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Effective Improvement of Leadership and Safety Culture – Intermediate Report

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Effective Improvement of Leadership and Safety Culture – Intermediate Report

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Summary

This research report describes the main findings of the SAFIR2022 project "Effective Improvement of Leadership and Safety Culture" (EPIC) in its first two years of implementation (2019–2020). The general objective of the project was to develop knowledge and approaches that support effective improvement of leadership and safety culture. To achieve this objective, two perspectives were applied and empirical case studies were conducted in all Finnish nuclear power companies.

First, the project examined how methodical safety culture improvement has been implemented in Finnish nuclear power companies, and what the experts' experiences were. A framework for modelling safety culture improvement as an organizational function was developed, which served as a structure for data collection and analysis. Good practices for implementing effective safety culture improvement were summarized according to the framework based on collected empirical data.

Second, the project examined safety leadership in three different contexts: the operational decision-making process, activities of middle managers, and safety walks. Each of these three case studies were analysed using the same approach, which combined multiple perspectives to leadership. The case studies resulted in sets of factors to take into consideration from leadership perspective in these contexts.

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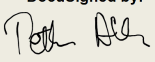
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1. Introduction

The concept of **safety culture** was introduced after the Chernobyl accident to help understand the social and organizational aspects of nuclear safety. Safety culture draws from the concept of organizational culture, which refers to the pattern of shared basic assumptions learnt through adaptation, and the espoused values and artefacts that reflect and influence the basic assumptions (Guldenmund, 2000; Schein, 1985). In the nuclear industry, safety culture is defined as "the assembly of characteristics and attitudes in organizations and individuals that establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance" (IAEA, 1991, p. 1). Good safety culture is expected in the nuclear industry, and licensees are required to implement systematic safety culture improvement activities to assure good safety culture (e.g., IAEA, 2016; STUK, 2019).

Leadership is a fundamental characteristic of a strong safety culture (IAEA, 2016, 2006, 1991; WANO, 2013). GSR Part 2 defines leadership for safety as "the use of an individual's capabilities and competences to give direction to individuals and groups and to influence their commitment to achieving the fundamental safety objective and to applying the fundamental safety principles, by means of shared goals, values and behaviour" (IAEA, 2016, p. 2). Leadership activities influence culture and are critical for directing the organizational attention and resources to continuous improvement of safety (e.g., Barling et al., 2002; Clarke, 2013; Donovan et al., 2016; Flin and Yule, 2004; Krause, 2005). After the Fukushima Daiichi accident in 2011, leadership for safety has received increased international attention and has been more explicitly included in the requirements for licensees (e.g., IAEA, 2016; STUK, 2019).

Despite extensive scientific research done in the area of (safety) leadership and safety culture (for reviews, see e.g., Donovan et al., 2016; Fleming et al., 2018; van Nunen et al., 2018), many questions related to development of leadership and culture for safety still remain open. These **open questions** include: what approaches and methods can nuclear facilities use for safety culture improvement, what are the best and more effective ways to implement these approaches and methods, how can leadership activities be applied for safety culture improvement, and how can their effectiveness be ensured.

The **general objective of SAFIR2022 EPIC** was to develop knowledge and approaches that support the effective[1] improvement of leadership and safety culture. The effectiveness of leadership and safety culture improvement activities is viewed from a multi-level perspective (sociotechnically, Rasmussen, 1997; and culturally, Schein, 1985). Such an approach acknowledges that leadership activities and safety culture improvement initiatives can influence phenomena at different levels of culture (e.g., artefacts, behaviour, attitudes, norms, basic assumptions), and at different levels of the sociotechnical system (e.g., organizational, social, individual or technological level).

Specific project objectives include modelling the good practices of methodical safety culture improvement and safety leadership activities in Finnish power companies. The research study results in the following outcomes:

- A framework describing effective approaches (good practices) to methodical safety culture improvement

- Characterization of safety leadership best practices observed in selected contexts

This research report describes the main findings from EPIC case studies conducted during its first two years of implementation (2019–2020).

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[1] By "effective" we refer to improvement that is "successful in producing a desired or intended result" (Lexico.com definition) and that has a positive influence on nuclear safety.

2. Methodical safety culture improvement

2.1 Introduction

Methodical safety culture improvement is done systematically, according to an established procedure, and with a planned and target-oriented approach (Viitanen et al., 2018b). In Finland, regulatory requirements set expectations for methodical safety culture improvement.[2] Nuclear power companies have implemented methodical safety culture improvement in their organizations, for example, by means of hiring experts in social sciences and implementing safety culture improvement programmes. Safety culture improvement has therefore become an **organizational function**, to be ensured by top management, and whose implementation is supported by safety culture experts.

The ways in which the safety culture improvement function has been implemented show some variability, even between Finnish power companies. To identify what practices and methods experts consider to be effective for safety culture improvement, this study modelled the different approaches to implement safety culture improvement in practice.

2.2 Safety culture improvement function modelling framework

A framework was developed for the modelling safety culture improvement function to provide a structure for data collection and analysis. The framework is based on the following assumptions:

- The **conceptualization of safety culture** (formal and informal) steers the way in which safety culture improvement activities are organized and implemented.

- The safety culture improvement function is **formally organized**.

- The implementation of any organizational function (including safety culture improvement) follows a **Deming cycle** (plan-do-check-act, ISO, 2015) and therefore all four phases should be evident in safety culture improvement activities.

- **Adaptive safety management principles** (Reiman et al., 2015) serve as an outline for what kinds of safety culture improvement activities can and should be implemented. These principles have previously been used to structure the analysis of safety professionals' work (Reiman, 2015; Viitanen and Reiman, 2020) and to analyse the effects of safety management tools (Reiman and Viitanen, 2019; Viitanen and Reiman, 2017).

- Safety culture improvement activities include both **transactional and transformational** (Avolio and Bass, 2001) approaches. Transactional approaches are task-oriented and involve the clear definition of goals and monitoring their implementation. Transformational approaches are people-oriented and involve creating a shared identity, and inspiring and motivating employees.

- The safety culture improvement function is **extensively connected** to other organizational functions because organizational culture emerges from the activities of the whole organization and therefore cannot be managed only by safety culture experts.

These assumptions form the basis for the framework, which includes conceptualization of safety culture, organizing, the elements of the Deming cycle, the principles of adaptive safety

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[2] E.g., YVL A.3 314: The safety culture shall be developed in a target-oriented and planned way.

management, transactional and transformation approaches, and organizational interactions. Figure 1 summarizes the framework.
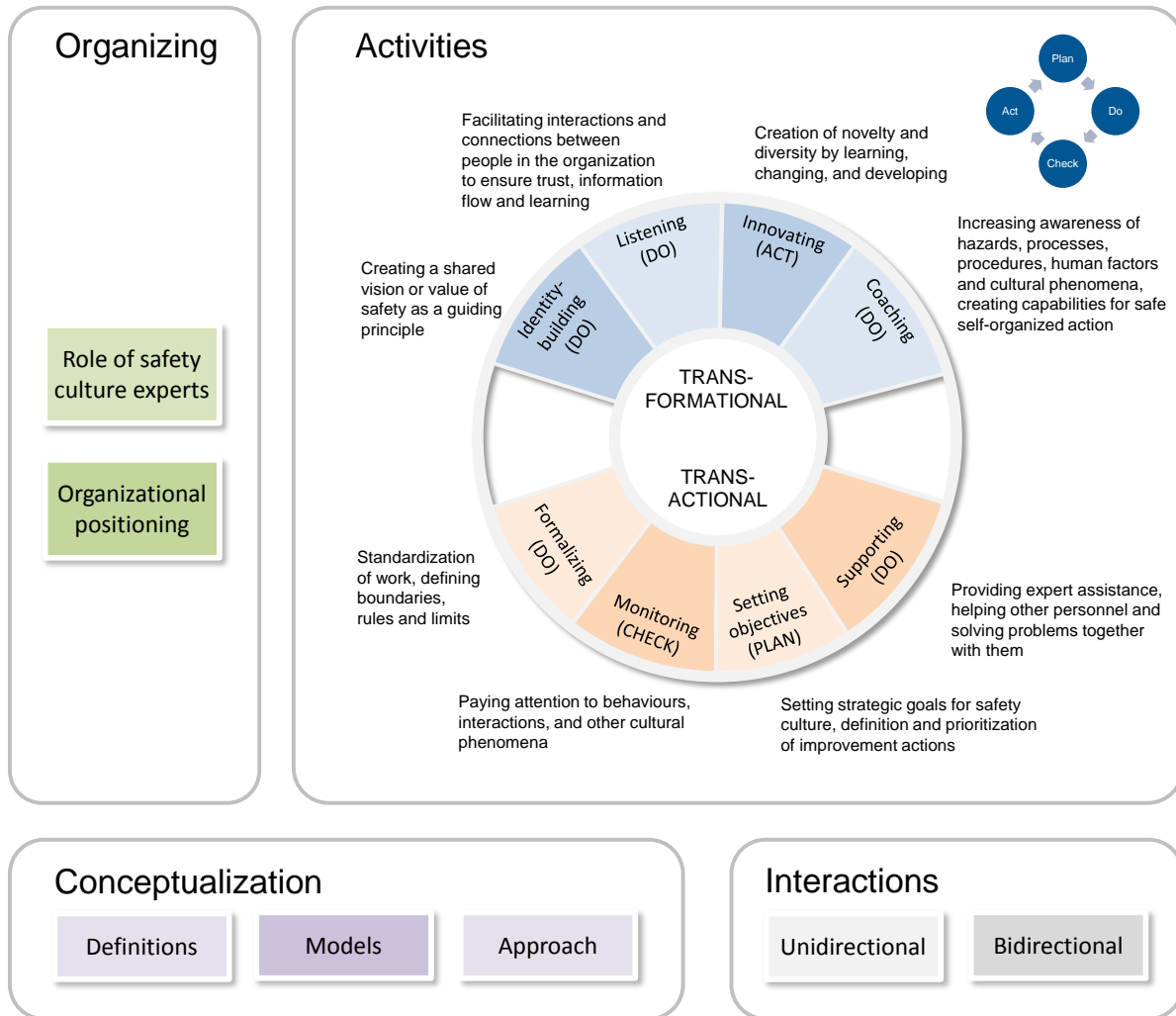
Figure 1. High-level illustration of the framework used for safety culture improvement function modelling. Activities marked in orange are primarily transactional and those marked in blue are primarily transformational.

For each of the main themes (conceptualization, organizing, activities and interactions) of the methodical safety culture improvement framework, a list of items was developed based on existing industry guidelines, scientific literature, as well as previous work done by the SAFIR2022 EPIC research team (e.g., Viitanen et al., 2018a, 2018b, 2017). A full list of the items can be found in Appendix A.

2.3   Methods

The research design was organized as case studies where the methodical safety culture improvement activities that are applied by the participating power companies were examined. The research design was based on the assumption that effective safety culture improvement practices can be identified by examining what the companies have implemented, what has been perceived as effective by the experts, and what the experts perceive as challenging.

All Finnish nuclear power companies (Fennovoima, Fortum, TVO and Posiva) participated in the study. Findings from the individual companies are not presented separately in this report – only integrated overall findings are presented.

All data collection was performed during COVID-19 restrictions in 2020 and 2021. This meant that only remote data collection methods were used.

The primary data collection method was remote workshops with safety culture experts. Nine workshops (approximately two hours each) were conducted, 2–4 in each power company.[3] There were 2–3 participants in the workshops from the power companies' side. Participants worked in their respective companies under titles such as safety culture specialist, safety culture manager, organizational development manager and safety manager. Question items of the framework (Appendix A) were discussed during the series of workshops. The workshops were recorded and transcribed.

Document analysis of relevant materials (e.g., safety culture programmes, implementation plans and other related procedures) was also conducted.

In the analysis phase, the research team identified and categorized safety culture improvement activities according to the analysis model. The experiences, good practices and challenges identified by the interviewed safety culture experts were also collected. Based on these findings, the research team then formulated generalized good practices, which describe the characteristics or preconditions for effective safety culture improvement (presented in blue text boxes in this report).

Quotes (translations) are reported as such while retaining the anonymity of the interviewees. Additional notes and ellipses are marked in square brackets. Ellipses were made in such a way that the original meaning of the sentence or comment was preserved.

2.4 Results

2.4.1 Conceptualization of safety culture

All companies referred to the same **formal definition of safety culture** from INSAG-4[4] in their documentation.

All companies used various types of **safety culture models.** The following types of models could be identified: models describing detailed characteristics of good safety culture (dimension models), models describing the levels of safety culture maturity (maturity models), and simple models used to promote or communicate safety culture towards employees (promotional models).

Almost all nuclear industry standard **dimension models** were either in use or had been in use: the IAEA five characteristic model (IAEA, 2006), WANO traits of a healthy safety culture (WANO, 2013) and the IAEA Harmonized safety culture model (IAEA, 2020). These models describe the detailed characteristics of good safety culture as dimensions[5] and attributes.

The reasons why power companies had selected a particular model were related to the models' international status or practicality. One safety culture expert described how their company decided which safety culture model to use as follows:

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[3] TVO and Posiva safety culture activities were discussed in the same workshops

[4] "Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance." (IAEA, 1991, p. 1)

[5] Common dimensions include, for example, leadership, questioning attitude, decision-making, accountability, learning and communication.

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> *"Previously we showed even three definitions and models in training, for general information. […] Then, in inspections, it was found that our employees could describe safety culture in their own words but could not say whether we use the IAEA or WANO approach. Eventually, we decided to choose what our safety culture approach would be, together with representatives from many departments. The WANO model was rejected right away because the translation of the definition was so difficult [Finnish]. The VTT model would have been easier to communicate but it was not internationally established. And since the other Finnish nuclear power company had already decided to use the IAEA model and we have common contractors, we decided to go with the IAEA approach too."*
> *(Workshop, translation)*

Another safety culture expert indicated a convergence of the nuclear industry safety culture models and noted that the selection does not necessarily have major effects on the end products (such as safety culture assessments):

> *"I think regardless of what model is used, as long as it is sufficiently valid, the most significant strengths and weaknesses can be identified anyway [in assessments]." (Workshop, translation)*

Organizations in pre-operational life cycle phases applied alternative approaches for elaborating the dimensions of safety culture: one had developed a custom safety culture model by benchmarking existing safety culture models and identifying the special characteristics of pre-operational phases, and another utilized INPO guidelines for excellence in nuclear projects (INPO, 2010). The safety culture experts from these companies commented on the background behind their choices as follows:

> *"These existing safety culture models were originally intended for organizations in the operating phase, so we had to think about how they apply to pre-operational phases. […] Initially, we thought the safety culture dimensions would be different, but as we started identifying the dimensions, we noticed how generic they are after all. The generic dimensions as such might not be different, but their manifestation differs [between life cycle phases]. […] Our model came close to the IAEA Harmonized safety culture model, even after reviewing the incidents and the safety culture phenomena that relate to pre-operational phases. This validates the IAEA model and our model." (Workshop, translation)*

> *"With nuclear facilities we have to take the life cycle phase into consideration. The same criteria do not apply as with operating plants. […] The INPO model was more sensitive to the design phase and the transitions between construction and commissioning phases than the IAEA model." (Workshop, translation)*

The safety culture experts of the company that had developed a custom model felt that creating the custom model had also facilitated their understanding of the model and of the safety culture phenomena:

> *"I think the additional value was that we took the time to reflect on its content, instead of just taking an existing model as a given. […] Safety culture experts need to operate on two levels: they have to have the theoretical understanding of the concept, but they also have to understand what good safety culture means in the real world. This requires truly adopting the model and thoroughly understanding it." (Workshop, translation)*

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The power companies used dimension models primarily in safety culture assessments, and to some extent for reporting or promotion. The models were used to steer the assessment process, to structure the findings and to help identify cultural strengths and weaknesses. Overall, the safety culture experts felt that the dimension models were useful and helpful in conducting assessments.

