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Making Complex Industrial Systems Safe Means Solving Unsolvable Communication Dilemmas



Keeping [industrial systems safe](#) requires the navigation of technology and human communication and [sensemaking](#). Our research with [nuclear power plant inspectors](#) confirmed that [in complex, technological organizations](#), *safety*, a routine “nonevent,” is accomplished collaboratively. [Safety processes](#) may be supported by acknowledging and accounting for unresolvable and unavoidable communication challenges. Doing so means recognizing how communication is itself a site of sensemaking. Instead of searching for *the* right way to communicate, safety systems should encourage continuous evaluation and reevaluation of communication processes to discourage the mindlessness that may be created by effective, but routine, practices.

Through participatory observation and interviews, our research sought to understand day-to-day safety oversight communication as designed. Effective information management depended upon the degree to which designs for communication allowed for the management of inherent, irresolvable dilemmas in inspection work. By taking this approach, we were able to question the effectiveness of particular communication strategies *and* the connections between situated, emergent problem-solving and the inspectors’ collective communication design.

We focused on daily status meetings, meant by inspectors to sort out what safety matters required attention and to manage information for safety oversight. These sorts of meetings (i.e., safety briefings) are common in settings where [operational safety is a principal concern](#) (e.g., energy, manufacturing, construction). They are important because they [make possible but also place limits on the enactment of safety](#).

Even though the status meetings were focused on safety oversight, informed by experience and safety research, and conducted very well, *the meetings still had to balance multiple contradictory, irresolvable safety-related goals and ideals*: transmitting information accurately and making meaning in the moment, dealing concretely with ambiguity and uncertainty, and focusing on the present facts but also the backstory without being too boring and thus mindless or too interesting and thus distracted. The difficulties of status meetings could not be managed away, and even best practices could, in the right circumstances, compound them.

Communication During Status Meetings

Daily status meetings reflected formal and informal guidance that inspectors and others received regarding how to communicate. Our research showed, however, that this guidance was shifting and, at times, was paradoxical. Communication dilemmas surfaced in participants’ arguments about the designable features of the meetings, including aspects of *what and how much information, how to communicate, and audience*. That is, although inspectors were given guidelines about what information to report, they also were told, “When it comes to safety, nothing is routine” and communication should include *anything* deemed important. Status meetings, therefore, relied on “interestingness” as a fuzzy guideline for what to share. At the same time, as issues unfolded, they were not (and perhaps could not be) completely known, which complicated deciding what to communicate.

Overall, those relaying information did so calmly and concisely without comment or emotion. Inspectors were careful with the language they used and relied on engineering terms and references to formal documents to precisely and accurately convey information. Yet, the safety significance of an issue was not always made explicit. Instead, sharing information relied on assumptions of shared knowledge and standardized expressions such as, “Plant X Unit 1 is yellow ... the alpha diesel is inoperable and they’re in an LCO for a couple of hours.” Status meetings also involved a structured *turn-taking* where inspectors reported in the same order almost all of the time, and they maintained consistent *timing and pacing*. Although status meetings could take as much time as needed, time was finite, and participants needed to

return to other work.

The principal audience was senior leadership, which meant that status meetings largely passed information up the hierarchy. Senior leaders called meetings to order, directed conversation, and kept notes. The routinized hierarchy of the meetings allowed for participation without rapt attention. Yet, the meetings also were intended to draw on the collective knowledge and know-how of all those present.

Values That Underpin Communication for Safety Oversight

Multiple, competing goals and principles exist in [safety communication processes](#), but not all goals and principles are relevant or salient in a given moment. Status meetings hinged on the ongoing negotiation of contradictory and shifting goals. The need to navigate this complexity was reflected in the decision-making about the meetings' designable features.



First, status meetings needed to be a space to transmit information while also generating collective sensemaking. Although their principal model for communication was that it was about clearly and accurately transmitting facts, many recognized that sensemaking required flexibility and interpretation of "the facts." Second, communication in meetings needed to draw on measurable, concrete evidence in making regulatory judgments, but also tolerate the ambiguity and uncertainty in inspection work. As one participant remarked, "Not everything is black and white. We can't treat it as black and white." Yet, for some, inspection work *required* it be so.

Third, status meetings needed to be methodical without being routinized. The transmission of information was standardized and repetitive to minimize distractions. Such standardization helped keep focus during emergent, uncertain times. However, routines can invite mindlessness, and seasoned inspectors became more effective at "predicting" the process and outcome of an issue. As such, inspectors often voiced reminders not to lose what they called a "questioning attitude" or a continuous, focused interrogation of information.

Finally, status meetings needed to focus on current plant conditions without ignoring the backstory. Although plant history was useful in interpreting the present conditions, inspectors also wanted to treat plants fairly across the board because "plant profiling" was not fair and could lead to supplanting hard facts with a loose sense of likelihood. Status meetings needed to maintain focus on the current conditions of the plants but also draw on shared wisdom regarding past issues.

Recommendations

Our findings support the expectation that safety is highly valued and nuclear plant inspectors are attuned to the maintenance of public safety. They also demonstrate how safety oversight needs flexible and continuous communication design. Such meetings should balance standardization and consistency alongside contingency and flexibility. Our recommendations highlight strategies for coping with the ongoing, persistent tensions created by doing safety work well. We recommend that individuals working toward safety:

- Sustain a continuous operational understanding of the sensemaking involved in communication. Communication is about transmitting words *and* interpretation and negotiation with and among others.
- Ask questions about the fit, function, and fragmentation of approaches to communication in collective communication design: Will a particular strategy address the multiplicity of goals and principles at play (*fit*)? Will we be able to implement it together (*function*)? How will the circulation of alternative approaches and competing ideals for communication complicate its implementation (*fragmentation*)?
- Create time or space for storytelling that can enhance understanding of the complexity of issues and their safety significance. Try when possible to avoid over-relying on brevity and technical detail.
- Deal with the repetitive practices by systematically changing routines. When we anticipate the flow of a conversation, it becomes easier to "check out." Change up the order of speaking, who sits where, and so forth. Experimentation can make conversations persistently new while retaining the benefits of consistency.

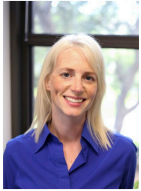


The research- and practice-based literatures on safety processes provide rich resources for keeping complex industrial systems safe, but even when everything is done correctly, accidents and errors can still happen. A sustained, reflexive focus on communication is needed to enable the most robust safety systems that are always (re)balancing the competing demands of getting safety right.

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