

Challenges in safety management within complex, subcontractor-driven environments: Reflections from Equinor's incidents

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Even with modern safety frameworks and analytical tools, maintaining safety in complex operational environments remains challenging, particularly when tasks are delegated to subcontractors. Safety requirements are not always clearly specified, and follow-up on training, workload, and validation is often limited. Reporting practices also pose challenges, as early warning signs and deviations may not be communicated due to limited psychological safety, concerns about efficiency impacts, or fear of conflict. Such conditions are well documented in high-risk domains, where gaps in oversight, knowledge transfer, staffing, and procedural compliance have contributed to safety incidents. This paper analyzes four cases: the 2012 outsourcing of oil and gas computer security to India; warnings in 2025 about Russian involvement in critical software development; outsourced drilling operations and driller-cabin design; and fall accidents in 2023 and 2025. Focusing on operator–subcontractor collaboration, the cases reveal recurring systemic patterns, including fragmented responsibility, gaps between espoused safety values and values-in-use, and weaknesses in verification, competence assurance, and stop-work authority. The findings indicate that effective safety management requires more than compliance; it depends on clear accountability, continuous verification of work-as-done (WAD), organizational learning, and psychological safety to prevent major incidents.

Keywords: Outsourcing, Organizational Learning, Human Factors.

1. Introduction and background

The use of subcontractors and outsourcing is a common feature of industrial operations, including the oil and gas industry. According to IOGP (2017), contractors often perform more work hours than operator personnel and experience a substantially higher international Fatal Accident Rate (FAR). Consequently, industry and regulators have emphasized the need for clearer responsibilities and best practices for managing outsourced work.

In Norway, Safetec (2023) noted that outsourcing and remote operations increase complexity and inter-organizational interfaces, affecting major accident risk and occupational health. Four mechanisms were identified: economic pressures that create time and workload constraints; organizational fragmentation that hinders communication and accountability; reduced competence due to turnover and the loss of installation-specific knowledge; and differing values between operators and contractors that lead to mistrust. Underreporting of incidents was also observed in our interviews. Additional

challenges include unclear accountability, weak oversight of the operator's "see-to responsibility (påseplikt)" and limited psychological safety in profit-driven settings. These factors hinder organizational learning and increase the risk of serious incidents. Norwegian outsourcing-related events have highlighted safety and security concerns, motivating this study. Accordingly, we examine published cases to explore: (i) clarity in goals, accountability, and outsourcing specifications; (ii) challenges observed in work-as-done (WAD) and incident reports; and (iii) implications for organizational learning and safe work practices. Drawing on regulatory reports, public investigations, and interviews, we analyze these issues as systemic conditions rather than isolated compliance failures.

1.1 Background from incidents

The Norwegian oil and gas industry aims to lead globally in HSE (health, safety, and environment) and reduce major accident risk. Equinor is a large Norwegian energy company and a major operator on the Norwegian continental shelf. Because of its

scale, its outsourcing practices, and its central role in offshore oil and gas operations, incidents and regulatory follow-up involving Equinor are particularly relevant for examining how outsourcing affects safety management, organizational learning, and accountability in high-risk environments. In 2019, the National Audit Office noted that the Petroleum Safety Authority (now Havtil) had not ensured Equinor learned from past serious incidents and that financial considerations often outweighed safety (Riksrevisjonen, 2019).

Havtil continued follow-up, reporting in 2025 that Equinor had not complied with orders after the 2023 fall incidents (Havtil, 2025) or with 2022 technology-related orders (Havtil, 2025a). In December 2025, Equinor was reported to the police for serious chemical-handling violations at Mongstad. Havtil's assessment of control room alarm management (Havtil, 2022) identified systemic weaknesses, including excessive alarms, poor follow-up, and reduced ability to handle abnormal situations. Many companies lacked documented analyses of cognitive workload. Follow-up assessments of driller cabins (Havtil, 2024; HFC, 2025) showed alarms were not always perceivable or manageable in time, and poor conditions caused high physical and cognitive workload, undermining situational awareness and increasing major accident risk.