However, a common challenge with applying dimension models in assessments was deciding which attribute to use when categorizing findings:

> *"When you go to the attribute level, it is hard to select where each finding belongs. One has to make the decision how to systematically categorize certain types of findings." (Workshop, translation)*

One company had already taken the new IAEA Harmonized safety culture model into use and found similar challenges:

> *"Things are ordered differently and it makes it a bit more difficult to understand. In the old [IAEA] model, the five dimensions and the attributes were defined in a simpler way. Now it is harder to identify what belongs where." (Workshop, translation)*

One safety culture expert also commented that the safety culture models are quite problem-oriented, which makes it more difficult to highlight strengths. The relative lack of psychological phenomena such as work stress and motivation in the models was also noted.

In addition to dimension models, most of the power companies utilized safety culture **maturity models**, specifically the IAEA three-level maturity model (IAEA, 2002, 1998). This model describes the stages of safety culture development as follows: stage 1 refers to safety based on rules and regulations, stage 2 is characterized by good safety performance becoming an organizational goal, and stage 3 adopts the idea of continuous improvement (IAEA, 1998).

The companies used the IAEA three-level model primarily for creating a compact summary of the status of safety culture that is then communicated to the management. All companies using this model increased the resolution of the model by creating additional levels (e.g., 2- or 2+). One safety culture expert described the history behind the introduction of the IAEA three-level model in their company as follows:

> *"It came from a request of the management who wanted a single number for the level of safety culture. Initially, we resisted this idea because it simplifies culture too much. Then we decided to use the IAEA three-level model to ensure compatibility with the rest of our framework. […] Now we use it for summarizing the level of safety culture." (Workshop, translation)*

The safety culture experts from this company continued that they try to avoid using the single numeric representation for communicating the safety culture level and instead try to highlight specific development topics. All companies that used the three-level model also used the more detailed dimension models in their safety culture assessments.

The studied power companies also used company-specific, visualized **promotional models** for describing the dimensions of safety culture in a simple and compact way.

One company had developed a simple promotional model containing four short safety culture principles that were disseminated through cartoons. Its development process was characterized as follows:

"We worked with the management and tried to define what is safety culture and what kind of leadership and behaviour we expect. We held workshops with directors and created multiple iterations of the model. It was developed together with supplier representatives, so we also got commitment from their side." (Workshop, translation)

The safety culture experts of this company felt that the resulting model was quite versatile. It has been used for many purposes, including opening up the safety culture concept towards non-expert employees and helping concretize it, structuring unit-level discussions on how to integrate safety culture into daily work, and serving as a reference of what types of topics can be included in safety concerns. The safety culture experts also felt that since the employees might know some of the principles of the model already (e.g., continuous improvement), it was beneficial that these principles are associated with the safety culture concept. One safety culture expert described the impact of the model as follows:

"Nowadays safety culture is more commonly brought up as a concept, but it is also brought up through the principles. The principles are generic, but that makes them easy to identify in their own work. […] When discussing with people, from top management to shop floor workers, the safety culture principles come up […] they have been a big factor in creating a shared understanding of safety culture and bringing it to everyday discussions." (Workshop, translation)

Another company had introduced a promotional model containing five themes that related to safety culture. This model did not use "safety culture" as the umbrella term, but instead integrated it with other associated concepts and summarized them as the company's expectations for a "nuclear professional". The safety culture experts from this company felt that using this term makes the non-technical safety factors more relatable to regular staff.

An identified success factor concerning the development of promotional models is related to their simplicity. Specifically, the safety culture experts felt that too complex a model (e.g., too many dimensions or overly long descriptions) would not be as effective for promotional purposes.

Overall, the approach to safety culture improvement in the studied companies was rather **pragmatic**. This was particularly evident in striving to concretize the inherently abstract concept of safety culture into its more manageable practical manifestations when assessing, integrating or communicating it. The safety culture experts sometimes utilized Schein's organizational culture theory, but it did not serve as an explicit foundation for the safety culture work. As a foundation, the companies used the various types of safety culture models. Schein's theory was applied informally by the experts when they pondered safety culture phenomena (see section 2.4.3.8 about assessments), or as a description of culture (the "iceberg" metaphor) in training. One company also used Schein's theory to structure their expectations for various types of safety culture assessments.

Good practice

A comprehensive safety culture model is utilized, thoroughly understood by its users, and its applicability for the organizational context is considered to ensure that all relevant dimensions of safety culture are taken into account. When communicating safety culture to non-experts, care is taken to avoid oversimplifying it by omitting some essential aspects or making it too complex to understand.

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2.4.2 Organizing safety culture improvement

2.4.2.1 Role of safety culture experts

All of the studied power companies employed experts with **job descriptions that explicitly included safety culture development**. In two of the companies, safety culture was also included in the experts' job title.[6] The number of experts responsible for implementing tasks specific to safety culture differed between the companies and ranged between two and four.

In power companies with new-build projects, **special safety culture expert resources were allocated to the construction site** (e.g., a safety culture specialist who primarily works at the site). This was considered an important aspect of maintaining and developing good (nuclear) safety culture at a new-build construction site.

In all companies, safety culture experts had certain **primary, safety culture-specific tasks** that they were responsible for implementing. These included, for example, safety culture assessments and training, and chairing safety culture working groups.

In addition, the safety culture experts had secondary tasks that involved activities led by another discipline. These activities were quite fragmented and diverse and included, for example, participation in investigations, observation review meetings, various other tasks or working groups, organizational development, and so on. In some companies, safety culture experts were also involved in providing expert services for external customers.

Overall, the safety culture experts indicated that an important part of their role is to develop the organization in an **indirect** manner (see more about the supporting role of safety culture experts in 2.4.3.5).

> *"When we refer to safety culture development, we prefer to talk about facilitating safety culture, because we do not directly develop [for example] decision-making or competencies. […] When the discipline experts lead the development, we provide safety culture expertise by identifying how it would affect our culture and also by reminding about the principles of good safety culture." (Workshop, translation)*

In addition to individual safety culture experts, all companies had multidisciplinary safety culture groups for supporting the experts (see 2.4.2.2).

Good practice

Expertise in safety culture is available and it is sized according to organizational demands. The expertise is used for specific safety culture assessment and development tasks, and to facilitate the development of safety culture throughout the organization.

2.4.2.2 Organizational positioning

The experts responsible for implementing safety culture-specific tasks were located in the **same organizational unit**, but they also had supporting experts from other units (see paragraph on multidisciplinary expert groups below). The organizational positioning of safety culture experts varied between the companies, but also within companies over time. In the studied power companies, safety culture experts were or had been located in quality, nuclear safety, oversight, organizational development and strategy departments.

The **balance between independence and the ability to affect the line organization** came up as one important factor, especially when considering positioning safety culture experts

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[6] E.g., safety culture manager or safety culture specialist

under independent functions (such as oversight). The safety culture experts felt that this limits the possibilities for hands-on development; on the other hand, they also felt that this positioning might help gain an external perspective to the organization.

> *"Oversight is outside of line organization, so it places some constraints on the development work. […] We need to somehow get the line organization to develop safety culture." (Workshop, translation)*

> *"When safety culture work was done in oversight, its task was to conduct independent assessments. We did not really implement it; we made recommendations. As long as you formulated and communicated the recommendations well, they went forward and had impact, but if you did not, then the impact was weak. […] The opportunities to have an effect were smaller, because you had to influence people in the line organization, you could not just start implementing things." (Workshop, translation)*

In this configuration, the nature of the relationship between oversight and the line organization was identified as a success factor. Some safety culture experts felt that being positioned in an independent organization and conducting external assessments was sometimes perceived negatively by the line organization. They emphasized that it is important to do comprehensive "preliminary work" before the assessment itself, including justifying the assessment and ensuring that the line organization feels comfortable, especially when conducting targeted assessments in some specific area.

Another identified outcome of organizational positioning related to the **interrelation between formal and informal structures**. The safety culture experts described how the formal structures (i.e., their organizational positioning) had affected informal structures such as co-worker networks or information flows as follows:

> *"When we are in meetings with certain people, it facilitates informal interactions with them. When it [our organizational positioning] changes, then you no longer have the same interactions. This changes the real possibilities to operate a lot." (Workshop, translation)*

> *"Previously I participated in nuclear safety meetings that might not have been directly related to safety culture, but they enabled getting information, and also taking information there. Now [after organizational change] this does not happen – information from nuclear safety comes primarily through the intranet […] whereas before, I had dialogues with people from nuclear safety." (Workshop, translation)*

One safety culture expert summarized these problematic areas by noting that regardless of which particular organizational unit the safety culture experts are located in, there will always be some advantages and disadvantages in terms of what kinds of information flows emerge naturally.

All power companies had some form of **multidisciplinary expert groups** that supported the safety culture experts. These groups had participants from all over the organization and their tasks included steering, coordinating or monitoring safety culture issues. The groups were perceived as important for these tasks, but it was also noted that due to the possible existence of other, similar multidisciplinary groups, their potentially high resource demand, or lack of organizational support, their practical implementation was sometimes perceived as challenging.

> *"Our safety culture ambassadors system has been a way to compensate for the fact that we cannot be everywhere. The ambassadors can promote safety culture topics in their own units and then bring information to us." (Workshop, translation)*

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"We review assessments and reports, summarize their main findings and discuss them together [in our safety culture network]. One important function of the network is to bring the findings to the nuclear safety meeting […] and to facilitate information exchange on safety culture issues. […] I have noticed that the visibility of safety culture has improved a lot and that this network has had a big role in this because it consists of people from everywhere and they discuss safety culture issues in their own organizations." (Workshop, translation)

"All participants [in our safety culture group] are from independent organizations, under oversight. We have meetings every four months. When the trimester ends, we review the status of safety culture and express our view on it." (Workshop, translation)

The **current development needs or organizational maturity** were also identified as a potential factor to consider. One safety culture expert highlighted that in the early days of its introduction, the safety culture improvement function might benefit from being positioned in an organization unit with strong authority, but then there might be a risk of it being perceived as an add-on. Another expert commented that when the organization is young, organizational development might be a natural place for the safety culture improvement function because it could support development directly; but in a more mature organization, when the focus moves to the maintenance and monitoring of safety culture, organizational positioning in other units might be more natural.

Overall, there was **no obvious consensus** of what the "optimal" way to position safety culture experts in the organization is – each configuration had certain advantages and disadvantages.

Nevertheless, sufficiently **direct access to top management** came up as a recurring consideration for the organizational positioning of safety culture experts, for the multidisciplinary expert groups, and generally for reporting practices.

"Our [safety culture] group reports to the highest level, as it should. It is not under the plant meeting or something like that, but it reports directly to CEO and top management." (Workshop, translation)

"Your immediate supervisor also has a very big impact. An active supervisor brings things to the top management persuasively and the top management has to listen. This ensures access to the top management if needed." (Workshop, translation)

Good practice

The organizational positioning of safety culture improvement function is informed by at least the following factors:
- There is direct reporting access to top management
- The balance between access to and independence from the line organization is appropriately managed
- The organizational context and maturity phase is considered
- How the organizational positioning affects information flows is acknowledged and compensated for
- A multidisciplinary safety culture experts group is implemented with representation from several organizational functions

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2.4.3　Content of safety culture expert work

2.4.3.1　Overview

Over ninety examples of safety culture experts' activities came up during the workshops (either prompted or spontaneous) and in the document review (Table 1). Examples of activities in all categories of the activity framework (see "Activities" section of Figure 1) were found in all companies. Examples of monitoring activities were most common, but this theme was also explicitly and extensively discussed as part of the workshop agenda (see Appendix A).

Table 1. Examples of safety culture experts' activities

Activity type (PDCA phase)	Illustrative examples
Setting objectives (Plan)	Defining objectives and targets for safety culture improvement in a safety culture programme
	Preparation of annual safety culture action plan
	Strategy definition for safety culture, human performance and leadership improvement activities in a "Nuclear Professional" steering group
	Formally setting project-wide safety culture principles together with supplier
	Selection of annual safety promotion themes
Identity-building (Do)	Promotion of annual safety themes
	Inclusion of safety topics in meeting agendas
	Development and dissemination of safety culture booklet
	Organizing training, promotion events and communications to root a "Nuclear Professional" mindset
	Motivating and encouraging personnel to direct attention to safety issues in safety culture training and courses
Formalizing (Do)	Preparation of safety culture development programmes and plans
	Implementation of human performance improvement programme and tools
	Setting contractual requirements for suppliers that relate to safety culture
Supporting (Do)	Providing safety culture-related expert advice to other disciplines (e.g., HR, decision-making instances, etc.)
	Discussing safety culture topics with multidisciplinary (safety culture) task groups
Coaching (Do)	Holding various types of safety culture training to increase personnel knowledge and awareness of risks, including safety culture induction training, advanced lectures on specific safety culture topics, lectures in working group meetings or events with suppliers, safety culture online courses, human performance training with safety culture content and project-specific (tailored) safety culture training
Listening (Do)	Being available for informal discussions on safety and safety culture in office, at plant or onsite
	Performing walk downs and site or plant safety inspections
	Facilitating interaction between suppliers and sub-suppliers at joint events and working groups
	Sharing and facilitating sharing of lessons learnt with suppliers in events and working group meetings
Monitoring (Check)	Participating in weekly or bi-weekly observation and screening meetings
	Participating in monthly CAP group meetings
	Preparing annual summaries of safety culture
	Conducting periodical safety culture self-assessments
	Participating in event investigations
	Organizing independent assessments of the organization
Innovating (Act)	Conception and update of safety culture development processes, programmes and related procedures
	Development of leadership programme and monitoring metrics for its progress
	Involvement in organizational development

2.4.3.2   Setting objectives (Plan)

Setting objectives principle involves setting strategic goals for safety culture, and definition and prioritization of improvement actions.

