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Organizational learning and documentation practices in pre-job briefings and post-job reviews

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Summary

In this report we describe a case study in a nuclear power company regarding pre-job briefing and post-job review documentation practices and their relation to organizational learning. In the case study power company, pre-job briefings and post-job reviews were documented as open feedback in a work permit system or as minutes of meetings. It was found that the documentation medium affects what is documented and whether the recorded information is used afterwards. We also found that the documentation can serve multiple functions. In addition to helping perform the same task again in the future, it can be utilized for various purposes by different stakeholders, including other work groups, training, supervision and oversight, and operating experience. Finally, a set of generic success factors to facilitate the generation and use of documentation from pre-job briefings and post-job review were formulated.

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1. Introduction

Human performance (HU) tools are a diverse set of good working practices or error-reduction techniques widely used in the nuclear industry. HU tools are utilized, for example, to structure meetings, to ensure communication, and to verify work (Viitanen, 2021). They are usually applied in the operational context by shop-floor workers (especially maintenance and control room workers). The most commonly used HU tools are pre-job briefings, post-job reviews, the STAR principle (self-checking), peer checking, independent verification, and clear communication (Oedewald et al., 2015).

Meeting-based HU tools (pre-job briefings and post-job reviews) involve holding meetings with task participants to prepare for the task or to reflect on it after it has been completed.

Pre-job briefings are held before a task is performed. According to the DoE Human Performance Improvement Handbook, their function is to review tasks, roles and responsibilities, critical steps, hazards, safety precautions, and operating experience (DoE, 2009, p. 34). **Post-job reviews**, on the other hand, are held after the task has been completed, and their primary function is to serve as a self-assessment to collect feedback and lessons learned (DoE, 2009, p. 54). In this way, meeting-based HU tools are temporally connected to each other: what has been examined in previous pre-job briefings and post-job reviews is relevant for future pre-job briefings when preparing to perform a task again.

The application of pre-job briefings and post-job reviews is usually graded according to the demands and safety significance of the task (DoE, 2009, pp. 34–35). In their most extensive variations, the meetings are documented in some way, usually by the supervisor or manager responsible for the task. This documentation can serve many purposes. In this case study, we focus particularly on their role as a vehicle for organizational learning.

Organizational learning is "the process of improving actions through better knowledge and understanding" (Fiol and Lyles, 1985, p. 803). Effective organizational learning is an important part of maintaining and improving safety: learning from failures, successes and normal operations are the cornerstones of many influential safety theories such as High Reliability Organizations (Weick and Sutcliffe, 2015), safety culture (IAEA, 2020; Pidgeon and O'Leary, 2000; Reason, 1997), and Resilience Engineering (Hollnagel et al., 2011).

One important mechanism of organizational learning is that lessons learned by individuals or teams are disseminated and utilized by the whole organization (e.g. Argote, 2013). In the context of pre-job briefings and post-job reviews, the documentation produced could be considered "organizational memory", which facilitates the organizational learning process. However, it is currently unclear whether the documented information produced by pre-job briefings and post-job reviews is sufficiently informative for organizational learning and whether it is actually used for this purpose.

In this case study, we discuss the following **research questions**:

- RQ1: What is naturally documented and what is not?

- RQ2: What should be documented?

- RQ3: How should the generation and use of documented information be facilitated?

This research report elaborates and concludes the case study concerning pre-job briefings and post-job reviews, and their documentation practices from an organizational learning perspective. The case study was conducted within the research project SAFIR2022 PARSA (Participative development for supporting human factors in safety). The preliminary results of this case study were previously presented in an intermediate research report (see Teperi et al., 2022). Chapters 3.1, 3.2 and 3.3 of this report are based on Teperi et al. (2022).

2.   Methods

The case study was conducted in a Finnish nuclear power company. The data collection methods involved document analysis, interviews and a group interview. The data collection and analysis was performed during 2020–2022.

The materials used for the **document analysis** were the company's procedure for performing pre-job briefings and post-job reviews, and the primary records produced as part of their implementation (open feedback fields in the work permit system and minutes of meetings). The purpose of the document analysis was to get a baseline of how the pre-job briefings and post-job reviews are expected to be held (procedure) and how they are held in practice (work permit feedback and minutes of meetings). All document analysis materials were in Finnish.

The dataset was limited to the year 2020. Due to the annual cycle of Finnish nuclear power plants, the dataset included tasks performed during normal operation and during the annual outage.

In the case study power company, pre-job briefings and post-job reviews are graded on four different levels, Levels 1 and 2 are verbal and Levels 3 and 4 are written. As part of this case study, we reviewed all the Level 3 and 4 pre-job briefings and post-job review feedback fields in the work permit system for 2020 (n=1372). The total number of pre-job briefings (Level 1–4) held in 2020 amounted to 3796. Some of the work permit system feedback referred explicitly to the minutes of the meetings. We used a selection of these minutes as an additional data source (n=12). Ten minutes of meetings were from pre-job briefings and two were from post-job reviews. Both post-job review minutes were related to a corresponding pre-job briefing, which was also available for analysis.

We conducted a thematic analysis to identify the themes that emerged from all the feedback comments in the work permit system and the minutes of the meetings. We used a similar theme structure for both data sources. We also reviewed the procedure for pre-job briefings and post-job reviews (what was expected) and compared it to the themes that emerged in the feedback and the minutes of the meetings (what we observed).

After a preliminary document analysis was completed, three remote **interviews** were conducted with power company employees that perform pre-job briefings and post-job reviews (coordinating supervisors). The purpose of the interviews was to gain a deeper understanding of why these meetings are documented the way they are. Interview themes included:

- Level 3 and 4 pre-job briefings and post-job reviews practices

- Factors influencing their implementation and documentation

- How the meetings and the documentation are perceived by personnel

- Things important to document

- How the documentation is or could be utilized by oneself or by others

- How the documentation practices could be developed

In addition, the preliminary results from document analysis were presented and discussed with the interviewees.

Finally, a remote **group interview** (4 participants) was arranged with the managers and experts who do not primarily work in the field and arrange pre-job briefings and post-job reviews but are responsible for monitoring and facilitating the implementation of pre-job briefings and post-job reviews in the case study company or otherwise utilize their documentation in their work. This group of people are referred to as "HU stakeholders" in this report. The group included representatives from maintenance, quality, and operating

experience departments or units. The purpose of the group interview was to elaborate the wider organization's expectations and practices concerning the documentation. Themes discussed during the group interview included:

- Perception of how pre-job briefings and post-job reviews function

- Factors influencing their implementation and documentation

- Things important to review and document during pre-job briefings and post-job reviews

- Discussion of preliminary results from document analysis

- Discussion of preliminary results from individual interviews

- How pre-job briefings and post-job reviews contribute to organizational learning

- How the documentation practices could be developed

Individual interviews and the group interview were held remotely in Finnish via Teams. They were recorded and transcribed. The interview transcriptions were analysed to identify emerging themes.