Major accidents have occurred despite strong HSE indicators. Investigations of BP Texas City (2005) and Deepwater Horizon (2010) showed that cost and schedule pressures often outweighed safety priorities. The Equinor cases examined in this study illustrate the same pattern. Outsourcing decisions, e.g., from computer security in 2012 to the Vissim software issue in 2025, created oversight gaps, while designs, such as drillers' cabins, ignored end-user needs. Fall accidents in 2023 and 2025 reveal the effects of "safety drift": even when metrics look positive, a culture that prioritizes efficiency over safety undermines maintenance, learning, and accident prevention. These cases underline the importance of organizational learning, psychological safety, accountability, and attention to human factors (HF) in preventing major accidents.

1.2 Organizational learning, psychological safety, and accountability

Organizational learning is the ability to detect and correct errors by changing underlying

assumptions, norms, and practices (Argyris & Schön, 1978). Single-loop learning adjusts actions without questioning governing values, while double-loop learning challenges how work is planned and governed. Persistent safety failures often stem from single-loop learning, addressing symptoms rather than systemic causes. Learning occurs only when insights lead to sustained changes in practice, such as Action Research (Greenwood & Levin, 2006; Steen et al., 2023). In safety-critical industries, this aligns with SMART accident learning, requiring actions that are specific, measurable, achievable, and relevant – they must be assigned and verified in WAD (Sikkerhetsforum, 2019). Without verification, organizations risk 'paper closure'.

Psychological safety—a shared belief that speaking up is safe (Edmondson, 1999)—is essential for learning. Low psychological safety suppresses reporting and normalizes unsafe adaptations. Gaps between espoused and actual safety values (Schein, 2010) often occur when production pressure, cost control, or contractual incentives predominate in decision-making. Under European law, operators retain safety responsibility when outsourcing through the "see-to responsibility." Subcontracting, combined with cost pressure and technological change, can increase complexity and reduce safety margins, as seen in the Boeing 737 disasters (Hopkins, 2025).

Human and Organizational Performance (HOP) has strengthened safety practice by emphasizing WAD, learning from normal operations, and a non-blaming approach (IOGP, 2026). Its application, however, sits within a broader literature that identifies three interrelated challenges in subcontractor safety research. HOP may remain at a single-loop level if "error traps" are identified without addressing underlying design, governance, or accountability structures. First, empirical evidence is constrained by the predominance of cross-sectional and qualitative designs, which limit causal inference, generalizability, and the evaluation of safety training effectiveness. The implications of heterogeneity in safety culture and enforcement across multiple subcontractors remain insufficiently examined (Ajmal et al., 2022; Valluru et al., 2017). HOP includes elements of team-level performance (Shorrock, 2019) but may overlook system-level engineering and organizational determinants unless supported by Human Factors Engineering (HFE) (IOGP, 2026;

IOGP, 2020). Second, despite increasing methodological sophistication, many risk assessment and modeling approaches lack robust field validation or are tested in narrowly defined case studies, reducing confidence in their broader applicability and their ability to capture the dynamic and interactive nature of subcontractor-driven projects (Guan et al., 2018; Davatgar et al., 2021). In addition to HFE, Effective HOP also requires accountability in action plans and strong operator assurance. Third, integration is limited, with frameworks often theoretical or tested outside oil & gas, and barriers—silos, fragmented regulation, and missing standard methods—are rarely addressed (Stefana & Paltrinieri, 2020). Without these enablers, HOP risks being merely descriptive, and learning often fails to sustain workforces, as “death by PowerPoint” and literacy gaps impede subcontractor learning (Valluru, Dekker, & Rae, 2017).

2. Methods and approach

A qualitative approach was chosen because purely quantitative methods may obscure assumptions related to task complexity, accountability, and the gap between work-as-imagined (WAI) and work-as-done (WAD). The study examines cases in which Equinor outsourced work to suppliers and where sufficient documentation was available. The aim was to analyze recurring conditions for organizational learning across phases from design and operations to incident reporting.

The empirical material combines public documents and semi-structured interviews. Document sources include media reports, Equinor and Havtil material, and reports from the Office of the Auditor General (Riksrevisjonen). Interviews were conducted with informed actors from Equinor, supplier organizations, consultancy environments, and academia. The interviews addressed operator–supplier collaboration, accountability, reporting conditions, Human Factors in design and implementation, and how lessons from incidents were translated into practice. Validity was strengthened through triangulation of documents and interviews. Public sources were treated as partial representations, and interview findings are reported as perceptions unless corroborated by documents.