All the studied power companies had a **formal approach to safety culture improvement** in place that defined safety culture goals and targets on strategic, tactical and operative levels. Strategic-level goals were defined in documents such as company policy, safety and quality policy, code of conduct, or long-term strategy of the power plant. Tactical goals and the means by which they are planned to be achieved were described in safety culture improvement programmes and related procedures. Operative-level goals were described as safety culture action plans. For further detail on programmes and plans, see section 2.4.3.4. Top management commitment at all these levels was considered important:

> *"There is a big difference if you start doing something that you have directly agreed with the CEO compared to doing something that you have just come up within your own unit. It is a completely different situation from the perspective of driving things forward." (Workshop, translation)*

In several of the studied nuclear power companies **multidisciplinary expert groups** had been implemented, whose role was to steer safety culture improvement activities (see also 2.4.2.2). As part of their steering function, these groups developed strategic goals, updated safety culture plans, and ensured alignment between all human, organizational and culture development programmes at a high level. In one company, a task group was formed to define company-wide safety culture principles that would also apply to suppliers (see 2.4.1). Another company had a higher-level steering group that covered a variety of non-technical safety-related areas including safety culture, human performance and leadership:

> *"It is an aggregate group above [individual working groups]. We can review, for instance, human performance plans, improvement actions, nuclear leadership, etc. to ensure that the overall whole works. It oversees the other groups. […] Operative decisions are made in the individual working groups, but this group reviews them on a strategic level – what direction we are going in, where we might have gaps and where we need to put more effort." (Workshop, translation)*

Good practice

Objectives for safety culture improvement are defined and coordinated with other non-technical development programmes and together with top management (and other interest groups when applicable) to ensure a unified approach.

2.4.3.3 Identity-building (Do)

The identity-building principle involves creating a shared vision or value of safety as a guiding principle in the organization. Although identity-building can be considered as the overall goal of safety culture improvement, in this framework we interpret it as comprising specific promotional activities that aim to create a safety-conscious mindset and attitudes.

A common promotional activity was the **motivational and mindset development aspect of safety (culture) training** (see more on training in section 2.4.3.6). For instance, one safety culture expert emphasized that safety culture case studies (either positive or negative) have been effective in building a safety-conscious mindset.

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> *"I consider it [safety culture training] mostly motivational. It is two hours from a two-week induction period – you cannot expect anyone to remember any specific practices or procedures. However, what people can remember are stories and anecdotes. […] I try to build the right kind of attitudes and practices using these stories." (Workshop, translation)*

Other common promotional activities were the implementation of **promotional tools and events** (e.g., development of booklets, company-wide safety culture principles, use of posters related to safety culture, and safety theme days), and the **inclusion of safety topics in meetings**. It was suggested by the safety culture experts that especially during changes (e.g., periods of personnel turnover), it is important to perform promotional activities continuously to ensure their effectiveness.

For example, one company organized safety culture theme days on the construction site. One power company organized such events twice a year together with the main suppliers, with participation of various OHSEQ experts, supervisors, managers and top management. The theme days aimed to increase awareness of safety (culture) issues. They involved holding presentations on various safety topics, such as thematic lectures on lessons learnt or operating experience, and presentations by contractors on their safety (culture) development activities, experiences and challenges.

> *"It serves as an information sharing day, but at the same time it is also an opportunity to ask questions, share your own thoughts and hear others' thoughts about safety culture." (Workshop, translation)*

One success factor in these safety culture theme days was their practical and concrete approach. Using examples and relatable content was found to be particularly important.

> *"At first the participants felt that they were too theoretical, that there were not enough practical, concrete things. Then we changed the content so that it included more concrete examples, and what safety culture means in daily work. We have received positive feedback on this. […] What they have found best are example cases that are easily relatable to the participants […] A completely different case like a nuclear power plant accident might not reflect the daily work that is done at the construction site." (Workshop, translation)*

The safety culture experts felt that the impact of these theme days was to serve as one outlet of a systematic and uniform safety culture promotion. Indeed, ensuring that the management at all levels of the organization promotes and communicates safety culture in a **uniform manner** was considered one overall success factor in safety culture improvement. This means that safety culture objectives cannot only be set on a formal level, but they should also be carried out in practice in daily work to ensure that safety culture is understood in the same way and that the same goals are evident when work is performed.

> *"There are many factors that affect safety culture. […] This [safety culture theme day] practice does not necessarily need to have an impact by itself. When safety culture promotion is systematic so that the same message is repeated through many channels – that is when you should see the overall impact. […] This includes the daily work that the management does, what safety culture experts do and what other safety experts do." (Workshop, translation)*

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"If we [safety culture experts] say that you should behave this way and that you should openly report errors, and that we just want to learn; and then the actual practice suggests that we do not want to learn or that there is blaming, then it cancels out the effect of our safety culture promotion work. This is why systematic and uniform messages and behaviour is particularly important." (Workshop, translation)

Another company had implemented annual safety promotion themes to direct attention to a specific, identified safety topic and to convey top management expectations. Top management selected the themes and they included topics such as fire safety, making observations, good working practices, team development, etc. The safety culture experts felt that this practice was especially effective for directing the organization's attention to certain technical issues that can be corrected in a straightforward manner. However, in case of non-technical challenges, such as development of leadership and supervisory activity, the safety culture experts felt that identifying straightforward improvement actions might not always be feasible.

Good practice

The organization uses promotional practices that send uniform messages and are appropriate to their audience and purpose to ensure the visibility of safety culture topics and to maintain a safety-conscious mindset.

2.4.3.4   Formalizing (Do)

The formalizing principle involves standardization of work, defining boundaries, rules and limits.

Most of the formalizing activities performed by the safety culture experts related to their **own procedure and process development**. For example, they developed safety culture development programmes. These programmes followed the structure of a typical management system document, and contained the following primary elements:

- **Conceptualization of safety culture**: Definition of safety culture (all companies referred to INSAG-4, IAEA, 1991), elaboration of the (nuclear) safety culture concept and its dimensions (references were made to safety culture models), and how it may manifest in practice.

- **Purpose**: The programme purpose was defined, for example, as facilitating the priority of safety, or ensuring the maintenance and continuous improvement of safety culture.

- **Scope**: The programme scope referred to the processes or activities that the safety culture programme covers.

- **Responsibilities**: The programmes referred to a responsible manager for nuclear safety (Nuclear Energy Act section 7k, MEAE, 1987) and top management as having the overall responsibility for safety culture, and safety culture experts as supporting or coordinating the implementation of specific safety culture activities. Some programmes also described the role of supervisors and all employees.

- **Safety culture assessment and improvement activities**: The programmes described what specific activities companies implement to improve safety culture (see summary in Table 1). Sometimes programmes referred to other processes or procedures for detailed descriptions of some activities (e.g., human performance programme, procedures for conducting assessments, corrective action process, reporting system process, etc.).

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In addition to the safety culture programme document, the companies also had annual safety culture action plans. These plans either existed as periodically updated, separate documents, or were integrated into a document that also described safety culture activities in general.

> *"In [our company] we have a four-year rolling plan, which is updated annually. [During the annual update] we remove actions if we see that something has been taken care of, and add actions based on assessment findings or some other events, but certain basic actions always remain."*
> *(Workshop, translation)*

The perceived impact of safety culture improvement programmes related, for example, to increased thoroughness of safety culture assessment and improvement activities, and to availability of resources.

> *"We have always done this [safety culture improvement work] in some form, but now it is more systematic. Now we are producing reports methodically, we look at things from many perspectives, and the impact comes from that."* *(Workshop, translation)*

Safety culture experts' activities that aimed to **formalize someone else's activities** were usually related to non-technical development programmes. This is indicative of their role as facilitators and experts outside of the line organization where the formalization activities would normally take place. Examples of such programmes related to human performance improvement, leadership development, nuclear professionalism, work community improvement, annual safety themes, etc. A safety culture expert described their involvement in the development of human performance improvement programmes as follows:

> *"We [safety culture experts] felt that we have to support the workers somehow. Before, our organization only talked about human errors and investigated them, without much thought about what the organization could do about it. We developed the programme for some years, and eventually the management decided to establish a working group, provide resources and implement it."* *(Workshop, translation)*

Since the actual end-users of formalization efforts such as human performance improvement programmes are the shop floor workers, ensuring their involvement and commitment is crucial for successful implementation. This means that coordination and cooperation between the safety culture experts and the line organization is important.

Another example of formalization was related to defining safety culture-related contractual requirements for suppliers. This involves the use of safety culture expertise to ensure that all relevant topics are included in the contract, but it is also something that affects the extent to which safety culture experts can do their work with the supply chain. The safety culture experts named systematic assessment and development of safety culture, implementation of corrective actions, leadership commitment and owner access to the supplier as examples of the most important requirements to include.

Good practice

Formal processes and programmes are used to ensure the systematic implementation of safety culture improvement objectives. Their content is coordinated together with affected organizational functions.

2.4.3.5 Supporting (Do)

The supporting principle involves providing expert assistance and help to other personnel and solving problems together with them. For safety culture improvement, this means experts' inclusion in a variety of organizational activities to provide a cultural perspective.

In all the studied power companies, safety culture experts participated in various **task groups, working groups or decision-making instances** that were led by another discipline or whose primary function was not safety culture improvement.

A common example activity was safety culture experts' participation in investigations or assessments where their role was to provide human and organizational factors expertise.

> *"We are involved in operating experience investigations. Before, we were specially invited if they [operating experience experts] had identified organizational issues, but now we are involved from the very beginning and we define whether it is a purely technical issue or whether there are organizational issues as well." (Workshop, translation)*

> *"It is specified in our processes that when conducting more thorough investigations, the safety culture unit shall be in involved, at least in the planning phase. However, we have also often been involved in actually conducting the investigations." (Workshop, translation)*

Safety culture experts in all the studied power companies were involved in meetings of multidisciplinary groups that monitored operational events, safety concerns, non-conformities, etc. (see also fast monitoring methods in 2.4.3.8) In addition, experts in all power companies also cooperated with their human resources department on various issues such as leadership and supervisory activity development, coordinating personnel surveys and occupational health.

Some safety culture experts were also involved in decision-making processes related to plant operation. These safety culture experts stated that this participation contributed to safety culture monitoring.

> *"Rule adherence, conservative decision-making… These are the kinds of things we look for on a daily basis when we participate in various forums where decisions are made." (Workshop, translation)*

One of the key success factors concerning supporting activities was an **organization's awareness of safety culture experts and readiness to use it**. Safety culture experts described the practical difficulties of providing support to other organizational disciplines as follows:

> *"People start to know us… maybe the next step would be that the others would take the initiative and ask us to participate and provide expert advice. Right now we are still mostly working in one direction – disseminating results, improvement actions and recommendations." (Workshop, translation)*

> *"Sometimes it feels like we force our ideas and barge in when we try to give advice. […] We have noticed that someone has started to work on something and did not discuss it with us first – even though we have just recently reported about this topic. This sort of slows things down and people end up doing unnecessary work when they could just get the help and support from us." (Workshop, translation)*

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Good practice

Safety culture experts are highly networked, and the organization actively utilizes them as experts in non-technical safety issues.

2.4.3.6   Coaching (Do)

The coaching principle involves increasing awareness of hazards, processes, procedures, human factors and cultural phenomena, as well as creating capabilities for safe, self-organized action.

The most common coaching activity was related to various types of **formal training sessions or lectures that related to safety culture**. All companies had implemented training with safety culture content.[7] Safety culture training was provided as part of employee induction and as part of periodical refreshers. Basic safety culture training was mandatory for all employees in all power companies. In addition to basic training, some companies organized special training such as optional lecture series on advanced safety culture topics, leadership training, project-specific safety culture training, and training or lectures for contractors. In addition to classroom and online training, sometimes hands-on approaches such as mock-ups were utilized. Depending on the training, they were prepared and held by the safety culture experts, or in collaboration with other personnel.

The safety culture experts had a two-fold view concerning the purpose of safety culture training. One the one hand, **training educated personnel on safety culture topics, and on the other hand, it served as a motivational tool** (for the latter, see section 2.4.3.3).

> *"I think it [the expected impact] is firstly the increase in knowledge, because people have to know what we are talking about when we use certain terms. However, I also hope that people would get the message: that they would have a critical approach and a questioning attitude, and that the training would encourage them that whenever they feel uncertain, they ask and have the courage to bring it up […]. I think the most important thing is to encourage the mindset that people reflect on their own work and remember that it has an impact on nuclear safety." (Workshop, translation)*

The **content of safety culture training** was quite similar between the studied power companies. All power companies used major accidents as case examples in their safety culture training. Usually the example accidents were from the nuclear industry (Three Mile Island, Chernobyl, Fukushima, and the Davis-Besse near miss), but sometimes accident examples from other industries were used as well (e.g., the Piper Alpha oil platform explosion). In one company, a success story (the Onagawa NPP recovery from the 2011 Tōhoku earthquake and tsunami) was used as a case example. One company also used operational events that have occurred at the plant as motivational examples in their human performance training.

In addition to major accidents, the safety culture training contained, for example, an overview of terminology used, descriptions of safety culture models, regulatory requirements and international expectations, descriptions of safety culture processes and practices, descriptions on how to act in accordance with good safety culture, and who to contact for further information on safety culture.

Some of the safety culture experts also highlighted that ideally, **reflective or participative content** should be included in safety culture training sessions. This could involve working in small groups and discussing safety culture topics. However, they acknowledged that this requires a lot of time, which is not always available for safety culture training.

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[7] Note that safety culture training are required by Finnish regulation (YVL A.3 311, STUK, 2019)

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One safety culture expert gave an example of a **tailored safety culture training session** with a project team consisting of fitters, their supervisors and contractors. The safety culture expert felt that a tailored approach to safety culture training can be more effective and help get the message across, and also make the safety culture experts more known among the shop floor workers.

> *"So we sat around the table, and went through safety culture topics in a dialogic manner. […] This enabled adapting the message to the context of these particular workers – if I had held traditional safety culture training, it would not have been as effective. Now we reflected safety culture from the perspective of their work." (Workshop, translation)*

In one company, the content of safety culture induction training was **systematically developed** using the IAEA's SAT methodology.[8] This included a thorough analysis of the training content as well as formally setting the goals for the training. As a result, the training became more structured due to the exact definition of learning targets. The involved safety culture expert felt that this approach systematized the training, but it also reduced the degrees of freedom in terms of what is included and how the content is presented.

> *"[For example], before, I spoke about the three accidents – Three Mile Island, Chernobyl and Fukushima – in a free-form manner […] and it was always a bit different every time. In the new framework, the learning targets steer the presentation. It is more exactly defined which specific things you must tell people." (Workshop, translation)*

This safety culture expert also noted that when applying the SAT approach for training that is fundamental rather than specific (i.e., safety culture training, as opposed to certain technical training), it may need to be adapted since it is difficult to define the safety-conscious behavioural requirements in a very exact manner.

Integration of safety culture with other training was considered desirable. For example, in one company, a one-week intensive training course on environmental, health, safety and quality topics started with a safety culture session. The safety culture expert who held this session felt that it provided a good opportunity to integrate the safety culture message into the entire training package:

> *"Although the safety culture session was short, when I knew the schedule, I could say what things will be elaborated later during the course. For instance, you will hear more about safety culture from the operating experience perspective later, etc. That enabled linking the whole course to safety culture, or at least including the mindset that this is related to everything that we are and do." (Workshop, translation)*

Another safety culture expert commented that safety culture topics should be integrated into the overall training programme of the company:

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[8] Systematic Approach to Training (SAT) is the nuclear industry's best practice for attaining and maintaining the qualifications and competence of NPP personnel and for quality assurance of training, which also incorporates aspects of safety culture promotion (IAEA, 1996).