In this report, translated quotes from document analysis or interviews are presented to illustrate a theme or an insight. Editorial comments[1] made by the authors of the report are included in square brackets.

3. Results

3.1 Procedure

The company has a written procedure for conducting pre-job briefings and post-job reviews: it has four levels of pre-job briefings, described by a matrix (event probability * severity of consequences). The documentation requirements are defined for each level: Levels 1 and 2 are verbal and do not require documentation, Level 3 requires documentation in the open text fields of the work permit system. There are two open feedback fields, one for pre-job briefing and another for post-job review. Level 4 additionally requires minutes to be taken in the meeting. Level 4 pre-job briefing, and post-job review documentation (minutes of meeting) is included as part of task documentation and attached into the work permit. There is a template for pre-job briefing and post-job review minutes. Post-job reviews must be documented at least when there is a documentation requirement for a pre-job briefing, either in the work permit system, in separate minutes, or as a final project report.

At all levels of pre-job briefings, a short risk assessment checklist is reviewed at the work site before starting the task. For Level 4 pre-job briefings, an extensive risk assessment is conducted before the meeting.

The procedure states that pre-job briefings and post-job reviews are mandatory.

The procedure sets goals for pre-job briefings and post-job reviews and defines the themes to be discussed. The general goal of pre-job briefings is to instruct workers prior to starting work. The themes expected to be covered by pre-job briefings include:

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[1] Editorial comments include clarifications about what the interviewee is referring to, names/details that are replaced with a generic term, and ellipses marked by three periods.

- Purpose, scope, and type of work

- Training/required competence

- Documents, permits

- Work methods

- Previous experiences

- Risks and their mitigation (including occupational and industrial safety, nuclear and plant safety, radiation safety, environmental safety, and production-related risks)

- What to do in irregular situations

- Responsibilities and contact persons

The general goal of post-job reviews is to learn lessons for similar tasks in the future. The themes expected to be covered include:

- Successes, observations, and potential for improvement

- Further actions

- Needs for documentation and reporting

Overall, the instructions for conducting the post-job reviews were much shorter (half a page) than those for the pre-job briefings (8 pages).

3.2 Open feedback in the work permit system

In the case study nuclear power company, an information system is used for various organizational needs, including issuing work permits. In this system, the work permits include open feedback fields for pre-job briefings and post-job reviews.

A total of 825 **pre-job briefing feedback fields** were filled in (60% of all Level 3 and 4 pre-job briefings). Their extensiveness varied considerably (the mean length was 11.1 words, standard deviation 11.4 words). There appeared to be no clear relation between the work content and the length of the feedback. However, there were great differences between the organizational units (of the coordinating supervisor) in terms of how often they had filled in the open text feedback field. Some units had filled in all or almost all their Level 3 and 4 pre-job briefing feedback fields, while others had filled in very few or none.

The total number of filled-in **post-job review feedback fields** was 78 (6%). Almost all the post-job review feedback related to a change in pre-job briefing level (e.g. from Level 2 to Level 3), and was not actual feedback. However, some respondents seemed to write post-job reflections in the pre-job briefing field. Overall, this means a very limited amount of information was available from the post-job review feedback fields for analysis. Consequently, only the analyses of pre-job briefing feedback are presented below.

Discussions concerning open feedback in the interviews with coordinating supervisors and in the group interview with HU stakeholders are also presented below.

Table 1 presents the overall results of the thematic analysis. **Risk identification and mitigation** measures were the most common themes.

Confined spaces and chemicals were the most often identified risks. COVID-19 was quite a prevalent risk, but 89% of the mentions of it were in the responses of only one team. Other identified risks included electric shocks, falling, radiation and contamination, fire, release of energy, other working groups, and asbestos. Plant safety (nuclear safety) risks were not separately reported, but foreign material risks did come up in some comments. Overall, the most typically reported identified risks seemed to relate to occupational safety.

The most commonly reported risk mitigation measure referred to various types of personal protective equipment (PPE). Special work process considerations were also often mentioned (procedures, practices, or work methods). Other mentioned risk mitigation measures included reviewing working conditions, warnings, or work site markings, applying cautious approaches, explicitly forbidding something, co-ordinating with others, preparing for emergency situations, and the presence of safety officials.

A description of the participants was another very common theme. Usually the participants' names, disciplines, or contractors were listed. Sometimes a general reference was made to the working groups holding the pre-job briefings. A list of participants was the only content in 15% of the feedback comments. The interviewed coordinating supervisors and HU stakeholders felt that the relatively high amount of feedback consisting of just a list of participants may indicate that the workers just wanted to enter something in the field to sign the task off. They associated this with data duplication (in-depth information is already in the minutes), optimization (if it is a routine task and there is nothing special, only the participants are listed), or minimum compliance (if something must be recorded before signing a task off, a list of participants is an easy thing to do).

Interfaces with other stakeholders (units or to contractors) were usually related to the participants in pre-job briefings who should be contacted or involved before, during or after performing a task, or awareness of the activities of other groups. In some cases, pre-job briefings were held by contractors.

Feedback that referred to **familiarization with work** usually stated that work had been reviewed (without being specific about the work). A few feedback comments described the actual work contents or phases in detail.

Documentation of **operating experience** was rare in the feedback. The respondents made references to similar or related jobs but did not describe detailed operating experience.

Four responses were categorized as **"lessons learned or feedback"**. It was unclear whether they were intentionally documented as pre-job briefing feedback.

Some of the comments were **not thematically classified**; these were either unrelated to work or comments with no evident content.

Table 1. Overview of emergent themes, example quotes, and approximate prevalence of themes

Pre-job briefing themes	Example quotes (translated from Finnish)	Prevalence
Risk identification	*"The basement is treated as a confined space."* *"Chemical hazards were reviewed in the pre-job briefing: alkali, acid and contaminated water."* *"Electricity room, be careful."* *"In addition to the task performance review, COVID-19 risks were identified, and mitigation measures were evaluated."* *"Acknowledge the radiation on top of the reactor cover."*	45%
Risk mitigation measures	*"Work is done in high places. Harnesses must be worn at all times."* *"Wear a visor and rubber gloves."* *"Task phases and work practices in confined spaces were reviewed in the pre-job briefing."* *"No one goes in the container. Put a prohibition sign on the lid."* *"Consider other working groups while performing the task."* *"Verified the location of emergency shower and exit routes."* *"Radiation safety officer is present at all times."* *"Risk of foreign parts, apply protective measures so that nothing falls."*	43%
Participants	*"Participants were from engineering, radiation protection, inspection and cleaning."*	36%
Interfaces with other stakeholders	*"Contact the control room before and after work."*	24%
General confirmation of meeting held	*"Pre-job briefings were held."*	24%
Familiarization with work	*"Tasks were reviewed."*	17%
Reference to minutes of meetings	*"See attached minutes of the meeting."*	9%
Work context and background	*"Last year, the container was opened and there was no need for cleaning. Therefore, now only a visual inspection is conducted."*	4%
Reference to work content or permit	*"Work was performed according to the work permit [code]."*	2%
Confirmation or description of work done	*"Work ok."*	2%
Not classified		2%
Operating experience	*"Similar task was performed during previous outages."*	1%
Lessons learned or feedback	*"We suggest building curved scaffolding for working inside the pressure vessel."*	<1%
TOTAL filled-in pre-job briefing feedback fields		825

Table 2 shows the **comparison** of the themes that emerged in the work permit system's feedback comments and the expected themes for pre-job briefings. The feedback relatively fully covered the purpose, scope and type of work, work methods and identification of industrial safety, radiation safety, and environmental safety. These are also core tasks of pre-job briefings. The need for training, documents or permits, preparation for emergencies, responsibilities, and contact persons were less commonly documented. However, apart from preparation for emergencies, documentation of these themes might not be particularly relevant.