The analysis was informed by industry guidance on contract management (IOGP, 2017), learning from accidents (Sikkerhetsforum, 2019), and best practice in accident investigation (NSIA, 2019). The theoretical framework draws on organizational learning (Argyris & Schön, 1978), psychological safety (Edmondson, 1999), and complementary Safety I–II–III perspectives (Aven, 2022). A systems perspective was applied, emphasizing interactions among technology, environment, organizations, teams, and rules, and treating deviations between WAI and WAD as opportunities for learning rather than grounds for blame (Figure 1).



Fig. 1 Organizational learning, SINTEF (2004)

In outsourcing contexts, the open sharing of weak signals between suppliers and operators is essential for learning and safety development. Figure 2 illustrates how organizational responses vary with accountability and psychological safety. Effective learning requires both accountability and support for speaking up, i.e., the “Learning Zone.” In contrast, low accountability and/or low psychological safety may lead to underreporting, concealed defects, and weakened organizational learning.

	Low Psychological Safety ("speak Up")	High
ACCOUNTABILITY	<p>The Blame Zone: "I never admit to errors, (I blame suppliers/others)".</p> <p>Results: Under-Reporting, Hidden Defects, missing organisational learning</p>	<p>The Learning Zone: "We have high standards of work, we are accountable, and we fix mistakes together without blame".</p> <p>Results: Proactive, High Performance, Resilient</p>
	<p>The Apathy Zone: "I do what I am told to keep my job".</p> <p>Results: Accident waiting to happen, Disengagement</p>	<p>The Complacent Zone: "Do not rock the boat (with accountability)."</p> <p>Results: Poor organisational learning, Poor change management. Real values are not as espoused, safety in limbo.</p>

Fig. 2 Psychological safety and accountability

3. Results from interviews

The interview material is used here as a source of informed perspectives on systemic conditions and perceived practices across operator–supplier interfaces. Unless otherwise stated, the interview findings should therefore be read as reported perceptions, which are discussed in relation to the documentary material rather than treated as independent factual proof. Interviewees consistently described a strong prioritization of technical issues in project definitions and Management of Change (MoC) processes. Human Factors (HF) considerations were rarely integrated at early stages, despite being required in standards. Users and HF competence were seldom involved from the outset. Several respondents noted an assumption that technical readiness was sufficient, leading to reduced attention to HF during design and implementation. In discussions of the regulatory review (Havtil, 2025b), one expert stated: “*What is the fundamental problem at Equinor that prevents them from learning and improving? The issues seem to be very basic and suggest no understanding of any HF.*” Some interviewees noted limited operational use of HFE knowledge in design and implementation decisions. Examples mentioned included poor alarm design and many standing alarms, both of which are basic HFE issues that signal poor understanding of fundamental HF issues.

Regarding psychological safety and reporting, interviewees reported that some Equinor employees were reluctant to raise concerns or openly discuss issues with the regulator (Havtil). In some cases, intermediaries were used to communicate concerns. This reluctance was attributed to perceived risks of negative consequences, such as strained relationships or reduced trust. Maintaining a cooperative, non-confrontational relationship with the regulator was described as a priority, and raising issues was sometimes seen as undermining this collaboration, even though several actors reported generally positive interactions with Havtil.

Interviewees from both operator and supplier organizations further reported that contractual arrangements may discourage open incident reporting. Reporting was perceived to impose negative financial consequences on suppliers, creating incentives to minimize or avoid reporting in the operator’s systems. This was described as a known practice (described by

interviewees as known to both operators and suppliers) and as a systematic practice rather than an isolated occurrence.

Finally, several sources expressed concern that raising safety or security issues with Equinor could have informal social or professional consequences, such as loss of trust or support. Similar concerns were reported in research collaborations, in which individuals who raised critical safety observations faced pressure to modify or retract their statements. Overall, the findings indicate that economic incentives, relational dynamics, and reporting structures may constrain psychological safety and hinder effective escalation of safety-critical information.

4. Results from cases: document analysis

Four cases are analyzed to illustrate recurring issues in subcontractor-driven environments: (1) outsourcing of IT/OT operations to India, (2) security risks in critical software, (3) cumulative human-factors degradation in outsourced drilling operations, and (4) fall accidents related to work at height and contractor assurance. Although technically different, the cases converge on similar organizational failure patterns.