"There are not that many training courses with the text "safety culture" in their title [in our company]. This is because the integration principle is applied: safety culture is included within so many training courses. It would be sort of overlapping to conduct separate training, like safety culture one and two. It is better that it is integrated everywhere. […] For example, in basic training for operators, they are taught to apply a conservative approach – that you do not disregard an alarm carelessly, but instead you examine closely what it means, and how you should act. […] The simulator trainers might not explicitly use the word 'safety culture' at all." (Workshop, translation)

Managing the balance between theory and practice was highlighted as a success factor when giving training on safety culture. Specifically, an overly theoretical approach was seen as a risk for the effectiveness of the training:

"[In training], we explain what the right way to act is, why our organization is like this, why we have procedures, why we have training, why we conduct investigations… That is safety culture. It used to be very philosophical when we went through the INSAG definition over and over. It was not helpful, but then we moved to a more down-to-earth approach. […] Before, people just did not understand what was meant by safety culture." (Workshop, translation)

Practical relevance was also associated with the **organizational context**, such as the life cycle phase of the nuclear power plant. One safety culture expert highlighted that the case examples presented during the training should feel meaningful for the trainees. Hence, the plant's life cycle phase should be reflected in their selection.

"Examples [from Japan] concerning siting decisions made in the licensing phase are relevant for the pre-construction phase, but they are not that relevant during construction, so it would be better to use something else." (Workshop, translation)

A common way to follow up on the effectiveness of training was to use **feedback forms**. In one company, the feedback forms included evaluation items for things such as meeting learning targets, self-assessment of one's own learning and the level of understanding after training, usefulness of training, applicability of the lessons learnt, quality of training structure and materials, overall satisfaction, and open comment fields. However, the safety culture expert conducting the training felt that the feedback was of limited value for evaluating the effectiveness of safety culture training and it was not actively used as part of safety culture monitoring:

"When I changed the training, I checked what kind of feedback was provided, but I do not usually review it in detail. […] I think it mostly reflects how energetic I was during the training. After all, training is a lot about presenting using our own persona and if you invest in it, it [feedback] is probably better." (Workshop, translation)

Overall, the safety culture experts were of the opinion that training is a useful method in the overall toolbox for safety culture improvement, but it is **not an end-all solution**.

"I think safety culture training gives you the basics. Then it needs to be strengthened and supported by the environment, communications and other things. One training course does not make you a "safety culture professional"; it is too complex an issue." (Workshop, translation)

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"Sometimes it feels like it is expected that training fixes everything. I think training is a really good and useful tool but it is not a panacea for everything." (Workshop, translation)

"You have to teach the basics [of leadership and supervisory activity], so you will need the training. However, at some point you also have to look at the work processes, check whether they make sense and whether the right things are done, etc." (Workshop, translation)

In addition to formal training sessions, the companies had also implemented **leadership coaching** sessions (for examples, see 3.3.3.5). Sometimes the companies hired external consultants to organize these sessions (see also section 2.4.4).

In one company, there was a regular but informal practice of safety culture status meetings between the safety culture expert and the top management. While its primary purpose was to bring safety culture status information to the management, the involved safety culture expert found that these meetings also provided a good opportunity to coach the top management on their role as safety leaders and facilitating their commitment. Indeed, several safety culture experts expressed that the way in which top management sees safety culture and its relevance to nuclear safety is a crucial success factor and a general task for safety culture experts to help improve (see also success factors for communicating safety culture assessment findings in section 2.4.3.8).

Good practice
Training on safety culture topics includes content that develops the personnel's and leaders' capabilities and motivation to improve safety. The training is designed and presented in such a way that it takes into account the organizational context, the needs of the trainees, and the overall competence management programme.

2.4.3.7 Listening (Do)

The listening principle involves facilitating interactions and connections between people in the organization to ensure trust, good information flows and learning.

Two categories of activities under this principle can be distinguished – passive and active involvement in listening – depending on how the interaction is initiated.

Passive involvement in listening involves making oneself available for interaction, without actively initiating it. One such activity is certain types of informal discussions. A safety culture expert characterized the role of informal discussions and how organizational arrangements can have an impact as follows:

"Often employees walked by and if they were not in a hurry and noticed me in my office, it reminded them of a safety culture issue. Then they walked in to discuss it. Good work design could maximize these kinds of random encounters. However, office reorganization and COVID-19 has reduced these encounters and consequently we get less information and are less visible in reminding about safety culture topics." (Workshop, translation)

Active involvement in listening involves organizing activities or creating forums whose purpose is to facilitate discussion and reflection on safety topics.

A common example of active listening activities that all power companies applied was some form of walk downs or tours. While walk downs and tours also have a monitoring function, their role in facilitating interaction was acknowledged:

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"Absolutely, the purpose of site tours is also to promote safety culture. We do not only monitor, we also have discussions and strive to promote good principles, to have discussions about what the workers think is good safety culture, and to also bring information on what is going at the site in terms of safety culture – we also share information." (Workshop, translation)

An identified limiting factor for safety culture experts concerning walk downs in operating nuclear power plants was related to security arrangements, which restrict access to certain areas (e.g., main control room, etc.).

The safety culture experts provided examples of various groups in which they participated that facilitated interactions. For example, one power company regularly organized one-day-long working group meetings with supply chain safety culture experts. These working group meetings ultimately ended up serving many functions, including monitoring the supply chain and sharing lessons learnt and good practices, but their original motivation was to create a discussion forum for facilitating interactions and creating a shared understanding of safety culture.

"In other working groups there was not enough time to examine safety culture topics thoroughly. […] [After talking to suppliers], we got the idea to establish a special working group. We found that safety culture topics need joint discussions and a forum where the contractors can genuinely discuss these things with us." (Workshop, translation)

The meeting agendas included, for instance, monitoring the progress of contractors' safety culture activities, holding presentations on safety culture topics given by the contractors, communication about various ongoing activities or topical issues, and holding lectures on safety culture matters. The safety culture experts felt that organizing these meetings not only provides a chance for facilitating interactions between the suppliers in a formal setting, but it also enables informal discussions since the key people are all physically present in one place. The latter, however, was affected by the COVID-19 situation, during which the meetings were held remotely.

Good practice

Safety culture experts actively interact with personnel on safety (culture) topics, and organizational practices and arrangements support it.

2.4.3.8 Monitoring (Check)

The monitoring principle involves paying attention to behaviours, interactions and other cultural phenomena.

All power companies had implemented safety culture monitoring activities at **several frequencies**. The companies used different methods or tools for each type of monitoring and the monitoring activities were also associated with different purposes (Table 2). Typically, the slower the cycle, the deeper the cultural analysis.

Some monitoring activities were primarily intended for safety culture assessment (e.g., safety culture self-assessment or safety culture summary in management review), while others were intended for other purposes but also provided information about safety culture (e.g., operation event meetings, observation meetings or various investigations).

Effectiveness follow-up of improvement and corrective actions was conducted at all frequencies. At fast-cycle monitoring this involved, for example, follow-up of corrective action implementation as part of the CAP system or follow-up of work plans describing safety culture-

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specific activities in multidisciplinary safety culture groups. At the annual level, follow-up of activities was performed as part of annual safety culture summary reports.

"In our [annual safety culture] report, there is a chapter where we evaluate our own performance and our activities, and their progress." (Workshop, translation)

Table 2. Types of safety culture monitoring activities

Type	Frequency	Examples	Purpose
Fast-cycle monitoring	Weekly, bi-weekly, monthly	Operational events, related screening meetings	Identification of grass-roots manifestations of safety culture
		CAP group meetings	Identification of issues that require quick response
		Safety concerns, related review meetings	Follow-up of corrective actions
		Safety walks, tours and inspections	Trending
		KPIs	
		Participation in decision-making forums	
Annual summarizing	Yearly	Annual safety culture summary report	Summary of status of safety culture based on existing data
		Safety culture chapter in management review	Follow-up of safety culture improvement activities
Slow-cycle assessment	Every 2-4 years	Safety culture self-assessment	Use of special methods for safety culture assessment (questionnaires, interviews, document review, focus groups, etc.)
		Safety culture questionnaire	
			Identification of deeper cultural phenomena
On-demand or opportunity-based assessments	Non-periodic	Independent safety culture assessments	Deeper analysis of specific or acute phenomena that relate to safety culture
		Conducting or participation in investigations	Utilization of assessments made by external parties
		Audits (internal or supply chain)	Utilization of findings from various assessments as indications of safety culture

Fast-cycle monitoring

The most common fast-cycle monitoring related to operational events or observations. In practice, this included safety culture experts' participation in meetings of various groups that reviewed observations, events or monitored the process of corrective actions. The safety culture experts felt that fast-cycle monitoring serves as a grass-roots method for getting information about the status of safety culture, and it enables a quick reaction to problems. Safety culture experts characterized how they used fast-cycle methods for monitoring safety culture as follows:

"Screening meetings are like an outpost of safety culture. When we review the event reports, we verify that they have received sufficient attention and that that they have been handled properly." (Workshop, translation)

"We maintain an internal worksheet that we use for analysing behavioural or safety culture issues [identified in screening meetings]." (Workshop, translation)

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"Safety culture is not reviewed as a separate topic [in monthly observation meetings]. […] However, I almost always participate to ensure that the safety culture viewpoint is considered. […] We bring a lot of information there, and we also take the observations into consideration when we make our annual safety culture report." (Workshop, translation)

"We participate in [monthly] corrective action process meetings where we review observations, operational event reports, internal and external audits, regulator's inspections. […] We get an overview and understanding of what is going on at the plant and we also listen to how our experts talk about things." (Workshop, translation)

One safety culture expert highlighted the importance of genuine involvement in fast-cycle monitoring as opposed to mere monitoring of trends:

"I think that since I read all the safety observations, it gives me an overall impression of what kinds of events there are – you will see the kinds of reoccurrences that you cannot find if you only use classifications." (Workshop, translation)

All companies had also implemented some type of site tour or walkaround practice (see also dedicated case study on this topic in 3.4). They were not exclusively conducted by safety culture experts, but instead applied generally by managers, supervisors or experts. Safety culture experts either participated in tours organized by other organizational units, or they conducted their own.

"I do a lot of fieldwork: face-to-face discussions and observations. During the site tours, I walk around the site and make observations, especially from a safety culture perspective. I also participate in inspections conducted by other departments and units and look at safety culture aspects. COVID-19 has decreased the opportunities to do this kind of work a lot, but normally, I think the best information comes from talking to people, in the office and during walkarounds." (Workshop, translation)

"Site walks provide all sort of information. […] Is the area clean, is there rubbish around, are routes properly marked, are area restrictions set, do people use protective equipment, how do they generally behave, use tools, etc. These kinds of activity-related things. However, when you go and talk to people, [this also provides information on] how people welcome you, how they talk and what kinds of topics they talk about. Many types of things emerge from these discussions that also say something about safety culture." (Workshop, translation)

Some of the companies also used various key performance indicators as part of safety culture monitoring. One company associated indicators with the IAEA 3-level safety culture maturity model by identifying indicators that help determine the extent to which a level is achieved. Some examples of the indicators were as follows. For level one,[9] the evaluation of procedure adherence and conservative decision-making, and results of regulator's inspections; for level two,[10] the evaluation of strategic commitment to safety through document review, personnel commitment through questionnaires, results from safety culture self-assessments, and availability of resources and competencies; and for level three,[11] safety culture survey response rate, questionnaire responses, and results from various assessments.

Another company also attempted to create a battery of safety culture indicators with a similar approach (according to the IAEA 3-level maturity model), but soon noticed that the data needed

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[9] Safety based on rules and regulations
[10] Good safety performance becoming an organizational goal
[11] Continuous improvement according to which safety performance can always be improved

for the indicators was not always structured in the right way in their systems and consequently they were not readily available for the indicator battery. The experts also felt that some of the quantitative indicators might be misleading:

> *"Then we have things like [the number of] safety observations. We think they rather indicate that we need to investigate something further: is it because there is really something wrong – that no one has the courage make observations – or is it that things are going so well that there is no need to make them?" (Workshop, translation)*

Because of these notions, their periodical safety culture summaries were qualitative rather than quantitative, and the findings were structured according to a safety culture model. The safety culture experts noted that the management has been happy with the qualitative summaries, but on the other hand they also hoped for some numerical data.

Overall, the safety culture experts felt that it is very difficult if not impossible to create a valid single quantitative measure for safety culture. However, they also felt that certain KPIs (e.g., the number of critical safety concerns) might be useful for following the trends of some specific safety culture-related phenomena.

Annual summarizing

All companies had implemented at least one type of annual summary of safety culture. These annual reports primarily summarized existing data from various internal and external sources, such as event reports and investigations, external assessments, regulator inspections, safety concerns and observations, audits, findings from various non-safety-culture-specific questionnaires, exit interviews, findings from WANO and IAEA inspections, etc. Most of the companies utilized a safety culture model in structuring the overall findings.

The safety culture experts described their process of annual summarizing as follows:

> *"In our annual report we use many information sources. Each of them is first individually analysed. Then we look at what is common and treat the report as a whole. […] We have not used a safety culture framework for categorizing the findings. It is more like a bottom-up analysis showing what we have found during a particular year." (Workshop, translation)*

> *"The annual reports are like a meta-analysis where we summarize the information we have received from various sources during the year. We first collect the material […] and identify the main findings, and then we classify them according to the main dimensions [of the safety culture model] and summarize this in the annual report. Then we make improvement suggestions and discuss the findings in a management review where an action plan is defined." (Workshop, translation)*

> *"Our [annual] reports have typically been quite extensive, but in the future we want the [safety culture] self-assessment to provide the baseline assessment and the annual report would update the situation. For example, what behaviours have we seen at the annual level and have we found something that challenges the previous self-assessment?" (Workshop, translation)*

Slow-cycle assessment

The studied nuclear power companies performed slow-cycle safety culture assessments (i.e., safety culture self-assessment projects) every 2–4 years. The utilization of special data collection methods for safety culture and the goal of revealing deeper cultural phenomena set these assessments apart from annual summarizing.

As part of slow-cycle assessment, all companies had implemented safety culture questionnaires. Companies with new-build projects had also implemented additional safety culture questionnaires for construction sites, which were also disseminated to contractors.

All companies also utilized other data collection methods (e.g., document review of procedures, memos, records of decisions and databases, and interviews) in addition to questionnaires.