Previous experiences, nuclear and plant safety and production risks were also rarely documented. Based on the feedback, it was unclear whether operating experience was examined in pre-job briefings, and if it was, what its content was and where the experience had been gained. The interviewed coordinating supervisors commented that previous experiences are typically not recorded in the work permit system because it would be duplicate work (if they are already recorded in minutes of meetings), or because the work permit system does not allow easy retrieval of the recorded information.

Nuclear and plant safety are an important part of the work in nuclear power plants. Even though foreign material risks and mitigation measures were sometimes mentioned, this theme was quite rare. The interviewed coordinating supervisors felt that many may perceive pre-job briefings and post-job reviews as something that relate to occupational safety—even though they concern all types of safety. One interviewee felt that this may reflect a good and mature occupational safety culture at the plant and that workers know how to identify the related hazards. The interviewee stated:

"Pre-job briefings and post-job reviews are largely associated with occupational safety even though they are a lot more. Maybe it relates to how they were initially promoted. But now in HU training and other trainings it is emphasized that these are important for work performance and all types of risks are reviewed." (interview)

Table 2. Comparison of expected and reported themes in the work permit feedback. Colour coding indicates the extent to which the expected theme was reported (green = well reported; yellow = somewhat reported; red = rarely reported)

Expected (procedure)	Reported (in feedback comments of work permit system)	
Purpose, scope, and type of work	Familiarization/preparation with work was a common theme	🟩
Training/required competence	Competence assurance was sometimes mentioned (risk mitigation measures)	🟨
Documents, permits	Procedures or permits were sometimes referred to	🟨
Work methods	Special work process considerations were a common theme	🟩
Previous experience	Operating experience was rarely reported	🟥
Occupational, industrial, radiation, and environmental safety	Occupational safety risks and mitigation measures were the most common themes	🟩
Nuclear and plant safety	Nuclear and plant safety risks were not highlighted, apart from risks of foreign material and related actions	🟥
Production risks	Production risks were not highlighted	🟥
What to do in irregular situations	Emergency practices were sometimes highlighted (risk mitigation measures)	🟨
Responsibilities and contact persons	Responsibilities were not often reported, but interfaces with other units or contractors were reported	🟨

3.3   Minutes of meetings

We reviewed the minutes of twelve meetings (ten from pre-job briefings and two from post-job reviews). These meetings were held by three different coordinating supervisors and in two different maintenance disciplines. Both post-job review minutes were related to a corresponding pre-job briefing, which was also available for analysis. Ten of the meetings were held either completely or partially remotely (including both post-job reviews).

The minutes of the **pre-job briefings** were not identically structured, and they varied in how extensively they were prepared. The most important topics were covered in all the pre-job briefing minutes: work description and background, training documents and permits, risks and mitigation, responsibilities, and contact persons, and operating in irregular situations.

Almost all (90%) minutes had a structure (subchapters) for risk identification and mitigation measures. Risks were structured as either high-level (work-specific issues, and occupational, plant, environmental, and production risks), or detailed (up to 14 specific risks, ranging from confined spaces, fire, slipping, to loose parts and radiation, etc.). Plant safety risks (40%) and loose parts (70%) were covered more often in the minutes than in the work permit system feedback.

Like in the work permit system feedback, PPE was the most often mentioned risk mitigation measure. However, preparation for emergencies was more often mentioned in the minutes (100%) than in the work permit feedback (4%).

Previous experience was referred to in almost all the minutes (90%). These references were either short statements or detailed descriptions of the experience and how it may affect the current task. However, it was unclear how the previous experience had been gained: whether it was through discussion during a pre-job briefing, a review of previous documentation, or something else. The interviewed coordinating supervisors described that they review minutes of previous pre-job briefings and post-job reviews when preparing for an upcoming task, which suggests that at least a review of previous documentation is done.

Some pre-job briefing minutes also mentioned other HU tools or referred to conducting a post-job review.

Table 3 compares the themes that emerged from the pre-job briefing minutes and the expected themes of the pre-job briefings. Overall, the pre-job briefing minutes template seems to ensure that all relevant topics are documented.

Table 3. Comparison of expected and reported themes in pre-job briefing minutes. Colour coding indicates the extent to which the expected theme was reported (green = well reported; yellow = somewhat reported; red = rarely reported)

Expected (procedure)	Reported (pre-job briefing minutes)	
Purpose, scope, and type of work	Described in all the minutes	🟩
Training/required competence	Review of competences was a very common risk mitigation measure, covered in almost all the minutes	🟩
Documents, permits	Review of procedures or permits was a very common risk mitigation measure, covered in all the minutes	🟩
Work methods	Special work process considerations were a common theme	🟩
Previous experience	Previous experience was discussed in almost all the minutes	🟨
Occupational, industrial, radiation, and environmental safety	Different types of risks were covered; very extensively in some of the minutes	🟩
Nuclear and plant safety	Plant safety risks were structurally included and covered in most of the minutes	🟩
Production risks	Production risks were structurally included in half of the minutes	🟨
What to do in irregular situations	Preparation for emergencies was reviewed in all the minutes	🟩
Responsibilities and contact persons	Responsibilities and contact persons were included in all the minutes	🟩

The two **post-job review** minutes were prepared by the same coordinating supervisor and were related to similar tasks. Both the post-job review minutes followed a similar document structure (subchapters) to that of their corresponding pre-job briefing minutes: instead of describing work plans and anticipated risks (pre-job briefing), the post-job review minutes described the realized work, risks, and experiences (including good practices and suggestions) (Table 4).

