *intended audience*, when defining high-quality procedures. Specifically, the procedure needs to account for the user's level of experience.

"*[The procedure should consider] If you're a qualified user who's been in the block for a while and you're trained on all the jobs.*" – A13

"*I would prefer more experienced loaders to have more of a checklist instead of like these long procedures to where […] it becomes redundan[t] or […] it's too long.*" – U19

3.3.6. Safety and regulation emphasis

Another theme that only appeared in the administrator interviews (8/13; 62%) was an *emphasis on safety* in procedures. The administrators underscored the importance of safety information in high-quality procedures, to ensure that the procedure users were able to safely do their job.

"*That perfect balance of [the] distilled steps to complete [the task] with enough hazards and precautions and notes to warn of any impending danger or circumstance that would cause us not to deliver the highest quality product in the most efficient way with safety and environment being the highest priority.*" – A11

A few of the users (4/26; 15%) also mentioned that high-quality procedures *follow regulations*. These users explained that high-quality procedures included the integration of legal paperwork and task documentation. For these users a high-quality procedure would facilitate the simultaneous completion of both in-house paperwork (via the procedure) and legally required documentation paperwork.

"*They've incorporated our H33 with it, which is […] our legal DOT document that has to go with every inner truck or rail car, and it's included with it. So it used to take us 25–30 minutes […] and now with the digital it's so much quicker.*" – U15

4. Discussion

Interviews with administrators and users revealed that both groups acknowledge that deviations from procedures do occur. If procedures reflect the way work should be done or the way work is imagined, then deviations from the procedure reflect instances where WAI and WAD differences exist in this high-risk industrial context. Notably, while both users and administrators know that deviations occur, users report deviating at a much higher rate than administrators estimate. This is potentially emblematic of the degree to which users and administrators have differing perspectives on procedures. Indeed, the differences between managers and users are a manifestation of the WAI/WAD framework in that the contrasts between the perceptions of those who use procedures (and thus do the work) and those who administrate or manage procedures in high-risk chemical processing plants (or who imagine how procedures will be used) are remarkably different. This deviation may suggest that those in the blunt end of work systems may not have realistic expectations and understanding of behaviors exhibited at the sharp end of the system. This finding may also suggest limitations in visibility of errors, error documentation, and reporting culture or processes. In addition, some users reported deviations as high as 90% while some reported much lower rates, yielding a large range; this may be due to task mastery—knowing how to perform the task better than how the procedure explains—as described in Peres et al. (2020). A closer examination of the different roles of the administrators did not yield significant differences in their estimations of deviation which warrants future work to shed light on potential differences.

By examining the perspectives of those who use and are administrators of procedures, this study has provided an important step in answering not just why deviations occur at the user level, but also what factors contribute to these deviations. Motivations for deviations varied and could be broken down into dimensions reflecting a hierarchy; deviations occurred at the individual, task, group, and organizational level. Individual reasons were most prevalent and almost all users directly stated that they have a reason for deviating. However, underlying the individual's decision to deviate were norms held by their group or unit. The user interviews revealed these norms were transferred through the onboarding and socialization processes. The organization's policies were also cited as a reason why differences between WAI/WAD are allowed to continue and deviation is normalized. Some reported reasons for deviation were entirely external and out of control of the user. Importantly, users confirmed that deviations differed based on task frequency where users have developed task mastery for repetitive tasks (Peres et al., 2020; Rasmussen, 1983). Less deviation occurred when tasks were infrequent and the user presumably did not have the same mastery, and some users reported that they did not deviate from procedures at all. This has important implications for the design of procedures for tasks that are done frequently; for instance, when editing procedures, the users who have the most experience with the corresponding task, or have completed that task many times, should be involved in the editing process as they have a comprehensive knowledge of the task that administrators may not have. Beyond task frequency, it is important to note the types of deviations that occur and which types should take priority in being addressed through procedure edits, as they may not all be equal. Deviations that are committed due to external factors or are out of control of the user should be addressed first as the user cannot change their actions or behavior in these circumstances. Other types of deviation that introduce safety risks should be mitigated through procedure edits if possible, as safety is often a top concern for many users and administrators (Brown, 1996). After safety concerns, mitigating deviations and improving efficiency through procedural edits would align with business needs and user expectations (Latief et al., 2020).