Safety culture experts from one company also described how general self-assessments were applied for safety culture assessment. These self-assessments consisted of various topics and were performed according to a standard WANO model. Safety culture was included in the topics and its assessment was implemented as a small group exercise facilitated by a safety culture specialist, with participation of experts from various organizational units (including nuclear safety, operating experience, project management, etc.). These assessments were perceived as useful for monitoring and promoting safety culture:

> *"I think the biggest added value was that you get to meet those people that you probably do not meet on a daily basis and that the daily reality of the plant comes into the discussion. I feel that some participants have really became aware of what our organization or work looks like in different parts of the company. We get the actual self-assessment done, but we can also create a shared understanding of the whole, which I think promotes safety culture and cooperation in general." (Workshop, translation)*

On-demand or opportunity-based assessments

The safety culture experts also utilized various on-demand assessments that are not performed periodically. These assessments included various investigations where safety culture experts either take part in or lead (safety culture) assessments conducted by external organizations (e.g., IAEA, WANO, regulator, consultants), audits, etc. These assessments were triggered either by an internal initiative (e.g., a significant safety-related issue), or by the decision of an external organization. Their depth and relation to safety culture varied: some were directly related to safety culture as a whole, while others focused only on a specific aspect of safety culture, and some provided safety culture information as a side product.

Examples of on-demand or opportunity-based assessments included:

- Investigation into work stress from an organizational perspective conducted by the safety culture experts

- Independent safety culture assessments conducted by external consultants

- Safety culture assessments performed by suppliers

- Internal independent review of ODM process (see 3.2) with participation of safety culture experts

- Performing supply chain audits with safety culture topics

- Event investigations or root cause analyses where safety culture experts participated and provided human and organizational factors expertise

All companies summarized the overall findings from these assessments in their annual reports and/or in safety culture self-assessments.

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Good practice

Safety culture monitoring is performed periodically on multiple time cycles – fast, annual and slow – as well as on-demand, to ensure that the monitoring produces a comprehensive overview of safety culture, and is quick enough to react to critical problems. Safety culture monitoring includes the evaluation of progress and the effectiveness of improvement actions. An independent perspective is regularly sought.

Success factors for safety culture assessments

During the workshops, the safety culture experts were asked to summarize the success factors that they felt were important for successful safety culture assessments.

Management support was considered an important overall success factor. Management support was associated with providing sufficient resources (including availability of time and personnel resources, which was also associated with increased quality of the assessment) and ensuring access to the company:

> *"One of the biggest success factors is that you get access. It must be a priority of the management and there needs to be not only a permit to conduct the assessment, but a genuine will that the management wants it." (Workshop, translation)*

The composition of the **assessment group** was another identified success factor. The safety culture experts particularly emphasized that it is important that the organization ensures sufficient independence of the safety culture self-assessment group, and that the group members have the courage to highlight problems, the ability to question and to see larger wholes.

> *"It [the safety culture assessment] would be really easy to conduct if you were a "yes-person" and only found the good things and checked everything was OK. When you are a group member and an expert in your field, when you say that things are not OK, you cause additional work for yourself. So, you have to have the right morals – when building the group you cannot include just anyone." (Workshop, translation)*

Being aware of **data limitations and possibilities and what can actually be deduced from the data** was another identified success factor. It is important to be aware of what kind of data is available that provides insights into culture, what requires additional data collection and what is readily available, and what data is needed for conducting an assessment.

All safety culture experts referred in some way to the use of multiple methods (including qualitative ones) in safety culture assessments. This was considered as a way to ensure the reliability and validity of the results:

> *"I have tried to not come to any strong conclusions based on one single information source. There should always be corroborating evidence from another source." (Workshop, translation)*

> *"Nowadays we use more qualitative approaches and meta-analytic methods. Before we only had a questionnaire, and everything was based on that." (Workshop, translation)*

A related topic concerns the depth of the assessment. Since Schein's theory of organizational culture[12] (Schein, 1985) is an established reference in management sciences, the safety culture experts were asked to reflect on their assessment process from its perspective. Specifically, we enquired how "deep" (in a cultural sense) safety culture assessments are meaningful and useful. The overall consensus of the safety culture experts was that their safety culture assessments primarily operate on the level of artefacts and values rather than on basic assumptions. The safety culture experts generally felt that the identification of basic assumptions as part of assessments was difficult or even undesirable in some cases; however, the experts from all companies also noted that they do reflect upon those issues during their work:

> *"They [basic assumptions] might be nice-to-know. However, it would be a dangerous goal if their identification was required. The validity of that kind of conclusion may become questionable." (Workshop, translation)*

> *"It would be great if you could identify them, and I suppose that is how the safety culture concept would provide genuine added value to organizational assessments. However, they are usually identified as part of accident investigations when there are resources to conduct a really thorough cultural analysis. […] From a cost-benefit perspective, it might be wrong to put a massive effort into identifying basic assumptions [in safety culture self-assessments]. Nevertheless, when we conduct our assessments well, we do get some information about basic assumptions." (Workshop, translation)*

> *"We operate on the values and attitudes level […] at least in reporting, but we do discuss those kinds of topics as well." (Workshop, translation)*

> *"We collect artefacts, and we reach the level of values and attitudes with them. We do not really reach basic assumptions in these assessments. However, we do have internal discussions about basic assumptions." (Workshop, translation)*

It was also noted that there are no tools available for the reliable identification of basic assumptions and that the IAEA methodology for safety culture assessment does not provide much support for this.

Overall, these sentiments suggest that safety culture self-assessments are primarily optimized for actionable results to support organizational development, rather than for conducting deep cultural analysis. The safety culture experts' views also indicate that it is important to be aware of the costs and benefits of the depth of the assessment.

The safety culture experts also highlighted the **selection and use of the normative (safety culture) model** as a success factor. The right model should suit the operational context or life cycle phase of the organization and the assessment group should understand it thoroughly (see also section 2.4.6). When it comes to continuity – using the same model every time – the safety culture experts did not fully agree. A factor seemed to be whether the model was used for categorizing findings during analysis, or whether it was just used as a normative reference for overarching findings:

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[12] Schein defines organizational culture as "a pattern of shared basic assumptions learnt by a group as it solved its problems of external adaptation and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (Schein, 2010, p. 18). It includes three levels: surface level artefacts (e.g., physical environment, behaviours, structures and performance), espoused values (e.g., ideals, goals, values, aspirations), and basic assumptions (i.e., unconscious, taken-for-granted beliefs and values).

"We have systematically used the same model as the framework for categorizing findings. This also helps ensure that assessments are commensurate." (Workshop, translation)

"I do not think it [loss of comparability] is a risk. After all, the assessment results are holistic and we aim to achieve an understanding of the overall whole. We have not compared the findings dimension by dimension or attribute by attribute." (Workshop, translation)

The right kind of **communication of the results and recommendations** was also considered an important success factor. It was associated with ensuring management support, and that the assessment actually leads to improvement.

One safety culture expert highlighted that the right way to present findings to the management is very person-dependent: some managers prefer a very actionable and concrete approach, while others like to operate with abstract concepts. Managers who prefer a concrete approach do not prefer to reflect upon cultural phenomena or other soft issues and instead want actions that are justified. The risk related to embracing an overly behaviouristic approach is that it may result in mechanical actions that might not have much effect:

"You do not want to just recommend the managers to state "nuclear safety first" at the beginning of meetings. They should themselves understand how they set an example for nuclear safety." (Workshop, translation)

On the other hand, managers that like to operate with abstract concepts may become defensive when providing overly concrete suggestions and may prefer being confronted with an abstract problem:

"For one manager, using an abstract, slightly obscure problem such as safety commitment worked best, because only then did he start to really think what this means, and how it manifests." (Workshop, translation)

"In management teams you often have different kinds of people. Some prefer proposals that are complete, while others prefer to contemplate them by themselves. This makes it [interaction with management] more difficult and requires certain situational sensitivity." (Workshop, translation)

To ensure the successful communication of safety culture assessments, it is therefore up to the safety culture expert to identify the management's orientation and to manage the balance between an overly simple (too concrete) and an overly complex (too abstract) communication strategy for findings and recommendations.

Another safety culture expert highlighted the fact that a lot of people in the nuclear industry see a technical education as a communicational challenge for safety culture issues, and noted that a thoroughly and systematically conducted assessment helps address it:

"Now that we have more time to really focus [on the assessment] and to find the big issues, it is also easier to communicate, justify and answer the questions that the management and the rest of the organization has. It has been very challenging […] to communicate it properly to the technical people, so that we would have a shared understanding and that they would take the findings into the field and implement them. Ensuring that the decision-makers understand the findings and include them in their decision-making is a big part of making our assessments effective." (Workshop, translation)

The appropriate **integration of findings and improvement actions with wider organizational development** was another identified success factor.

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*"We generally feel that it would be better to develop things in one
development programme and everything would be concentrated there,
instead of everyone implementing separate actions on their own."*
(Workshop, translation)

In the context of new-builds, good **coordination with the supply chain** was considered an important success factor for ensuring effective safety culture monitoring on construction sites.

*"We work together with suppliers by defining the roles and responsibilities
regarding who monitors what, and then we combine and compare the
results to create an overall view. This is something that has worked well for
[safety culture] monitoring. If we had to monitor everyone – even the
bottom-tier suppliers – ourselves, it would be really challenging."*
(Workshop, translation)

Good practice

Conducting a successful safety culture assessment involves at least the following:
- Ensuring management support
- Identifying the management's and the organization's orientation in order to optimize communication style
- Selecting an appropriate assessment group
- The selection and use of an appropriate normative (safety culture) model
- Being aware of the constraints and opportunities of the assessment, and what you can conclude based on your data
- Integrating findings and recommendations from safety culture assessments with wider organizational development

2.4.3.9 Innovating (Act)

The innovating principle involves the creation of novelty and diversity in the organization, by learning, changing and developing. For safety culture improvement activities, this means continuously developing practices and creating new ones when necessary.

The development of safety culture-specific processes, practices and methods was a common activity that related to the innovation principle. This was particularly evident when reviewing the historical development of safety culture improvement activities (see also section 2.4.6) during which novel ideas were developed. They included, for example, creating a custom safety culture model from scratch, developing a company's safety culture development programme and process, rearranging organizational structures by integrating multidisciplinary safety culture group with corrective action process group, and so on.

Safety culture experts were also involved in **general organizational development**. Here, their role was either to provide safety culture expertise, or they were involved as stakeholders if the change involved their unit or department. In one of the power companies, the safety culture expert's formal job title included organizational development. Some examples of involvement in general organizational development included the development of safety concerns and observations system, the development of leadership programme and metrics for its progress, the preparation of management system documentation, and conducting process modelling, etc. Some safety culture experts indicated that involvement in general organizational development is time-consuming and that it may reduce time spent on safety culture-specific activities. However, at the same time they also saw many benefits, such as the fact that

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involvement in organizational development provides better opportunities to conduct safety culture work in the long term and to integrate it into organizational practices.

Good practice

Safety culture experts continually improve safety culture-related processes and practices, are actively involved in general organizational development, and develop novel methods when necessary.

2.4.4   Interactions with other organizational functions

Many interactions between the safety culture improvement function and other organizational functions came up as part of the descriptions of safety culture experts' activities (see section 2.4.3). Examples of the interactions are summarized in Table 3. The interactions can be categorized by their direction as unidirectional or bidirectional (e.g., based on information flows). Unidirectional interactions are directed and commonly included, such as steering, reporting, sharing information or monitoring. Bidirectional interactions are related to various coordination activities.

As a part of their safety culture process development, one company attempted to make the interactions between the safety culture improvement function and the other organizational functions more visible by using a **BPMN-style diagram**[13] that shows how they are interconnected with each other (across "swim lanes"). The safety culture experts felt that the main benefit of this analysis was that it made it evident that one organizational unit cannot conduct safety culture improvement work alone and that there must be cooperation across the organizational units. Process modelling is an example of how the necessary interactions for the safety culture improvement function can be systematically identified and communicated using commonly available business management tools.

Safety culture process development was also ongoing in another power company. Safety culture experts at this company considered that appropriate process development could be one solution to help integrate safety culture into the daily life of the organization.

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[13] Business Process Model and Notation (BPMN) is a graphical modelling approach used for designing, managing and realizing business processes.

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Table 3. Examples of interactions with other organizational functions

Activity	Other involved functions	Direction[14]	Description
Defining company expectations for safety culture	Top management	Bidirectional	Overall safety culture expectations are defined by top management, facilitated by safety culture experts
Reporting of safety culture status	Top management	Unidirectional (from)	Safety culture experts regularly present an overview of safety culture status to top management, e.g., in a separate meeting or as part of management review
Operational planning of safety culture activities	Various	Bidirectional	Selection and prioritization of safety culture improvement activities is done in multidisciplinary expert groups that are chaired by safety culture experts
Development of safety culture training	Training	Bidirectional	Training department facilitates the definition of safety culture training goals and development of materials with safety culture experts
Coordination of leadership development programmes	Training	Bidirectional	Implementation of leadership development programmes is coordinated together with training department and safety culture experts
Event analyses and investigations	Operating experience	Bidirectional	Safety culture experts provide human and organizational factors expertise in event analyses and investigations
Safety culture communication	Communications	Bidirectional	Safety culture experts prepare messages about safety culture topics and disseminate them throughout the whole company with support of communications department
Monitoring safety culture in decision-making instances	Plant operation	Unidirectional (to)	Safety culture experts participate in operational decision-making meetings and perform assessments of its implementation
Coordinating monitoring of safety culture in the supply chain	Supply chain management, QA	Bidirectional	Safety culture experts coordinate the ways of safety culture monitoring together with supply chain management and quality assurance disciplines
Utilizing external experts	External consultants	Unidirectional (to)	Safety culture experts hire external consultants to provide independent view (e.g., safety culture assessment) or to provide specific competencies
Safety culture training	All other functions	Unidirectional (from)	All employees participate in mandatory (safety culture) training held by safety culture experts

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[14] Unidirectional interactions marked with "to" involve information flows from another function to a safety culture improvement function (e.g., steering, monitoring), and interactions marked with "from" involve information flows from a safety culture improvement function to another function (e.g., communication, reporting).

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> **Good practice**
>
> Safety culture improvement activities are extensively coordinated with other organizational functions. Business management tools are used to visualize, design or facilitate the interactions.

2.4.5   Role of international nuclear associations

International nuclear associations, particularly the IAEA and WANO, and to some extent the INPO, have had a significant effect on how safety culture improvement is implemented in Finnish nuclear power companies. However, the contribution of these associations has not always been sufficient for local demands and the power companies have had to create their own solutions for some of the challenges.

The most common impact of the international nuclear associations has been **introducing the safety culture concept and elaborations of its characteristics**, and hence providing practical tools for assessment and communication. The safety culture models developed by the IAEA, INPO and WANO were widely utilized by the studied power companies as part of their safety culture improvement work (see section 2.4.1). Still, the safety culture experts found certain limitations in the international approaches, such as their applicability for pre-operational life cycle phases.

Another contribution was the various **requirements, standards and guideline documents** that related to human and organizational factors. The safety culture experts used these, for example, as guidance when designing and conducting safety culture assessments. However, the apparent isolation between the different non-technical approaches to nuclear safety was sometimes seen as a potential problem:

> *"I feel that the topics such as leadership, safety culture and human factors are very fragmented. Then there is nuclear professionalism as a separate thing. […] The worst-case scenario is that if different people start implementing these things and steering them in different directions, the overall approach suffers." (Workshop, translation)*

The international nuclear associations also perform **inspections, reviews and support missions**. The results and recommendations have had an effect on the power companies' activities concerning safety culture. For example, initiatives such as annual safety themes and human performance improvement programmes originated from these activities.