4.1 Case IT/OT outsourcing to India

This case illustrates systemic risks associated with outsourcing safety-critical IT/OT operations. In 2012, Equinor outsourced parts of its IT/OT operations to the Indian company HCL, primarily for economic reasons. The scope included maintenance of technical and process-near networks, and HCL personnel were granted access to firewalls and process control systems. Earlier, Equinor (CISO/R. Røisli and OLF/T. Langeland) had collaborated with security experts and industry representatives to establish IT security guidelines NOROG 104 (Johnsen, Ask & Røisli, 2008). Although these guidelines reflected awareness of security risks, it is unclear whether they were applied during the outsourcing decision.

In 2014, an IT maintenance error by an HCL employee in India led to an unintentional shutdown of production at the Mongstad refinery (NRK, 2014). The incident revealed that external IT personnel had extensive access to safety-critical systems across facilities. Internal reports documented a lack of personnel security clearance, repeated unauthorized access events, insufficient verification of competence, and weak

operator oversight. Given Norway's role as a supplier of natural gas to the European Union, the case demonstrates that failures in outsourced IT/OT systems can have consequences extending beyond company-level risk. The outsourcing decision appears to have lacked a sufficiently clear project definition regarding safety, security, and operator assurance responsibilities in a changing threat environment.

Equinor's 2014 incident investigation found multiple barrier failures, gaps in risk assessment, leadership, governance, and compliance, and poor follow-up of similar past incidents. Repeated unauthorized access showed weak organizational learning. Potential impacts included refinery shutdown, lost safety functions, reputational damage, and production losses of ~15–20 million NOK.

Following the incident, some safety-critical infrastructure tasks were later insourced and returned to Equinor's direct control due to safety concerns (NRK, 2017). Overall, the case demonstrates how outsourcing safety-critical functions, when combined with insufficient operator verification and assurance, can delay organizational learning—a pattern that also reappears in the maritime case discussed below.

4.2 Security in maritime software

Since the late 1990s, Equinor has relied on maritime surveillance software from the Norwegian company Vissim to monitor vessel traffic around approximately 70 offshore oil and gas installations on the Norwegian continental shelf. Parts of the software were developed between 2003 and 2023 by a unit in St. Petersburg, Russia, including periods of heightened geopolitical tension. Experts from the Norwegian Defence University College and independent IT specialists have warned that software developed in such contexts may be vulnerable to compromise, potentially degrading situational awareness for critical national and European energy infrastructure (NRK, 2025).

Equinor has acknowledged the Russian development involvement but rejected the need for source-code review or system replacement, citing network monitoring and the absence of detected breaches, while assigning responsibility for software integrity to the supplier. In light of Equinor's earlier experience with outsourcing safety-critical IT/OT functions to HCL, this raises

questions about organizational learning and the robustness of operator assurance for outsourced security-critical systems. Industry guidance (IOGP, 2017) emphasizes that such functions require clear scope definition, verification, and independent assurance. The reluctance to explicitly acknowledge the plausibility of embedded software vulnerabilities, despite documented international cases of compromised systems, may reflect concerns about accountability, blame, or reputational risk.

Overall, the case suggests gaps in psychological safety, organizational learning, and the operator's "see-to" responsibility, as well as a misalignment between espoused safety values and real outsourcing practices.

4.3 Safety in drilling operations

This case concerns the outsourcing of drilling operations to drilling contractors. Over time, several incremental changes were made to the driller's control cabin. Vendors introduced new systems, adding screens, alarms, and interaction devices. Although each change was locally justified, its cumulative effect fundamentally altered the driller's working environment. Field studies and interviews by Equinor showed that drillers experienced information overload, poor ergonomics, frequent interruptions, and reduced ability to maintain situational awareness during complex, time-critical operations (HFC, 2025).