Examination of what administrators and users viewed as features of a high-quality procedure revealed strong agreement between users and administrators that high-quality procedures are detailed, efficient,

effective, ordered/sequenced, and need to be tailored to the intended audience. Overall, administrators mentioned these themes more often than users did. Two features, detail and efficiency, are apparently contrasting in their description from users and administrators; slightly more administrators favored detailed procedures over efficient procedures, while slightly more users favored efficiency over detail. While it is documented that these two features should be balanced in the creation of procedures as either too much or too little information could lead to disuse of the procedure (Hattemer-Apostel, 2001), this apparent trade-off may suggest potential miscalibration of WAI/WAD. In particular, detailed procedures deemed necessary for safe execution of tasks may be perceived as unnecessary detail by the users and may result in deviation. In addition, users' emphasis on efficiency may contribute to the issue of speed versus accuracy when completing tasks (Förster et al., 2003). Furthermore, many more administrators emphasized the importance of effective and detailed procedures. This may suggest that administrators place a great level of importance on the documentation being effective while users may see themselves as the effective agent in the completion of a task rather than the procedure.

Two themes that were unique to administrators were discussions about high-quality procedures being informative and emphasizing safety. On the other hand, the users explained that high quality procedures are dependent on the individual's skills and preferences and should follow legal regulations. There was an interesting contrast between the language and focus of administrators and users. Administrators stressed the general importance of safety on the job while users focused on following regulations. When discussing high quality procedures, the users did not mention their own personal safety, but instead mentioned how helpful it was to incorporate legal documentation into the procedures themselves. The distinction between personal protection, as emphasized by the administrators, an important group in promoting a safe workplace (Thompson et al., 1998; Wu et al., 2010), and legal protection, brought up by the users, displays another level of disconnect between the two: the administrators want the users to be physically safe during task performance but the users want to ensure they are not legally responsible in the event something goes wrong, especially if the procedures are out of date (as some have noted). However, while not explicitly noted as a feature of a high-quality procedure, the users are focused on safety as they will deviate from outdated procedures to be safer while completing certain tasks. Higher percentages of administrators, compared to the users, shared thoughts on each of the different components of what constitutes a high-quality procedure, which may suggest that administrators are more concerned with quality in procedures than users, aligning with other industries where managerial interests drive procedure quality (Hollmann et al., 2020; Manghani, 2011).

4.1. Limitations

These results reflect the opinions of users and administrators at one organization and cannot be assumed to generalize to the presence or nature of WAI/WAD differences in other organizations and industries or across other geographic and cultural contexts. The extent to which the extracted themes can be generalized and used to further examine the WAI/WAD differences across other industries and contexts are compelling theoretical and empirical questions. Further, while participants were assured of their anonymity, there is always the possibility of social monitoring and impression management where individuals are less likely to provide information that may present them in an unfavorable light (Peck and Levashina, 2017). Similarly, self-report on adherence to guidelines has been found to be less accurate than reality, and may have impacted the responses from the interviews (Adams et al., 1999). However, given the candor present in the responses of both groups, we believe that those we interviewed were honest in their responses. Finally, there was some degree of using the terms deviation(s) and use interchangeably when describing behavior. Previous research

has suggested these two behaviors be differentially operationalized in the procedures domain (see Hendricks and Peres, 2021; Hendricks et al., 2023). Indeed, individuals can deviate from WAI whilst using the procedure and conversely perform WAI while not using the procedure.

4.2. Future directions

If the estimations provided by users are accurate, then on average users at this organization are not adhering to the procedures as they are written for approximately 1/3rd of their work. The reasons underlying WAI and WAD discrepancies and how these may cost organizations deserve further examination. The extracted themes can become a starting point to integrate the findings and theories of relevant multidisciplinary literatures and propose ways that we can bridge these gaps between WAD and WAI. Five avenues for future research are proposed.

First, only administrators made note of errors or unintentional deviations; users never recognized those errors and reported primarily intentional reasons for deviation. In effect, administrators were relying on the incomplete information provided in error reports. To the extent that other organizations share this gap, it could be valuable to investigate the full range of procedural deviations through observation, audits, or cognitive walkthroughs. As an example, a cognitive walkthrough would involve users talking through the task while they perform it, while simultaneously viewing the procedure to compare actual work and what they ought to do.