Finally, the international nuclear associations provided **educational support** in the form of training, workshops and seminars. These included, for example, consultancy or training on how to conduct safety culture assessments. One safety culture expert also felt that the visibility of safety culture topics in international seminars organized by these associations increases general awareness and provides certain external pressure to support safety culture improvement work.

> **Good practice**
>
> International guidelines and services are utilized for the continuous improvement of safety culture. Their local applicability and limitations are identified and taken into consideration during implementation.

2.4.6 Development phases of safety culture improvement work in Finnish power companies

In all the studied power companies, practical safety culture improvement work started with **active individuals** who had a personal interest in topics related to safety culture. In operating plants, this occurred during the 1990s. At this phase, these individuals did not have explicit job descriptions or roles as safety culture specialists, and the organization did not yet have elaborate organizational processes or structures in place that related to safety culture improvement. The activities of these individuals included, for example, conducting safety culture questionnaires, holding lectures on safety culture, initiating safety culture implementation action plans, and facilitating the definition of safety culture expectations.

One workshop participant described the early days of safety culture work as follows:

> *"My manager told me that it would be good to find out what safety culture and human factors management are all about, and sent me to a training course. I brought back a lot of materials and we started working on it. Then it took off and we realized that we do not have an expert on behavioural sciences – we needed one for handling these human and organizational issues. So we decided to recruit one." (Workshop, translation)*

Recruitment or defining positions with safety culture responsibilities were a common, key historical turning point towards more systematic and specialized safety culture work. Depending on the company, the recruitment of experts in the social sciences started in the mid-2000s and continued throughout the 2010s.

After the recruitment of experts, the power companies started to **actively develop safety culture improvement activities**, and the practices became more established. At this phase, safety culture development processes, programmes and implementation plans were developed and various supporting structures such as multidisciplinary safety culture networks were established.

Many of the current safety culture activities are characterized by striving towards **integration** with other organizational activities. Some of the safety culture experts referred to a more isolated time period in the history of safety culture development, which suggests that integration has been a way to address it. The safety culture experts characterized integrated safety culture improvement as something where the safety culture experts not only perform special safety culture tasks, but also function as experts of non-technical safety topics in various organizational forums.

The safety culture experts also highlighted various contributing factors that affected how safety culture improvement activities had evolved. One such factor was **management support**. For example, the safety culture experts provided examples of situations where the support from top managers who were people-oriented and had an interest in leadership and cultural issues, or who had learnt to adopt it, helped establish and expand safety culture improvement work, make the concept more visible and gave more weight to it.

> *"Back when the management was very technically oriented, they were not really interested in these things. They were also different times when there was less awareness about safety culture. […] But nowadays, management is clearly more interested, and also specifically asks about safety culture issues." (Workshop, translation)*

The safety culture experts also noted **organizational changes**, which often served as opportunities for reorganizing or further systematizing safety culture improvement. The organizational changes affected the organizational positioning of safety culture experts (see also section 2.4.2.2), reporting lines, job descriptions, etc.

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"After the big organizational change, which resulted in the reorganization of the nuclear safety department. […] That was when nuclear safety reports were introduced and then we started to systematically, three times a year, evaluate the level of safety culture." (Workshop, translation)

"After an organizational change […], these special positions were established. […] For example, my task was to look at human, organizational safety culture issues. This way, safety culture matters became more explicitly articulated." (Workshop, translation)

The **demands of the organizational context** were another identified contributing factor. One such demand was new-build projects, which set special needs for adopting safety culture work so that it also covers the large supply chain. In practice, the power companies addressed this with additional resources, special supply chain monitoring methods, and various cross-organizational collaboration practices (for examples, see 2.4.3).

Another type of organizational context was related to **operating experience**. Specifically, some safety culture experts provided examples of operating events that directed the focus of safety culture improvement work to certain aspects of safety culture.

In summary, safety culture improvement work in Finnish nuclear power companies started with general awareness characterized by active individuals. Then it proceeded with the hiring of experts and formalizing positions, the responsibility of which is to implement safety culture-related tasks, which resulted in the systematization of activities through processes, procedures and organizational structures. Finally, this led to the phase where the companies strive to move away from isolated safety culture work in favour of a more integrated approach. It is worth noting that the individual power companies in this study did not necessarily go through these stages sequentially, but characteristics of multiple phases were evident in a given development phase. The characteristics of these four generalized development phases are summarized in Table 4.

Table 4. Generalized development phases of safety culture improvement function

	Development phase			
Area	Awareness	First steps	Systematization	Integration
Experts	Not formal.	Expertise in safety culture is available and is formally included in job descriptions.	Organizational structures or networks are established to support safety culture experts.	Safety culture experts are recognized company-wide as internal advisers and facilitators.
Processes	Policy-level commitment.	Safety culture assessment and development activities are included in work plans.	Safety culture-specific processes and procedures are established.	Processes and procedures as a whole support the development of safety culture
Examples	Active individuals with personal interest perform some safety culture-specific activities. Safety culture training is received from external providers (e.g., IAEA, WANO).	Experts in social sciences are hired. First safety culture assessments are conducted. Training includes safety culture topics.	Safety culture group or network, safety culture ambassadors system. Safety culture development programmes, roadmaps.	Safety culture experts are involved daily organizational work, including assessments, decision-making instances, supporting leaders and supervisors, etc.

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> **Good practice**
>
> When implementing a safety culture improvement function, the organization commits to its continuous development and integration.

2.5 Summary

This chapter described how Finnish nuclear power companies have implemented methodical safety culture improvement in practice. The different ways of conceptualizing safety culture, implementing safety culture improvement as an organizational function, and conducting various safety culture improvement activities were examined, and practical experiences were summarized. Finally, good practices were formulated for each topic.

The good practices described in this chapter can be used as guidance by those nuclear industry organizations aiming to launch a systematic safety culture improvement initiative, or by those aiming to continuously improve their existing practices. The chapter also includes example practices and methods for managing the special demands of power companies in pre-operational life cycle phases. Due to their relatively general nature, the good practices may be applicable to safety-critical industries outside the nuclear field, provided that they are applied in a way that considers the operational environment and risk profile of the industry in question.

3. Safety leadership in the Finnish nuclear industry

3.1   Introduction

International requirements have recognized **effective leadership** as being critically important for ensuring the long-term safety performance of nuclear power organizations (e.g., IAEA, 2016). However, despite the global nature of the nuclear industry, what is considered good leadership may vary from one country to another. Moreover, the actual intended impacts and unintended consequences of leadership activities in the organizations may remain elusive. Sometimes leaders perform activities, which are seen as good but might not have an impact, or may have negative effects in the long term. There is a need for a thorough understanding of the characteristics of leadership in the Finnish nuclear industry, and to gain general in-depth knowledge on how to improve leadership for safety and managerial decision-making, specifically in light of the IAEA's GSR Part 2 requirements (IAEA, 2016, pp. 7–8).

EPIC addressed this need by identifying **how safety leadership activities in selected contexts enhance safety culture, and by identifying the preconditions for good safety leadership, best practices and observed challenges**. The project carried out focused case studies on leadership activities in all Finnish nuclear power companies (Fennovoima, Fortum and TVO). Leadership contexts were selected together with power companies, and they included operational decision-making process and the related meeting practices, safety leadership best practices of middle managers, and safety walks.

Our approach involves reflecting the data from multiple theoretical perspectives. First, nuclear industry expectations for leadership and its outcomes (e.g., behavioural or cultural change) serve as the baseline (e.g., GSR Part 2, IAEA Harmonized Safety Culture Model). Due to the general nature of how leadership is described in the nuclear industry documents, we complement them with additional models or approaches to leadership. The leadership style maturity model (Watts and Paciga, 2011) is utilized to characterize the extent to which leadership activities cover all relevant aspects of the sociotechnical approach to safety, including technical leadership (focus on technology), systematic leadership (focus on processes and systems), systemic leadership (focus on people), and unitive leadership (focus on integration and alignment of human, technology and organization). The organizational tensions and contradicting goals described in the model of adaptive safety management (Reiman, 2015; Reiman et al., 2015) are utilized to identify the types of (contradicting) roles that safety leaders may assume. These perspectives are summarized in Figure 2.

LEADERSHIP ROLES

IDENTITY LEADER	PRACTICAL ASSISTANT
FORMALISER	COACH
SUPERVISOR	INNOVATOR
DECISION-MAKER	FACILITATOR

INDUSTRY EXPECTATIONS

IR. Individual Responsibility
QA. Questioning Attitude
CO. Communication
LR. Leader Responsibility
DM. Decision-Making
WE. Work Environment
CL. Continuous Learning
PI. Problem Identification and Resolution
RC. Raising Concerns
WP. Work Planning

LEADERSHIP STYLE MATURITY

TECHNICAL LEADERSHIP	→	SYSTEMATIC LEADERSHIP	→	SYSTEMIC LEADERSHIP	→	UNITIVE LEADERSHIP
Focus on technology		Focus on processes and systems		Focus on people		Focus on integration and alignment of human, technology and organization

Figure 2. Summary of the perspectives used to examine leadership within EPIC

3.2 Case study "ODM process"

3.2.1 Background

The focus of this case study was to apply a leadership perspective to a **safety-critical decision-making process** that the power company considered to be working well from managerial perspective. The operational decision-making (ODM) process is a formalized procedure for decision-making. In the studied power company, ODM has three levels. We focused on level 2 ODM, where the focus is on deviations from the operation and safety systems, and faults and disturbances that do not require immediate action, but require the consideration and cooperation of several organizations.

In this case study, we examined leadership in the process in general, and in the context of one specific case meeting, which the power company selected.

3.2.2 Methods

Primary data collection methods were **semi-structured interviews** and **document analysis** of procedures and minutes of the specific (remotely held) meeting of interest. Four online interviews were conducted. Two interviewees had attended the case meeting. The other two were familiar with the ODM procedure and the content of the case meeting due to their position and tasks in the organization.

Interview themes included the following: interviewee perceptions of the ODM process and leadership in ODM, procedural and cultural preconditions for successful ODM implementation, description of the process and content of the particular meeting in question (including group climate land dynamics), and leadership and its development in the company in general.

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After data collection, interview recordings were transcribed and thematically analysed. Results were presented to experts in the case study company in a feedback workshop and the implications of the results were discussed.

3.2.3 Results

3.2.3.1 Interviewees' perceptions of ODM process

The interviewees described the ODM procedure and the selected case in a similar way and the descriptions corresponded to the minutes of the meeting and instructions of the ODM procedure. The interviewees also considered the procedure to be working well for its purpose. The interviewees stated that the ODM procedure has improved over the years, moving in a more systematic, formal and documented direction. They felt that the atmosphere in ODM meetings was open and conversational, and that conservatism of the decisions is ensured by background studies, diversity of expertise present in the meetings (including the safety expert), joint discussion and standardized risk assessments. Overall, this suggests that the **interviewees felt that the ODM process is working well and is a matured practice**.

3.2.3.2 Safety leadership in ODM process

Overall in the company, the interviewees felt that leadership style has changed in a more inclusive, more conversational and less hierarchical direction. Senior management was perceived to set the expectations for the company's activities, and they show commitment. For example, their presence in all types of meetings in general was considered to promote this.

> *"Earlier the boss had all the wisdom, now experts have their competencies and they can speak up." (Interview, translation)*

Usually, ODM meetings are held face-to-face. However, during the COVID-19 pandemic, online meetings were established. The interviewees felt that online ODM meetings were working well. Specific benefits of online ODM meetings included that they can be organized faster. The interviewees also highlighted some challenges related to online ODM meetings, including not being able to see facial expressions, emotions and opinions without physical presence. Sharing certain type of documents was also considered challenging in the meeting. In general, the interviewees felt that in remote working mode, monitoring work, setting goals, reporting tasks and assessing work satisfaction was more challenging.

3.2.3.3 Identified procedural preconditions for ODM process

The ODM process begins with the identification of a problem, a fact-based issue related to power plant operations.

The interviewees described a variety of preconditions they felt important for a successful procedural implementation of the ODM process.

Preconditions **before the ODM meeting** included:

- An observation of the operational issues is made and documented

- Employees are aware of the situation when the ODM procedure is applied

- The scope and process of ODM is clearly defined

- Relevant information and solution options are gathered

- Chair invites mandatory participants and case-related experts

- Participants are prepared for the meeting

Preconditions **during the ODM meeting** included:

- Mandatory and relevant expertise is present

- Meeting procedures are followed

- There is no time pressure

- The "voice of the field workers" is heard

- Situational awareness is formed based on background studies and discussions

- A decision or solution related to the problem is made

- The authorization of the decision is assessed

- There is a clear responsibility for decision-making

- Adequate reasoning and the right decision are ensured by asking everyone present during the meeting

Preconditions **after the meeting** included:

- Minutes of the meeting are prepared, checked, signed, and possible disagreements are written down

- Participants take the information to the field to avoid misunderstandings

- Managers and supervisors inform their subordinates and the regulator about the decision

- Traceability is ensured by documentation

- Minutes are reviewed in the plant operating meeting

- Self- and independent assessment of the decisions are conducted. Essential assessment topics included whether the decision-maker had the power to make a decision, whether the procedure is followed and whether the decisions followed the conservative decision-making principle

3.2.3.4   Identified cultural and leadership preconditions for the ODM process

The interviewees also brought up various cultural and leadership preconditions concerning the ODM process and its implementation. They included:

- Management is committed to safety and supports the ODM process

- Everyone involved knows each other

- Procedures are written, understood and followed

- There is open discussion, a good atmosphere and a questioning attitude: everyone can ask questions and question the decisions

- The contribution of field workers is acknowledged

3.2.3.5   Positioning of findings against safety culture and leadership models

Findings from the ODM process case study were modelled against the IAEA Harmonized Safety Culture Model (Table 5) to identify how characteristics of good safety culture manifest within the ODM process. This exercise indicates that ODM process and practices consist of cultural preconditions, procedural and structural preconditions and leadership activities that enable its successful implementation. These findings are summarized in Table 5.