Table 4. Comparison of corresponding pre-job briefings minutes and post-job review minutes

Theme	Pre-job briefing minutes (n=2)	Post-job review minutes (n=2)
Work description/ background	Descriptions of planned schedule	Descriptions of realized schedule
Training, documents and permits	Reference to risk assessment form Reference to work permits, procedures, and training materials Description of previous experience and special requirements	Reference to work permits and procedures (repeated from pre-job briefing minutes) Other topics discussed in pre-job briefing minutes were sometimes included in the structure of the minutes but had no content ('Nothing special')
Risks and mitigation	Work specific issues Occupational, plant, and environmental safety and production risks and mitigation measures	Risks discussed in pre-job briefing minutes were included in the structure of the minutes but had no content
Responsibilities and contacts	Table of names and phone numbers	Statement that responsibilities and contacts realized as planned
Operation in irregular situations	Description of what to do in irregular situations	Description of issues observed at work site and corrective measures
Reference to post-job review	Reference to post-job review to be conducted by the co-ordinating supervisor	Notion of good practice and suggestions for improvement

3.4 Interviews with coordinating supervisors

3.4.1 Pre-job briefing practices and influencing factors

All interviewees regularly organized some type of pre-job briefings, but the more comprehensive ones (Level 3 or 4 that are required to be documented) were less common. The interviewees estimated that they arrange less than ten documented pre-job briefings per year. Sometimes Level 2 pre-job briefings may also be documented, for example, if the task is unique or otherwise special. Generally, the less comprehensive, Level 1 and 2 pre-job briefings were considered a daily routine.

The interviewees typically arranged the Level 3 or 4 pre-job briefings a week before the task performance.

The interviewees also mentioned other preparation meetings in addition to the formal pre-job briefings. Smaller scale pre-job briefings were held within teams before sending the workers into the field or before a specific phase of a task. Coordinating supervisors sometimes participate in these meetings. Higher-level weekly meetings ("Thursday meetings") were used to coordinate all maintenance department works for the upcoming weeks. If a task requires a lot of preparation, the supervisors might hold a specific pre-job briefing about the preparation. In addition, outage preparation meetings are held where the maintenance department prepares for the annual outage as a whole. The two quotations below explain these aspects:

> *"These preparatory meetings ["Thursday meetings"] do not rule out or remove the need for the actual pre-job briefing, because in pre-job briefings, task-specific things are discussed: how to communicate, what is the work process, when do other groups perform their tasks, what things to consider, who handles protective measures, etc. In the "Thursday meeting", we discuss on general level if tools and equipment are available, and who needs them for what task and when. It is a general overview to all upcoming tasks." (interview)*

> *"My style is that first we have a pre-job briefing in the meeting room, but then we also review the task at the job site. There we go through a risk identification checklist and the most important aspects of the task." (interview)*

This means that there are many levels of preparation meetings for one specific task, each with a different function:

- **Weekly maintenance department meetings**: many tasks and departments coordinate things together, resource needs are anticipated

- **Formal Level 3 or 4 pre-job briefings**: the task performance group prepares for the whole specific task, formally documented

- **Team or phase-specific "toolbox talks"**: held right before going into the field or at the job site, or when starting a specific phase within a task

The combination of the preparatory meetings that the supervisors used depended on the task characteristics and demands. It seems that the use of pre-job briefings or other analogous tools is quite fluid and case-specific, and their practical application is either adapted to the situation at hand or complemented by other preparatory meetings. This was explained by one of the interviewees as follows:

> *"In some tasks there is so much preparatory work that I have held a pre-job briefing about the preparations. Sometimes the task performance just covers the details, so we have held the pre-job briefing just with the supervisors to discuss the overall arrangements, and then we agreed to hold phase-specific pre-job briefings at the job site to review the details." (interview)*

The interviewees identified many **factors influencing** the successful implementation of pre-job briefings. The most commonly highlighted success factor was how well the coordinating supervisor had prepared for the pre-job briefing. Things to prepare for included scheduling the meeting, defining the meeting content, and knowing the task context, as explicated in the following quotations:

"I think that when I arrange and send the invitation for the pre-job briefing well beforehand – not the same day when the task begins – it makes it possible for everyone to participate and prepare for it."
(interview)

"If the arranger is not prepared at all, the participants will not gain anything from the meeting. The arranger needs to take time to prepare for the meeting properly. If you just read text from a procedure and that's it, it will not be useful for the participants nor for the arranger." (interview)

"The [coordinating] supervisor needs to know the overall context of the work. You can't just go there without preparation: then the meeting will become long and frustrating and take an hour or two instead of ten minutes." (interview)

Experience in arranging pre-job briefings was another commonly mentioned success factor. The interviewees felt that experience helps not only to improve the smoothness of the meeting, knowing what is important to review and communicate, and knowing all relevant stakeholders, but also understanding the benefits of the pre-job briefings.

Other factors that the interviewees identified as important included facilitation of open communication about the task, and that the right kind of expertise is present, as explained below:

"When the right experts are present who know how the task should be performed, then questions can be raised about what to check before starting the work, and sometimes the work plan may need to be changed. […] I think that those who actually perform the task should be present, because sometimes even their supervisors might not know what they know." (interview)

Opinions concerning pre-job briefing instructions were mixed. Some interviewees felt that pre-job briefing practices (and other HU tools) were well covered during various training events and that they are actively promoted at the plant. However, the interviewees also felt that the written instructions and meeting templates for pre-job briefings were sometimes too heavy and inflexible. This may suggest there is still a need for further development of a graded approach when applying the procedures. The quotes below express these sentiments:

"I think it has been well communicated why we have these [pre-job briefings] and what are their goals. I would not say that people do not understand them." (interview)

"There are a lot of things to review [as per instructions] that are not always necessary. Even though we have a template in our document management system, it still requires a lot of editing because you must remove a lot of notes from the template before you can start working on it. I have created a template for myself that I use in my tasks."
(interview)

The interviewees also identified factors hindering the successful implementation of pre-job briefings. One interviewee highlighted that lack of participation is one such factor. For example, if one group does not participate in the pre-job briefing, it can reduce the motivation to arrange the meetings. Holding meetings remotely during the COVID-19 period slightly helped this situation.

3.4.2 Post-job review practices and influencing factors

Post-job reviews were not perceived to be as well-functioning as the pre-job briefings. The interviewees felt that they were not used to the extent that they could be used.

Logistical problems were identified as one contributing factor. Not everyone involved in the task might participate or be able to participate. This was especially the case during outages when some groups or contractors might have already left the plant before the post-job review. Sometimes the invited people might just send an email indicating that everything went well and then do not participate in the actual meeting. Low interest in participation was particularly the case if nothing special had happened during task performance. This suggests that post-job reviews could benefit from a graded approach that is not directly linked to pre-job briefing levels (which are defined by event probability * severity of consequences matrix), but instead should also consider what the learning opportunities are.

3.4.3 Documentation practices

The interviewed coordinating supervisors had mixed opinions concerning the **documentation of pre-job briefings and post-job reviews**. On the other hand, they felt that written documentation was useful for information preservation, and it could be used in future tasks. In fact, some interviewees made more extensive documentation than what was required in the procedures (e.g. also documenting Level 2 pre-job briefings). On the other hand, the interviewees noted that the overall opinion in their organization concerning documentation is not unified and that many workers are less motivated to prepare extensive documentation because they do not see any benefit in it.