Second, compared to infrequent tasks, deviations are much higher for those tasks that users complete frequently, yet some users do not deviate at all. In order to determine how to get everyone to the "don't deviate at all" mindset it would be valuable to examine what traits those users share (e.g., whether those individuals are more risk averse). Future work may elicit this information from users as well as administrators to define profiles or personas that exhibit such behavior, contributing factors, and effective interventions to prevent it. Further, both administrators and users indicated that it is important for procedures to be both detailed and efficient, but these can often be conflicting attributes. Users noted that the preferred balance of these competing requirements was highly individualized. The extent to which procedures can be tailored to preferences or experience can be something to pursue in future research. The themes manifested in the current study are likely seeds for grounding future development of measures of WAD/WAI concepts that could be subject to rigorous psychometric analysis and therefore more rigorous hypothesis testing. These measures could be deployed to gather high quality procedure preferences from a larger sample. A follow-up A/B test comparing various procedure designs could then be deployed to test user acceptance of the high-quality procedure preferences in practice.

Third, users in this study focused on paperwork and regulations while administrators focused on safety and safety-related behaviors. This mis-match is interesting and perhaps reflects an area where communication of the organization's desire for a culture that emphasizes safety could be improved. As an extension of this study there are ongoing efforts to catalog differences in these employees' perceptions of the procedure change process. Organizations must effectively articulate to users that their desire for safety is not only regulation based. Enforcing and clearly communicating organizational safety policies and practices are proven to improve employees' safety behaviors, reduce safety hazards, and improve safety climate (Zohar, 2003). Research such as follow-up interview studies can further identify boundaries to the communication of the importance of safety and regulations.

Fourth, an observation study of users completing their tasks may provide a more objective understanding of their actual deviation rate. By following users in their natural work environment, and logging their actions in relation to the procedure they are using to complete a task with a post-task debrief, their deviation rate, the type of deviations that occur, and the rationale for such deviations can be recorded for analysis. This would allow for a comparison between the users' and

administrators' perceptions around deviation and the actual deviation of users.

Finally, in conjunction with continuing to alignm with the conceptual bases of WAI/WAD (e.g., Hollnagel, 2017b), more work is needed to converge other relevant work such as De Keyser et al.'s work on contextual factors impacting decision making in complex and risky environments (De Keyser et al., 2001) and time considerations for task completion (De Keyser, 1995), among others. Viewing the worker through these different lenses will account for different roles, environments, and temporal factors in the occurrence of deviations in the workplace.

4.3. Contributions and conclusion

This examination used the framework of WAI/WAD differences to further the investigation of longstanding issues with procedural adherence. The extracted themes provide support for previous reviews and can set some foundation to facilitate future examinations and interventions for WAI/WAD differences. Previous research (e.g., Bullemer and Hajdukiewicz, 2004; Jamieson and Miller, 2000; Uema et al., 2020) has fallen short by not directly assessing the perceptions of administrators from both organizational ends in a parallel manner as the current study. Additional contributions include findings from direct comparisons of user and administrator perspectives of how procedures are used and when they are or not most useful. Furthermore, we have provided a starting point for more thoroughly understanding WAI beyond the procedure alone by unveiling the perceived contributing factors to deviations from the perspective of those who are imagining it. The revelation should lead to better operationalization of the WAI side in future WAI/WAD studies. While it is unlikely that WAI in procedures will ever be able to account for the complexities of the workplace, there are promising avenues to increase its alignment with WAD.

CRediT authorship contribution statement

Anjelica Mendoza: Data curation, Formal analysis, Writing – original draft. **Sin-Ning Cindy Liu:** Data curation, Formal analysis, Writing – original draft. **Alec Smith:** Data curation, Formal analysis, Writing – original draft. **Joseph W. Hendricks:** Conceptualization, Methodology, Writing – review & editing, Investigation. **S. Camille Peres:** Conceptualization, Funding acquisition, Project administration, Supervision, Writing – review & editing. **Farzan Sasangohar:** Conceptualization, Investigation, Methodology, Project administration, Resources, Software, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:
Farzan Sasangohar reports financial support was provided by Next Generation Advanced Procedures Consortium.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ergon.2024.103564.

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