Table 5. Findings from ODM case study modelled against the IAEA Harmonized Safety Culture Model. [C] = cultural precondition, [P] = procedural/structural precondition, [L] = leadership activity

Safety culture dimension	Findings from ODM case study
IR. Individual Responsibility	People understand and accept the ODM procedure. [C]
	Collaboration between the units and expertise areas and diverse thinking is ensured by meeting invitation process [P]
QA. Questioning Attitude	Describing solution options is part of procedure to avoid only one option. [P]
	If there is not enough information to make a decision during the meeting, another meeting will be organized before the final decision is made. [P]
CO. Communication	Everyone knows each other, which enhances communication [C]
	Meetings include members of all levels. It is considered important to also get the voice of "field workers" heard on the issues. [C]
	Minutes of the meetings are distributed to relevant units. [P]
LR. Leader Responsibility	Leaders are present in the meetings and usually chair them. The chair's role is to make the final decision and to make sure that the safety relevance is studied, the procedure is followed, and relevant expertise is present in the meeting. [L]
	Listening and asking questions is considered important. [L]
	Leaders set the expectations that the procedure is followed. [L]
DM. Decision-Making	The existence of the ODM process is a systematic approach to decision-making. [P]
	Decisions are justified and risks assessed according to procedure. [P]
WE. Respectful Work Environment	The atmosphere in the meetings is open and everyone can share their opinion. [C]
	Different experts' opinions are heard in the meetings in order to gain the best/safest solution. [P]
CL. Continuous Learning	ODM procedure supports continuous joint learning process and problem-solving. [P]
	The procedure and decisions are assessed regularly to enhance continuous learning. [P]
PI. Problem Identification and Resolution	ODM is a systematic and standardized method for problem identification defined in the instructions. Background studies are conducted, and the safety relevance of the problem and solution options are evaluated in the meetings consisting of managers and relevant expertise. Risk assessment is conducted, and the best solution option is chosen. [P]
RC. Raising Concerns	Everyone knows each other and the atmosphere in the meetings is open. [C]
	Every participant is expected speak up if they have concerns. [C]
	If someone disagrees in the meeting about the chosen decision, it is written in the minutes. [P]
WP. Work Planning	ODM is part of the work process that plans and controls how problems are solved. [P]

3.2.4   Summary

The interviewees' responses indicated that the operational decision-making process (ODM) process works well for its purpose and is a matured practice. Factors behind the successful ODM process included procedural and cultural preconditions, and leadership activities.

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3.3 Case study "Safety leadership best practices of middle managers"

3.3.1 Background

The focus of this case study was to analyse how middle managers that were considered good leaders by their subordinates practise leadership during their daily work.

3.3.2 Methods

The primary data collection method was **semi-structured interviews** with middle managers. The case study nuclear power company selected the interviewees based on ratings from a leadership survey that the company had conducted. In the leadership survey, subordinates rated their supervisors' leadership activities. Six online interviews were conducted. Each interviewee had 3–10 immediate subordinates and work experience in the company ranged between 2.5–7 years.

Interview themes included the following: interviewee's motive and approach to leadership, main activities as immediate supervisor, situations where the immediate supervisor has a significant role and how the situations are resolved, interactions with own team and various other groups, leadership during COVID-19, and relation to formal leadership development.

In addition to the interviews, relevant **management system documents** were reviewed as a background information.

After data collection, interview recordings were transcribed and thematically analysed. Results were presented to HR and safety culture experts of the case study company in a feedback workshop and the implications of the results were discussed.

3.3.3 Results

3.3.3.1 Motive and approach to leadership, and main activities as immediate supervisors

The interviewees indicated that there were **motivated** for leading and that they had developed their **own approach** and ways of working as a leader. Many mentioned their own previous supervisors as "mentors" or examples of leadership behaviour.

> *"I am motivated as a leader by the possibility to influence people to work towards a shared goal [...] I want to make things clear in the critical areas and show direction in terms of how to proceed." (Interview, translation)*

> *"I want to support my employees [...] and be active [...] and be consistent and clear." (Interview, translation)*

> *"I want to give them opportunities to succeed […] and give them support when needed." (Interview, translation)*

> *"I want to know people and their skills and personalities." (Interview, translation)*

All interviewees emphasized orientation both to production (setting goals and achieving tasks) and to people (seeing leaders' role as enablers, supporters, motivators) (Figure 3).
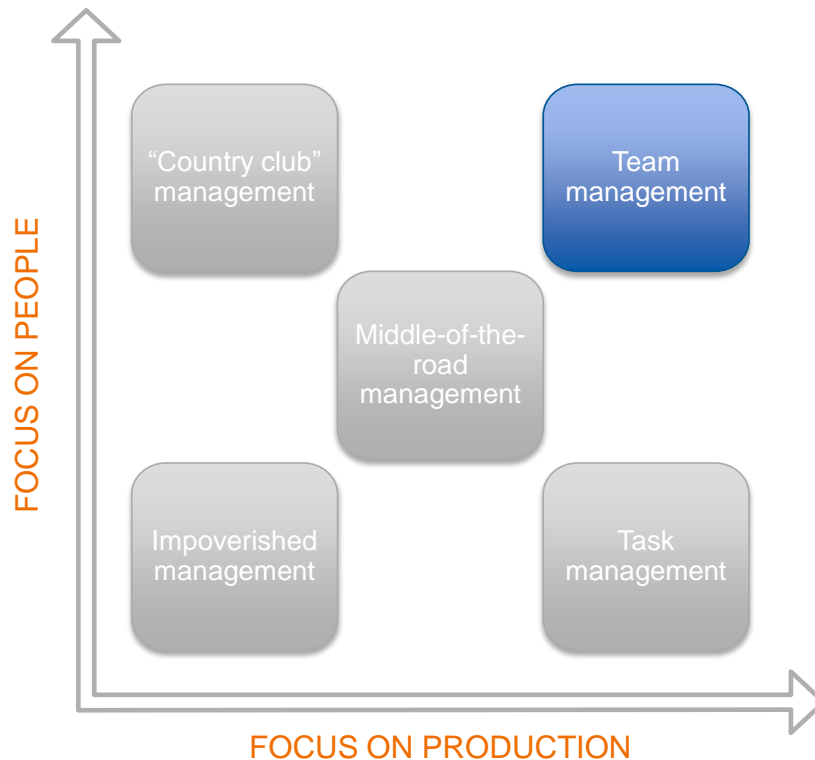
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Figure 3. The Managerial Grid (Blake et al., 1964) considers the top-right corner (high focus on production and people) as most the effective leadership style and the goal of managerial training

When the researchers asked the interviewees to describe their **main activities as immediate supervisors**, they mentioned activities related to tasks, individual subordinates and the team.

Activities related to **tasks** included:

- Setting direction, goals and tasks, supporting and giving feedback, estimating workload

- Solving problems, creating solutions and new ways of working, brainstorming

- Making decisions when things are unclear

- Prioritization of tasks when not everything could be done

- Taking responsibility for decisions and prioritizations

Activities related to **people** included:

- Interest in subordinates' personal wellbeing, personalities, feelings, level of stress, motivation

- Supporting personnel career development

- Backing up if things do not go as planned

- Creating a culture of openness and trust by giving time and space for joint meetings and criticism

- Facilitating shared understanding within the team

In addition, the interviewees noted that they have various administrative tasks such as handling absences, etc.

3.3.3.2 Situations where the immediate supervisor has a significant role and how the situations were solved

The interviewees identified both short-term and long-term orientations in relation to **situations where the immediate supervisor has a significant role**.

All interviewees emphasized short-term actions, such as addressing and solving various problems, concerns, unclarified issues and making decisions. These related, for example, to work quality and personal problems, workload, scheduling and resources, and clarification of roles and responsibilities.

> *"If things do not go as planned or they are in a grey zone […] I immediately step in. Then I have a decisive role, or I check the manual." (Interview, translation)*

The interviewees also mentioned managing long-term issues. They included planning and ensuring personnel wellbeing, motivation and competence development, balancing workload, emphasis on preventive actions, and managing new projects.

> *"I always keep in mind that the problem I am solving right now is not the last one. Other problems will come along and in that case, I need to work with these people to find an optimum way from their perspective too […] not to focus too much on the delays, but focus how we will proceed. I would say they are motivated in this way." (Interview, translation)*

The interviewees brought up many types of **challenging situations** in their work. They included: not having sufficient time for discussions, having misunderstandings and conflicts due to unclear interfaces and roles and responsibilities, delayed documentation from suppliers causing an immediate reorganization of the tasks, and the COVID-19 situation causing friction and emotional outbursts in meetings. The interviewees noted that such issues cause confusion and take up a lot of the supervisor's time due to extra meetings and discussions.

The interviewees all had a similar approach to addressing and solving challenges. They emphasized immediate reaction, discussing openly one-to-one and/or with the team, seeking solutions together, and contacting senior management if needed. In addition, the interviewees made decisions and took responsibility for prioritization.

> *"If an issue is critical, I aim to solve it immediately, not via email. I talk directly. And then I summarize the discussion in an email." (Interview, translation)*

> *"I try to calm people down and encourage them not to take things personally. I contact others and things are usually solved. I prefer to call first – not to make a formal non-conformity report." (Interview, translation)*

One interviewee had a notion of learning and sharing lessons from previous challenges.

> *"We should write a guide and gather information on how project management has resolved issues and share know-how." (Interview, translation)*

3.3.3.3 Interactions

Four types of interactions were discussed during the interviews: leading the subordinates and one's own team, relationship with senior management, collaboration with other units, and interaction with suppliers (Figure 4).
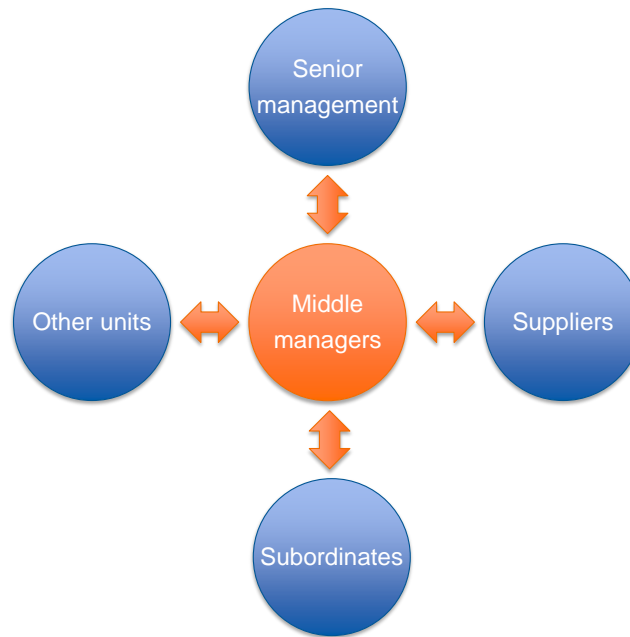
Figure 4. Four types of interactions between middle managers and other entities

The interviewees indicated strong commitment to their **own team and their subordinates**. In practice, the interviewees created and developed the team's own ways of working and solving problems, applied the coaching approach and avoided micro-management, facilitated shared understanding of issues and encouraged open discussions, including criticism. Other leadership practices included organizing regular meetings and informal discussions to maintain personal relationships and trust and to support subordinates. Typically, the interviewees expected their subordinates to work independently and to openly tell others if they had any concerns. Giving negative feedback (e.g., concerning work quality, absences, mistakes, etc.) was commonly considered a challenging leadership situation. The interviewees emphasized that when addressing such situations, direct one-to-one discussions, support, empathy and confidentiality are essential.

> *"I had not seen any manual where it's written specifically that you should have a meeting with your subordinate […] we developed it by ourselves. I simply try to start with something and then during the time we have, agree that this is good practice, or it should be done in a different way."*
> *(Interview, translation)*

> *"You are there for them and we stand as one team in front of others."*
> *(Interview, translation)*

> *"We call each other and discuss all the things that are on our minds"*
> *(Interview, translation)*

> *"I ask how people are and if they seem not to be fine, I book a one-to-one meeting." (Interview, translation)*

> *"I expect them to be able to work independently [...] that they can make decisions… and that they can bring solutions to me." (Interview, translation)*

> *"Absolute confidentiality is a must." (Interview, translation)*

The perception of **relationship with senior management** differed between the interviewees. Most considered the relationship supportive, but not all. Positive examples included informal communication and ease of contacting senior management directly, and speaking up in joint meetings. Challenges were related to senior management's lack of time for strategic

discussions, or general lack of support or coaching. The interviewees also stressed that senior management expectations should be visible, aligned and well-communicated.

> *"Top management should have time to lead the overall entity [...] They should not do micro-management and hands-on practical work." (Interview, translation)*

> *"I arrange some special meetings, coordinate with other leaders, prepare communication with our supplier and decide if this is the way we are going to move forward and how this is solved." (Interview, translation)*

> "*Clarity of responsibilities is needed to enable leaders to communicate the expectations, tasks and roles and responsibilities.*" *(Interview, translation)*

Organizational structures and processes were also mentioned as affecting leadership. In this power company, a wide-ranging organizational change had been introduced, and had been under implementation for an extended period. From a leadership perspective, the interviewees associated the organizational change with division of responsibilities and communication. A certain amount of confusion was created in terms of what the exact roles and responsibilities of some organizational units were. Many interviewees felt this affected their leadership work as they had to manage and address this confusion.

The interviewees generally applied a similar approach and attitude when **collaborating with other units** to collaborating with their own team: direct discussions and active problem-solving. The interviewees mentioned that contacting senior management is one way to proceed if a solution is not found between the teams. However, the interviewees did emphasize that it is important to act as one team and to have a shared perspective in front of others. They felt that the leader stands up for their team and takes responsibility for their team's decisions if there are any conflicts.

> *"If we do not agree in the joint meetings with other teams, we discuss, and I intervene and even stop the discussion and say to others that we need to discuss this matter internally first." (Interview, translation)*

Most of the challenging situations mentioned by the interviewees related to situations where there seemed to be unclear roles and responsibilities and a different focus between organizational units.

Some interviewees mentioned that **interaction with suppliers** can be a challenge due to limited possibilities to influence them, a different focus (licensee as an overall responsible vs. suppliers as delivering a product), and scheduling changes. They mentioned a variety of ways to overcome the challenges, including trying to gain an understanding of the suppliers' perspectives, regular cooperation (e.g., meetings, task forces, direct calls), forming a clear and shared view within their own company, finding ways to support the suppliers, and coming up with ways to cope with the stress and complexities involved in subcontracting.

> *"We have meetings with our supplier; or not only meetings of course – we also have calls and standard ways of communication. If I am looking for some solution, I directly call the person who is handling this problem or their boss." (Interview, translation)*

> *"I need to understand what their motivation is [...] and figure out why they are doing what they are doing." (Interview, translation)*

> *"We have weekly meetings [with suppliers] about a joint view." (Interview, translation)*

3.3.3.4   Leadership during COVID-19

During COVID-19, the case study nuclear power company had been for the most part in remote working mode. The interviewees felt that tasks had been done well and efficiently during COVID-19 despite the remote working. However, the interviewees felt that they were lacking the knowledge of **how people are doing**.

> *"Effectiveness has increased […] there are many meetings in a row […]*
> *welfare has decreased and [...] there is less time for brainstorming."*
> *(Interview, translation)*

> *"I do not know the status or pulse of how people are doing. People do their*
> *work in an exemplary way, but it would be good to see the eye bags – that*
> *life in general is in order." (Interview, translation)*

Overall, the interviewees highlighted communication issues as resulting from the COVID-19 situation. For example, there were problems in finding practices and systems to replace the informal and formal communication at the office. Experiences of online meetings differed. On the one hand, some perceived them as causing more misunderstandings and sometimes frustration. The interviewees also mentioned the issue of some individuals dominating online meetings. On the other hand, some interviewees felt that online meetings could provide a way for more balanced communication, since people have the possibility to prepare their message.

Ways to overcome communication challenges included paying close attention to one's own communication style and clarity of messages. Due to the special characteristics of online meetings, the interviewees also felt that leaders should act as moderators in the online meetings to prevent the adverse side effects of the medium. Using cameras during meetings was also found to be good practice.