A significant theme affecting the motivation to document things (particularly concerning the work permit system) related to the **searchability and retrievability** of the documentation from storage. For example, the interviewees felt that finding useful information from the work permit system was difficult for the common person. All interviewees highlighted that the current system of feedback in the work permit system does not function well from this perspective. The interviewees explained that data is not entered into the work permit system because it is difficult to retrieve, which further reduces the motivation to enter anything in the work permit system. The following quotations echo this sentiment:

> *"It decreases the willingness to arrange the meetings when the information is not easily retrievable when you perform a similar task later again." (interview)*

> *"It is easy to write in the feedback fields. I'd prefer that people wrote more than not write anything at all. […] There should be a library or database where the pre-job briefing, and post-job review documents were available in a centralized manner. But if they are in the work permit system, it is difficult to find them quickly." (interview)*

One interviewee considered the **identities** of office workers and field workers and how they perceived documentation of pre-job briefings. Since preparing various documents is the core task of the office workers, they may perceive pre-job briefing documentation to be more important than field workers who might emphasize more concrete work.

The interviewed coordinating supervisors were also asked to describe what they felt was **important to document.** Examples of things considered important to document (in some system) included descriptions of risky phases or special conditions, how the task is planned to be conducted, what specific tools will be used in the task performance, and how the task is coordinated with others.

After task performance, the interviewees felt that it was important to document aspects such as whether something went wrong or if something could be done differently in the future, or if some specific tools or spare parts were used in the task, as the quotations below illustrate:

*"In the feedback field we should more thoroughly describe the label
and location of a spare part if it was used. It speeds it up a lot if there
is a fault in the future in some safety-critical system so we can find
the spare part." (interview)*

*"Of course, if something had happened. But also, observations such
as that it would be better to use some other type of working
equipment. For example, we have made notes that in lifting tasks, it
would be better to use white gloves. These kinds of things we have
noted in post-job reviews." (interview)*

3.4.4 Documentation as part of organizational learning

Documentation as part of organizational learning was approached from three perspectives: how the interviewees used their own documentation, how the interviewees used someone else's documentation, and how the interviewees saw that others could use their documentation.

All the interviewees were positive towards the documentation of information as such and felt that it is important to do to **retain organizational knowledge**. However, not all means of information storage were considered to be very effective for later use. The interviewees felt that entering data into the work permit system was not very useful (due to issues with retrievability) and were also concerned about unnecessary work if the same information is entered in multiple systems such as the work permit system and in the minutes of meeting or in a group-specific database. Minutes of meetings were generally considered more useful due to their extensiveness. The following quotations illustrate some of their thoughts on these issues:

*"I think the minutes are useful because I can see what we have
reviewed in the previous meetings." (interview)*

*"Writing the minutes is also about preparing for the future: I cannot
know if I will work here for the next ten years or if it is someone else
will be doing this work. The documentation helps whoever does this
work in the future." (interview)*

*"I don't really see any benefit in writing feedback in the work permit
system because I haven't figured out how I could utilize that
information. Sometimes I have added an attachment there [minutes],
and in the open field I have written that the pre-job briefing was held
and listed the participants." (interview)*

*"When there was [a maintenance task], I reviewed the minutes of the
same task from the last two years to collect previous experiences. I
did not document this work in the work permit system, because I
already documented it on the paper [minutes]. I definitely do not want
to do double work." (interview)*

Indeed, most of the interviewees did not use work permit feedback later in their work. The primary reason for this seemed to be **retrievability**: the work permit system does not provide easy access to the recorded data. Some interviewees attached minutes of meetings to the work permit system, but in practice, these minutes were retrieved from their own local databases or network drives when preparing future tasks. Most of the interviewed coordinating supervisors referred to their **own databases**, network drives or similar local storage solutions where they retain information which is relevant to them.[2] However, these local systems

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[2] Data in the local storage was not reviewed in this research project.

were effectively only available for that one group, which can lead to silos of information inside the organization. Overall, this suggests that the information that is natively stored in the work permit system (content of open feedback fields) and the information that is attached there (minutes of meetings) may be "forgotten" or its potential may be underutilized because it cannot be easily found. The following quotations explain this aspect:

"We do not have a clear tool for using this [work permit feedback]. I have stored our pre-job briefings in our group's drive, and I can easily find them there and benefit from them. […] It is not a solution either if the whole document is attached [to the work permit system], because it cannot be found there anyway." (interview)

"The work permit system search is a bit difficult. We have Excel reports for this purpose, but I know that many do not know where to find them or how to get a summary of the feedback. […] The system of generating reports is new in this context. We have made many reports, but are they visual and easily retrievable? There is a lot of room for improvement." (group interview)

Using pre-job briefing documentation that was **prepared by someone else** (other groups) was not seen a common practice. One interviewee identified the circulation of minutes of meetings to groups that have related tasks as one mechanism for utilizing pre-job briefing documentation made by others, but it depended on whether the groups knew each other's task scopes and whether there was overlap. The weekly "Thursday meetings" were seen as one way of identifying such tasks and they were also a forum where the pre-job briefing minutes can be distributed to relevant groups, as one of the interviewees explained:

"I don't think anyone uses someone else's pre-job briefing minutes. […] Pre-job briefing minutes are sent to the participants, or sometimes to a wider audience. That's the way they are shared. […] I think they should be used more [by others], if only they were available somewhere. But I don't think many would read a pre-job briefing document if it's just sent to them. Maybe they would read it if I wrote that your group also has this task…" (interview)

The interviewees were asked to consider how their pre-job briefing and post-job review documentation could potentially be used by other groups. They identified mostly practical issues that related to work processes. One interviewee also noted that participating in pre-job briefings held by others could help improve one's own pre-job briefing process. These sentiments are expressed in the following quotations:

"Our tasks relate to lifts, and they are done everywhere in the plant. I'm sure many would benefit from our documents. […] Recently we tested [new lifting equipment], and during the post-job review, I made a document about the test and shared it with various stakeholders who could be interested in it: maintenance and occupational safety." (interview)

"There are a lot of things that are useful if they relate to your task. If we do some special tasks in a certain area, the things that need to be taken into consideration are all there [in the documentation]." (interview)

The interviewees also commented on more **informal organizational learning practices**: networks of people and generally knowing your colleagues and representatives from contractors were seen as the way information is often shared. HU stakeholders also felt that informal discussions among work groups were an important forum for organisational learning. However, the interviewed coordinating supervisors also

identified some downsides with this. Information that is shared in informal networks only reaches a small audience, and if it spreads wider, there is a risk of misinterpretation—a sort of "broken telephone" effect. Documented information was seen as a more reliable carrier for information. The quotations below describes this aspect:

> *"If someone has had a good insight, it is discussed in work group*
> *meetings outside the pre-job briefings. After that, the information*
> *propagates to other meetings, coffee table discussions or elsewhere."*
> *(group interview)*

3.4.5 Development needs

The interviewed coordinating supervisors most commonly identified the **work permit system** and how it is used for storing pre-job briefing and post-job review documents as a development need. Better use of search terms such as task descriptions, locations and part codes were concrete examples of things to improve. There was thus a hope for a better search engine for the work permit system. However, the interviewees were somewhat sceptical as to whether the work permit system would be flexible enough for such purpose, as the following quotation illustrates:

> *"It should be so that if you search [for a task], it will find all the work*
> *permits that relate to that type of task and their pre-job briefing and*
> *post-job review minutes. And you could also filter them [by location]."*
> *(interview)*

Other development suggestion included **unification** of documentation practices across the organization to ensure their high quality. Improvement of templates of minutes was mentioned as one example. This included making them more flexible to suit the situation at hand, but also ensure that they are sufficiently homogeneous across the organization.