3.3.3.5   Formal leadership development

Formal leadership development methods were discussed with an HR representative. There were many formal leadership development methods implemented at the case study power company. They included utilizing several types of surveys for leadership assessment (e.g., Työvire, Työyhteisövire, 360 surveys), methods for sharing best practices on leadership (e.g., stories in intranet, leaders group in Teams), various support tools for managers (e.g., work planning, development discussions and early care guides and templates, HR clinics, leadership handbook), and training (e.g., leadership in conflict situations and intercultural training, training for coaching, change management). The company had also defined their vision for leadership, which includes dialogue (regular formal and informal meetings and discussions), employee involvement (coaching approach, hiring people wiser than you, joint problem-solving) and mutual trust (open discussions, confidentiality, holistic approach to wellbeing).

At the time of data collection, the overall emphasis of leadership development was on general leadership, and not specifically on safety leadership. Safety leadership was not included as a leader's key responsibility. However, safety culture principles were introduced as part of training programmes. In addition, the company was in the process of integrating a safety leadership module in their leadership training programme. In the feedback workshop, the company representatives felt that it was preferable to include safety leadership as a topic within the general leadership framework, rather than the other way around.

Needs for formal leadership development were discussed with the interviewees. Overall, the interviewees were content with HR assistance in terms administrative matters such as recruitment, organizing general training and needs-based support. Specific needs that were mentioned included formal templates for long-term career paths and training plans to support personnel motivation and commitment, and support for arranging tailored training for the personnel. The interviewees did not recognize any specific development needs related to their

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immediate leadership activities: they felt that they themselves reflect and develop their ways of working continuously and independently.

"There are not too many instructions on how we should be leaders;
somehow it is assumed that we know it already." (Interview, translation)

3.3.4 Summary

Interviewees were middle managers perceived to be good leaders by their subordinates. All interviewees emphasized both task-orientation and people-orientation. The interviewees were highly motivated to lead (not just manage) and had developed their own ways of working with their subordinates, emphasizing trust and loyalty to their team.

Supervisors have the biggest role in the situations that need fast short-term problem-solving related to things such as work quality and load-related issues, and long-term actions ensuring personnel competence development in the long run. Interviewees considered the most challenging situations as leaders having enough time for discussions and solving conflict and misunderstandings. Practical examples of addressing these challenges were immediate reaction, discussing openly one-to-one and/or with the team, seeking solutions together, and contacting upper management if needed.

Top management leadership and organizational structures set the conditions for leadership. Immediate leadership seems to be aligned with the company's vision for leadership enhancing dialogue, employee involvement and mutual trust at the team level. However, there is a challenge of how to enhance a similar approach between teams and upper management when there are more conflicting issues and dialogue is time-consuming. In addition, organizational structures created some ambiguities in the interfaces, roles and responsibilities. This seemed to cause most of the challenging situations that the interviewees encountered.

3.4 Case study "Safety walks"

3.4.1 Background

The focus of this case study was on leadership in safety walks (EHS) that included safety-related discussions between managers and employees.

3.4.2 Methods

In this case study, safety walk register (from 2020) analysis and document analysis were performed. The open feedback field of the safety walk register was analysed by categorizing findings based on their polarity (negative, positive), the inclusion of "people leadership" issues as well as other relevant themes. In addition, there was four interviews with observers and two group interviews with employees between 15 and 27 April 2021.

Interview themes were adjusted for managers and employee groups and included the following: backgrounds of the interviewees, their experiences and practices in participating in safety walks, how safety walks and safety discussions are planned and conducted, perception of interactions between the observers and those that are being observed, reporting, and development needs. In addition, there were questions related to general leadership practices and safety leadership in the case organization.

After data collection, interview recordings were transcribed and thematically analysed. Results were presented to safety culture experts of the case study company in a feedback workshop and the implications of the results were discussed.

3.4.3 Results

3.4.3.1 Background and procedure

EHS safety walks have been conducted in the case organization for about 20 years. In the beginning, the focus was more on occupational health and later more on observations of technical issues. Currently, there seem to be various kinds of safety inspections and walks at the plant, including operators' field observations, observations related to IAEA and STUK inspections, WANO peer reviews, and so on. In practice, it seemed that the focus of safety walks has been more on the observation of technical issues – not on ways of working or behaviour. There does not seem be upper-level guidelines or coordination for the variety of the safety inspections and walks. Managers plan and conduct their tours quite individually or conduct them in a group. In addition, it seems to be difficult to differentiate between the purposes of different safety inspections and walks from the employees' perspective.

The aim of safety walks is to improve safety management at the power plant. All power plant supervisors perform EHS safety walks at least once a month. Safety walks must include safety-related discussions. Supervisors record safety walks in a separate document (the safety walk register) afterwards. This document is public inside the organization, and it is for internal use for supervisors and subordinates. Safety observations and deviations are recorded in separate systems and processed accordingly. The heads of units monitor the implementation and the results of the safety walks within their area of responsibility. In practice, there seem not to be consequences if a supervisor does not fulfil the minimum requirements. The number of walks is reported monthly in the EHS report. Instructions for the safety walks are provided in the "Quality operations and field observation" leaflet. There is also training material in the e-learning portal, including step-by-step instruction and behavioural guidance for the safety walks.

> *"During the safety walk, the supervisor handles safety issues in a positive spirit with an open-minded discussion. The emphasis is on the safety-focused discussion with the people working at the site." (Quality operations and field observations leaflet, translation)*

3.4.3.2 Safety walks in practice

According to the register, in 2020 over 1100 EHS safety walks were performed by 116 different managers and supervisors. Supervisors from the operations unit conducted most of the tours. Some 31% of the tours were conducted in a group. Most active managers performed over 20 tours a year (max=32).

The interviews indicated that it is usually easiest to visit the same place: it is easy to access and there are familiar people working. Based on the interviews, the focus seems to be on technical topics, such as examining the state and systems of the facilities, housekeeping, and general observations and reporting.

According to the register, 88% of the safety walks included a safety discussion. The reasons why safety discussions were not always held according to interviews included:

- Safety walks and inspections are conducted in locations where there is no one working

- It is too noisy to have a discussion on the spot

- Lack of resources: combining different inspections saves time of the managers

The register included the possibility for observers to write open-field comments. Most of the open-field comments were classified as describing the topic or the theme of the safety walk and describing corrective measures and development needs. Ten per cent of the comments indicated that non-technical issues were addressed during the safety walk, while 31% of the comments were taking a stand and could be classified as:

- Positive: *"In general, everything is fine", and "Places in order" (Safety walk register, translation)*

- Negative: *"Scaffolding unpacked even if the work is done", and "Corridors have become storage facilities" (Safety walk register, translation)*

- Neutral: *"It is quiet at the site" (Safety walk register, translation)*

It was perceived by the employees that there are more managers in the field before major inspections, which increases the workload and creates sense of hurry. It was also mentioned that the quality of the safety walks and observations is dependent on the observer; different observers make different observations about the same facilities.

Recommendations from recent reviews for the plant emphasized that more focus is needed on behaviours and the ways of working, and specific themes are developed to support this. Interviewees acknowledged various suggestions for improvement:

- The overall system of different safety inspections and walks needs to be evaluated, reorganized and coordinated

- Focus on quality and coverage of the safety walk and systems integration

- All the data should be uploaded to one system

- Training for supervisors about expectations and criteria for making the observations

- Observations should guide or have a clear impact on development activities

- Specific themes for each month would sharpen the focus

3.4.3.3 Safety-related discussions

According to guide, the purpose of the safety-related discussions is to increase interaction and shared understanding of safety and work instructions. Interviewees felt that it is easy to discuss when people knew each other. The topics mentioned in the discussions related to technical issues and housekeeping. Based on the employees' perceptions, safety discussions are considered beneficial for the following reasons:

- Helps avoid becoming blind to one's ways of working

- Enables the receipt of relevant feedback on one's work

- Allows the possibility to avoid misunderstandings and unnecessary paperwork

- Enables leaders to understand the real situation in the field

According to the supervisors' perceptions, safety discussions are considered beneficial for the following reasons:

- Helps to notice and intervene the unofficial/unsafe ways of working

- Enhances leaders' presence at the plant

- Highlights the importance of meeting and talking to different people

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"Non-technical matters? No one has ever raised anything like that in the field. We do not ask questions about such things. We usually deal with technical matters. Of course we check that the job site meets our requirements, and we will raise it if it is untidy or if the demarcations are not in order or something like that." (Interview, translation)

"In radiation protection, it is natural to discuss shoe limits, etc. and safety issues." (Interview, translation)

3.4.3.4 Balancing the tensions related to safety walks

Based on the data, there seems to be a contradictory perspective on the safety walks that the organization could reflect on when developing the procedure. Figure 5 summarizes these perspectives.

Figure 5. Contradictory perspectives on safety walks

3.4.4 Summary

The variety of safety inspections and walks is big. The safety walks are mostly focused on systems, technical aspects and "housekeeping" instead of interaction with personnel, which was their original purpose. The purpose and reason for each safety inspection or walk is not apparent to employees. There seems to be a lack of overall responsibility, coordination and monitoring of the procedure and clear criteria about the basis on which the safety inspections and walks are done. There is a notion that the numeric goals for the safety walks may be overriding, which is manifesting in a lack of safety discussions. Although all the interviewees felt that it is easy to interact with people, they acknowledged that there might be some unwillingness or reluctance for managers to interact with workers and discuss wellbeing aspects and how they are perceiving the work. The organization collects the data of the safety walks, but it could be better utilized in organizational monitoring and learning.

Limitation of the study: The managers that we interviewed were not conducting the EHS safety walks with safety discussions, which were the focus of the study. They had experience of other kinds of presence of leaders at the plant. The group interviewees had also not experienced these EHS safety walks, including safety discussions. Therefore, the results indicate more general perspectives and viewpoints related to the safety walks.

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4. Conclusions

The general objective of SAFIR2022 EPIC was to develop knowledge and approaches that support the effective improvement of leadership and safety culture. To achieve this objective, two perspectives were applied and empirical case studies were conducted in all Finnish nuclear power companies.

First, the project examined how methodical safety culture improvement has been implemented in Finnish nuclear power companies, and what the experts' experiences were like. A framework for modelling safety culture improvement as an organizational function was developed, which served as a structure for data collection and analysis. Good practices for implementing effective safety culture improvement were summarized according to the framework based on collected empirical data.

Second, the project examined safety leadership in three different contexts: the operational decision-making process, activities of middle managers, and safety walks. Each of these three case studies were analysed using the same approach, which combined multiple perspectives to leadership. The case studies resulted in sets of factors to take into consideration from leadership perspective in these contexts.

It was not within the scope of this report to discuss the empirical findings from the perspective of existing scientific literature. Integration of the described empirical findings with scientific knowledge is seen as a further research need, in order to identify gaps and to validate the identified good practices. Furthermore, the focus of this study was safety culture experts and staff at middle management or supervisor levels. Top management and shop floor employees also play a significant role in promoting or implementing leadership and culture for safety in their daily activities. Expanding the research scope to cover these two groups is seen as another research need.

Acknowledgements

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Appendix A. List of question items of the safety culture improvement function modelling framework

TOPICS	QUESTIONS					
	A. DESCRIPTION	B. ACTION	C. PURPOSE	D. INTERACTION	E. CHANGE	F. EXPERIENCE
01. Conceptualization - Definition	How do you **define** safety culture in your company? What safety culture **models** are used? What kind of safety culture **improvement model/theory** is used (can also be implicit)?	n/a	What is the **purpose** of the safety culture models/definitions? Have you defined functions for safety culture improvement activities? E.g., how each activity contributes to each characteristics of good safety culture?	Who has **defined safety culture/participated in model/definition selection** or development?	Have the models/definitions used **changed**? Why current models/definitions are used?	What advantages and disadvantages have you found in the safety culture **definitions/models** you use?
02. Organizing - History	When did **safety culture work start** in your company? What were the **historical turning points** for safety culture work at your company?	n/a	What was the **motivation** for starting safety culture work?	**Who (units or individuals) were involved** in initiating or changing safety culture work?	n/a	n/a
03. Organizing - Human resources	How many **people are primarily involved** in safety culture work (safety culture experts)?	n/a	What do safety culture experts **do?**	Are there **shared resources** (people whose main task is not specific to safety culture) available for safety culture work?	How have **changes** (if any) in human resources (safety culture experts or shared) for safety culture work influenced content or efficiency of safety culture work?	What are your experiences in utilizing **shared resources**?
04. Organizing - Management system	What **documents and management system processes** define safety culture activities?	n/a	n/a	What **other processes** safety culture process (if one exists) feeds into?	How have **safety culture work documents and processes changed** over years? Why?	n/a
05. Organizing - Roles and responsibilities	What are **roles and responsibilities** for safety culture: a) CEO b) top management c) SC experts d) other workers	n/a	n/a	n/a	n/a	n/a
06. Organizing - Organizational positioning	Is there a **separate unit or division** responsible for safety culture development?	n/a	n/a	Where is it **positioned** in the organization?	Has the unit always been organizationally positioned this way, or has there been **changes?**	**Characterize** this organizational position: is it best place for safety culture work, or would another organizational position be more suitable? How have changes in organizational position of safety culture unit (if any) influenced content and possibilities to do safety culture work?
07. Planning - Setting objectives	How do you define and revise **safety culture development objectives** (e.g., selection of overall goals and targets and selection of safety culture activities)?	Provide **examples** of objective-setting activities.	n/a	How is **top management** involved with safety culture development strategy formulation? Who else is involved with setting objectives?	Has objective setting for safety culture development **changed** over years?	In your experience, what are the key **success factors** for setting objectives for development strategy?
08. Implementing - Activities overview	n/a	What kind of **safety culture improvement activities** are conducted?	n/a	What **other organizational units** are/have been involved in safety culture improvement activities? What was their role?	Have safety culture improvement activities always remained the same or has there been **changes?** If there have been changes, what triggered them?	What kinds of **effects** have you observed that are the result of safety culture work? What do you attribute them to? How did you observe them?
09. Implementing - Training	What is the **overall approach** to safety culture training?	What kinds of **trainings** are held that relate to safety culture?	What **functions** safety culture trainings entail: a) education, b) motivation, c) acculturation?	Who **participates** in the trainings? Who are involved in **conducting** safety culture trainings?	How has **safety culture training changed** over years? What has triggered this change?	How is **training effectiveness** assessed?
10. Assessing and monitoring - Assessment process	What **overall approach** is applied for safety culture assessment?	What **safety culture and leadership assessment methods** are used, and at what intervals?	What is the **function/purpose** of each type of assessment method? How do they contribute to safety culture assessment?	How do **other organizational units** support safety culture monitoring and assessment?	Has the approach to safety culture assessment **changed?** Why?	What are the **prerequisites for successful implementation** of each type of safety culture assessment?
11. Continuous development - Development and innovation	How are safety culture development processes or methods **developed or innovated?**	Provide **examples of new innovations** for safety culture development.	What was the **reason** behind developing something new or for innovating?	Who was **involved** in the development or innovation?	n/a	What **changed** after development or innovation?

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