3.5 Group interview with HU stakeholders

3.5.1 Documentation practices and their effectiveness

The HU stakeholders felt that the meeting practices themselves functioned well, and that they have improved a lot in recent years. However, they felt that there was still room for improvement concerning the documentation. The HU stakeholders mentioned the **complexity** of the work permit system interface (both visually and that there are several fields to fill) and the **lack of content** in the work permit feedbacks as primary documentation issues. This is illustrated in the quotations below:

> *"The task feedback field concerns the equipment that was worked on.*
> *There you write notes for the next task. […] Then there is the*
> *feedback field for the work permit, if there is something in the work*
> *permit itself: unnecessary or missing steps. […] And then there are*
> *the pre-job briefing and post-job review fields."* (group interview)

> *"There are a lot of fields to fill, and not everyone knows what to write*
> *and where. […] What should be written in these open fields that it*
> *would be useful afterwards? I think this is something we should pay*
> *attention to."* (group interview)

> *"My observation is that the feedback is often a bit lacking. Maybe it*
> *shows that the workers don't feel that whatever is entered there will*
> *actually be used later. It's a kind of an administrative step to set the*
> *work permit in the right state."* (group interview)

Indeed, the work permit system includes certain **enforced administrative steps** (such as ticking that the post-job review has been held) before it allows signing the task off as completed. The coordinating supervisors noted that this can be problematic in schedule-critical conditions such as outages. Sometimes the post-job review is ticked as completed before actually holding it to allow the outage to proceed. The post-job review is then held on a more suitable date. There had been internal discussions in the organization whether it makes sense to require that these feedback fields are filled (because this expectation is not fully met in practice), but the organization's policy was that it is important and that they should be filled.

When asking what is important to document in the feedback fields, the HU stakeholders discussed the **added value of the open feedback fields**, particularly in case of Level 3 pre-job briefings (which do not require the preparation of minutes of meetings). They wondered that if the pre-job briefing was held according to procedure and the risk identification checklist was gone through, whether there was a need to also enter anything about the pre-job briefing in the feedback fields? They also discussed the option of requiring the preparation of meeting minutes for Level 3 pre-job briefings as well, which might help to solve the issue of documenting in the work permit system. The HU stakeholders concluded however that requiring of meeting minutes from Level 3 pre-job briefings would be too resource-demanding and that it would be preferable to try to improve the work permit system feedback practices. They also felt that it is important that the work permit system is used as the storage medium because all work processes are arranged through it anyway, as mentioned by one of the interviewees:

> *"The work permit system enables making the information available for*
> *later use smoothly; there are integrated functionalities to find*
> *observations from similar tasks to support continual improvement and*
> *learning. The work permit system is better for this than minutes of*
> *meetings which would have to be separately opened and processed."*
> *(group interview)*

3.5.2 Documentation as part of organizational learning

Organizational learning was discussed with HU stakeholders from the perspective of how they utilize or could utilize the documentation from pre-job briefings and post-job reviews, and how they as outsiders facilitate the distribution of information stored in this documentation.

Oversight of HU tool use was mentioned as a use case for the documentation. This involved making sure that the application of pre-job briefing, and post-job review practices are implemented as expected. For example, this organization had conducted trend analyses of the feedback entered in the work permit system to follow-up how it was applied by the workers. One of the interviewees noted:

*"One of the things [we use documentation for] is to gain confidence
that the expected topics have been properly handled. This is
something that we cannot currently see in the work permit feedback."
(group interview)*

Post-job review documentation was seen as potentially useful for **training** if lessons learned from an incident or event have been described. One of the group interviewee participants commented that having practical examples in the training make the lesson learned more persuasive and that adverse events in general have been used for educational purposes.

Minutes of meetings are also used in **event investigations** to provide additional information concerning the work process and its underlying reasoning process, and how the event was handled afterwards. However, the primary way for learning from incidents is the operating experience feedback process, which involves conducting event investigations and preparing event reports of various types. The difference of functions between operating experience feedback process and post-job reviews was also discussed with coordinating supervisors and it was implied in the plant's post-job review procedure. The distinct function of post-job reviews when compared to operating experience feedback is that they are used for collecting lessons learned for performing similar tasks in the future.

Responsible persons for plant systems (in Finnish "*järjestelmävastaava*") use the feedback documentation from a **technical perspective** in their work. They use the feedback information to verify that issues related to equipment and technology are properly documented so that they can, for example, be used for managing future procurements. However, it was noted that the responsible persons for plant systems might not put much focus on reviewing pre-job briefing and post-job review feedbacks.

We also inquired whether it would be meaningful to develop an **organizational function** that reviews the feedback data and creates summaries, or lessons learned for the rest of the organization. The HU stakeholders felt that this is something that the operating experience feedback function is already doing on a general level. Adding new supporting organizational functions was not considered beneficial; instead, they found that helping those who need the information to find the information themselves would be a better course of action, as explained below:

*"The world is full of lessons – should we have a separate group to do
just this thing? It might help, but we cannot have an infinite number of
groups and teams that just produce supporting information for the
operative staff. […] Then the operative staff decreases and
supporting staff increases. We should not unnecessarily increase the
amount of supporting personnel." (group interview)*

Overall, the HU stakeholders did not feel that **supervisors** read pre-job briefing and post-job review documentation much—especially not outside of their own scope. They also felt that experienced workers who have performed the task many times before might not consider it useful to write down basic things that make the work smoother or that contribute to management of risks. The sheer number of various factors contributing to successful performance was seen as a potential issue that could result in overload, as the quotations below describe:

*"I think currently people do not review old post-job reviews
systematically. Some supervisors might, but a lot do not. […] I think
this is because [documentation] cannot be easily found." (group
interview)*

*"I'm not sure if it's a good or bad thing that there are established
routines, the risks are the same and that they are reflected upon. The
supervision resources are somewhat scarce and if you must
document the same things in many places, it can be quite resource
demanding." (group interview)*

*"I think this is why the documentation is prepared: to better mitigate
risks and make the task performance smoother. […] This should
motivate; the documentation can also protect yourself if something
goes wrong as it shows that everything was done properly and
recorded." (group interview)*

3.5.3 Development needs

Creating a **shared understanding** of why the documentation of pre-job briefings and post-job reviews are done and how they could be utilized for learning (as opposed to just signing off the work permit with a simple note), was recognized as a development need. Key people facilitating this development were the leadership of coordinating supervisors and group supervisors: their commitment would result in everyone else's commitment. Management level commitment was also seen as important driver. The interviewed HU stakeholders also felt that additional promotion with newsletters or refresher courses could be used to share success stories of how post-job reviews were used to develop work. This would help motivate their use. This was explained by one of the interviewees, who noted:

*"Nothing happens if there is no decision from the top. We already
have a mandate from the management to implement this widely and
there is an ongoing development project with the field workers. I think
if your colleague says that it is a good thing to do, they are more likely
to be heard than if an expert and stranger who does not know
anything about field work comes to promote something." (interview)*

Improving the **user experience** of the work permit system was identified as another development need. The HU stakeholders discussed whether a checklist should be included with the open feedback fields to support data entry, and whether the number of feedback fields in the work permit system should be reduced to simplify the system.

4. Discussion

4.1 RQ1: What is naturally documented and what is not?

In the studied nuclear power company, pre-job briefings were documented either as open text fields in their work permit system, or as separate minutes of meetings. When **open text fields** were used for documenting pre-job briefings and post-job reviews, the resulting documentation tended to have the following characteristics:

- **Varying and often low information value**. Low information value is reflected in feedback that was empty, declarative, trivial, or otherwise not useful for future use. Contributing factors for this

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included low perceived usefulness of the recorded feedback, lack of structure (open fields do not contain instructions or requirements for content), and administrative enforcement (workers tend to just quickly fill something in to be able to sign off the task or step). Post-job review fields were not required to be filled in 2020, and consequently they were all effectively empty.

- **Focus on occupational hazards**. Many tasks, locations and equipment in nuclear power plants are not nuclear safety significant, but most tasks involve some type of occupational hazard. Occupational hazards may also be more readily identifiable. This was reflected on the distribution of identified and documented risks, which were often occupational.

- **The motivation to document things is linked to how IT solutions have been implemented**. Since the open feedback fields were natively located in the plant's work permit system, its implementation from the IT perspective influences the way they are written and retrieved afterwards. Motivation issues emerge if data entries are not easily retrievable, of if the user experience is bad.

In case of **structured minutes of meetings** (with a standard template), the resulting documentation tended to the have the following characteristics:

- **All expected topics were covered**. The template structure helped ensure and demonstrate that all matters were covered. However, there was still variability between how supervisors utilized the templates and how extensively each topic was documented in the minutes of meetings.

- **Preparing minutes requires significant effort**. The application of a graded approach to choose which types of pre-job briefings and post-job reviews are to be documented was considered important to avoid reducing the documentation quality and motivation to document things, and to avoid excessive resource use.

- **Standardized templates may increase workloads**. Standard templates—if too excessive—may increase the workload (e.g. if there are a lot of instructions to remove when preparing the minutes). Some supervisors circumvented this by adapting the template for their work context and created a "pre-cleaned" template which they used in their meetings.

- **Effectiveness for organizational learning depends on IT solutions**. Minutes of meetings in this power company were regular documents which enabled their storage in various locations. Attaching the minutes in the work permit system has the potential to enable organizational learning because access is provided to everyone, but due to issues of retrievability, this did not occur effectively. Instead, coordinating supervisors stored the minutes in their local databases (with limited access rights) for easy retrievability, resulting in information silos.

4.2   RQ2: What should be documented?

What should be documented in pre-job briefings and post-job reviews depends on what has been defined as the **purpose** of the documentation. The results of the case study suggest that documentation produced during pre-job briefings and post-job reviews could be useful for at least the following three purposes:

1. Demonstrating that the meetings were held as expected (oversight function)

2. Encouraging employees to systematically conduct the meetings (leadership function)

3. Enabling organisational learning (continuous improvement function)

First, the documentation for pre-job briefings and post-job reviews can provide a **paper trail** for demonstrating that the meetings were held as according to expectations. This helps in monitoring their implementation and development. For this to be effective, the documentation needs to provide reliable

information that the expected topics were reviewed in the pre-job briefings and post-job reviews. Due to their unstructured and open character, feedback fields in the work permit system in their current form in this organization serve this function only partially. Collecting documentation as open feedback cannot effectively be used for identifying whether certain topics were covered in one specific meeting because coordinating supervisors do not commonly report all aspects of the meeting in the open field. Hence, it is not possible to determine which topics were really discussed during the pre-job briefings or post-job reviews. However, an analysis of the overall trends of the topics covered in open feedback provides general indications of how the pre-job briefings and post-job reviews are held. A more reliable conformation can then be found from pre-job briefing and post-job review minutes of meetings, particularly if they are structured (as was the case in this power company).

Second, documentation can serve as **encouragement** to systematically conduct pre-job briefings and post-job reviews, and to reflect on work performance in teams. Document templates, guidance, and open fields in the work permit system may help structure and motivate reflection, which may otherwise be difficult to do or to remember. The pre-job briefing minutes templates seemed to be useful for ensuring that all the relevant topics were covered and that the topics that did not naturally emerge in work permit system's feedback comments were included. By providing a concrete structure for the meeting, preparing the documentation supports the implementation of the pre-job briefing and post-job review procedure. There is also a potential risk of creating negative associations with documentation: the observed issues with information retrieval and user experience of the work permit system feedback fields may result in workers treating the documentation as a purely administrative step that is done to merely sign off the permit. This reduces employee motivation and the quality of the documentation.

Third, the documentation of pre-job briefings and post-job reviews can be seen as information storage for **organizational learning** (i.e., organizational memory): the documentation created could or should be used by someone else or sometime later for learning and development.

Based on this case study, the documentation seems to be only partially useful for this purpose. For example, a great deal of the work permit system feedback was rather declarative and as such may have little value for organizational learning. The reason for preparing the documentation may be primarily due to rule adherence rather than genuine motivation. This reduces its quality and usefulness for learning purposes. In this case study, this was particularly evident in work permit feedbacks. Indeed, 40% of the Level 3 and 4 pre-job briefings had no filled work permit system feedback fields and there was no post-job review feedback. Difficulties in retrievability meant that the feedback that was entered was not systematically used.

On the other hand, minutes of meetings were actively used by coordinating supervisors to collect experiences and lessons learned. Their application by coordinating supervisors was usually limited to their own scope, which suggests that the organizational learning was primarily temporal (information is gained from previous points in time) rather than spatial (information is gained from other organizational units).

Sometimes supporting organizational functions utilized pre-job briefing and post-job review documentation in addition to coordinating supervisors (Figure 1). It is noteworthy that each stakeholder views pre-job briefing and post-job review documentation from their unique perspective and use them for different purposes. This means that what the stakeholders consider useful documentation differs to some extent. For example, for work performers useful information is something that helps to perform the task again but in a safer and more effective manner; for oversight it is useful that the documentation has a structure which can be utilized to verify whether and how a certain step was done or not; for training it is useful that descriptions are vivid and practical, etc.
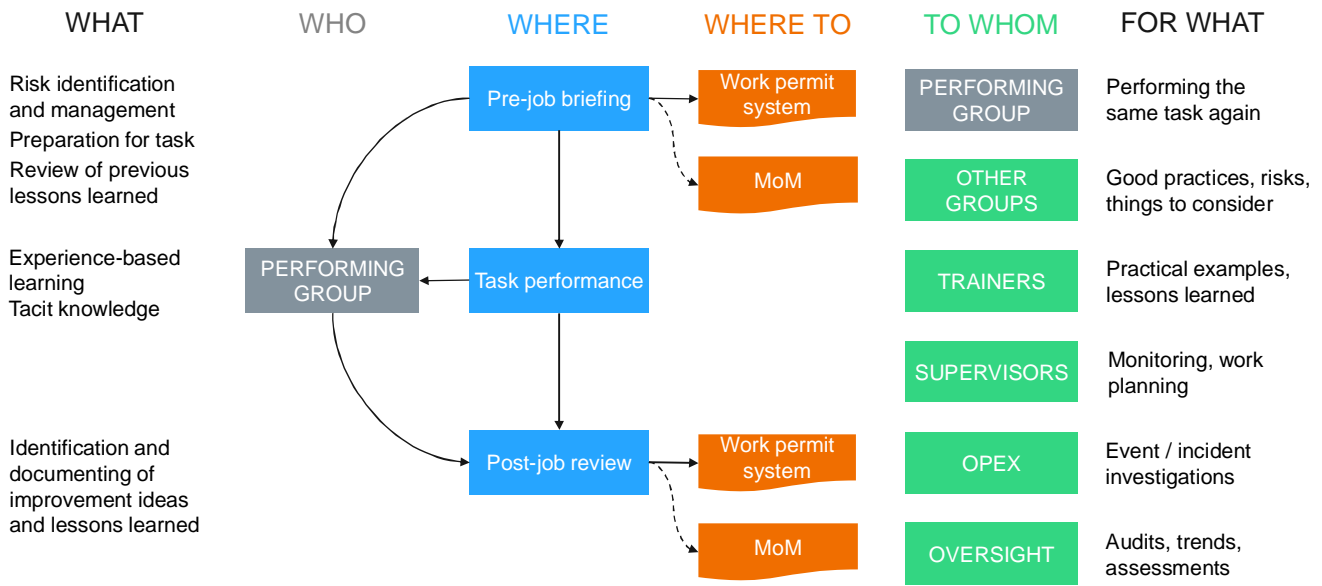
Figure 1. Organizational learning model describing the relationship between pre-job briefings, post-job reviews, and various organizational actors who could benefit from them

4.3 RQ3: How should the generation and use of documented information be facilitated?

The following generic success factors to facilitate the generation and use of documentation from pre-job briefings and post-job review were formulated based on the case study:

- **Management support**: Management should strive to create a "documentation culture", which involves aspects such as setting expectations for documentation in accordance to a graded approach, encouraging employees to explicate and document work-related knowledge, and providing the resources (time and tools) for preparing the documentation, and perhaps most importantly, encouraging and enabling the employees to utilize the documentation that has been produced.

- **The purpose of the documentation should be defined and communicated**. Pre-job briefing and post-job review documentation can serve many functions, including oversight of compliance, providing encouragement for reflection, and organizational learning. A clear understanding of the purpose of the documentation is needed to design an effective strategy (e.g. documentation requirements, practices, and tools) to meet all relevant purposes. It is also relevant to consider the documentation practices of pre-job briefings and post-job reviews, and other preparatory or debriefing meetings to avoid overlaps and to enable synergies.

- **Coordinating supervisors' ownership and awareness should be ensured**: The ownership of coordinating supervisors (or others responsible for holding pre-job briefings and post-job reviews) is a key factor in ensuring that the meetings and their documentation are perceived as useful and to maintain motivation. To facilitate this, the coordinating supervisors should be involved in developing documentation practices, including what to document, how extensively, and which tools are used. In addition, the awareness of the coordinating supervisors regarding the documentation practices, how to use the documentation tools, and the way information can be retrieved, should be ensured. This may involve, for example, training courses or continuous promotion via internal information channels.

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- **Other stakeholders and their interests should be identified**. Pre-job briefing and post-job review documentation are used by other stakeholders than the groups performing the same task again. The interests and needs of these stakeholders should be identified to help define documentation requirements that are useful also for them. The balance between documentation requirements that serve the performing group vs. other stakeholders should be closely considered to avoid specifying documentation requirements that do not make sense to coordinating supervisors.

- **Expectations and instructions for using open feedback fields should be clear**. Open feedback fields are an effective and low-threshold method for documenting pre-job briefings and post-job reviews. They are particularly suitable for documenting less extensive levels of meetings where minutes of meetings would be unwarranted. However, their unstructured nature means they can result in the production of records that have low information value. To ensure the high quality of records, expectations regarding their content should be clearly defined and communicated to the personnel. These expectations may include observations that are novel or safety-critical, lessons learned, details that are easy to forget, or improvement ideas.

- **Tools used for documentation should be effective and easy to use**: Common tools used for documenting pre-job briefings and post-job reviews include templates of minutes of meetings and feedback fields in documentation management system (work permit system in the studied power company). The design of these tools influences what is documented, to which extent, and whether coordinating supervisors are motivated to use them. The application of complementary documentation methods (e.g. videos, audio recordings, and the use of mobile technology) could be considered to more effectively integrate the preparation of documentation with work performance.

- **Storage medium choice facilitates organizational learning**. The choice of storage medium affects what is documented and whether the recorded information is used afterwards, either by those that recorded the data, or by other stakeholders. Centralized databases (as opposed to local storage systems with limited access rights) such as company-wide document management systems can provide storage and access to everyone in the organization, which can facilitate organizational learning. However, due to their centralized nature, such solutions should come with easy-to-use search and/or recommendation engines to ensure that the stored information is found and utilized by all stakeholders.

4.4 Limitations of the study

The study has certain limitations that should be considered when interpreting the results or generalizing them to a wider context.

Firstly, the data was collected in one nuclear power company. While the company is a fairly typical nuclear licensee, it might not be representative of all nuclear power plants or how they have implemented pre-job briefings and post-job reviews.

Second, the number of interviews was small, which means that data saturation was probably not reached, and some viewpoints might not have been identified. In the future, a higher number of interviews (particularly with coordinating supervisors) would be advisable. Using a self-administered survey of pre-job briefing and post-job review practices could be a useful tool to complement the interviews.

Finally, the data collection methods—while relatively diverse—did not allow the researchers to gain detailed insight into how pre-job briefings and post-job reviews were held in a real-life context. Conducting observations of these meetings is suggested to better understand the process and dynamics of pre-job briefings and post-job reviews and their documentation.

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5. Conclusions

In this report we described a case study in a nuclear power company regarding pre-job briefing and post-job review documentation practices and their relation to organizational learning. In the case study power company, pre-job briefings and post-job reviews were documented as open feedback in the company's work permit system or as minutes of meetings. It was found that the documentation medium affects what is documented and whether the recorded information is used afterwards. We also found that the documentation can serve multiple functions. In addition to helping perform the same task again in the future, it can be utilized for various purposes by different stakeholders, including other work groups, training, supervision and oversight, and operating experience. Finally, a set of generic success factors to facilitate the generation and use of documentation from pre-job briefings and post-job review were formulated.

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