IOGP guidance and HFE standards emphasize early definition of scope, interfaces, and change governance. However, control-cabin upgrades were largely treated as technical improvements rather than safety-critical changes to human-machine interaction. HF requirements, system integration responsibilities, and limits on cumulative change were weak or implicit, while real priorities favored rapid technology deployment and vendor autonomy. During operations, practical control over design evolution was distributed among contractors and vendors. The absence of a holistic, human-centered design authority resulted in fragmented interfaces, screen clutter, and increased cognitive and physical workload. Drillers adapted through workarounds, but these adaptations seemed largely invisible to management. Usability issues and discomfort were poorly reported and treated systemically. Production pressure and low

psychological safety weakened drillers' feedback to design, operations, and contracting.

The case illustrates a gap between espoused safety values and real priorities in outsourced drilling operations. Improvements include treating all control-cabin modifications as management-of-change issues with explicit HF criteria, assigning a single integrative design authority across vendors, and embedding mechanisms for learning from WAD through systematic observation, non-punitive reporting, and user involvement. Psychological safety remains essential to surface early signals and ensure operational experience informs future design and outsourcing decisions.

4.4 Fall from scaffold 2023, follow-up 2025

On 18 January 2023, a scaffold worker fell approximately 23.5 meters onto a concrete floor at Equinor's Mongstad facility during scaffold frame assembly (Havtil, 2023) and sustained catastrophic injuries. The scaffold worker died in January 2026. The accident was assessed as potentially fatal "under slightly different circumstances." A regulatory follow-up was published in 2025 (Havtil, 2025).

The initial investigation identified both technical and organizational contributors. Technical issues included deficiencies in scaffold design and maintenance, reliance on personal fall protection, and inadequate job-specific planning and scaffold documentation. More critically, the investigation identified organizational weaknesses, including insufficient operator follow-up of contractor systems under the "påseplikt," competence and language risks, and strong productivity pressures linked to unit-rate contracting. The report noted that Equinor had reduced close-field follow-up of scaffolding work by eliminating a technical authority role with a stop-work mandate. Safety responsibility was transferred to contractors without stronger verification. Although Equinor formally acknowledged its duty, investigations showed assurance was ineffective in practice. The Equinor investigation described several relevant weaknesses, but the analysis of underlying organizational mechanisms remained vague.

Two years later, Havtil's follow-up confirmed that while Equinor had implemented some risk assessment improvements, a central deviation persisted: Equinor still did not sufficiently ensure that its own and contractors'

management systems for scaffolding and work at height functioned as intended. This persistence indicates delayed organizational learning and a gap between formal system improvements ("paper compliance") and reliable field-level assurance (WAD verification). Weaknesses persisted in contractor governance, competence verification, equipment integrity, and adherence to scaffold design, assembly, and maintenance norms.

Safetec (2023) provides an explanatory framework for why such weaknesses persist: outsourcing, cost pressure, language barriers, and reduced installation-specific competence gradually drift WAD toward unsafe practices. Operators must enforce "påseplikt" through verification, monitoring, learning, and support for psychological safety and reporting.

4.5 Fall from scaffold 2025

On 24 April 2025, a serious fall accident occurred at Equinor's Melkøya construction site. A worker fell 4.4 meters onto concrete, sustaining severe leg injuries. According to Equinor's internal investigation, the accident could have been fatal (Equinor, 2025).

The work was characterized by inadequate protection, insufficient fall-arrest systems, time pressure, and poor supervision. The investigation noted that the work team experienced little practical room to stop unsafe work, despite having raised concerns. This reflects low psychological safety, where workers perceived that stopping work or raising concerns entailed interpersonal or organizational risk.

Equinor's investigation demonstrates several strengths aligned with good practices outlined by the Safety Forum (2019) and the Norwegian Safety Investigation Authority (NSIA, 2021). The report avoids scapegoating, frames worker actions as locally rational responses to system conditions and adopts a broad systems perspective. These elements align with the "new view" of safety (Safety II-III) and NSIA's emphasis on learning rather than blame.

However, important gaps remain. Scaffold design or part mixing was not discussed. Human and organizational factors are described narratively but not analyzed using a structured HF framework, as recommended by the Safety Forum and NSIA. Distributed situation awareness failures—such as stop-work decisions not reaching the field and overloaded supervision—

are identified but not analyzed as information-flow breakdowns. Although multiple systemic weaknesses are identified (contractor assurance, competence verification, and permit-to-work quality), they are not clearly framed as Equinor-owned systemic safety problems or systematically compared with IOGP guidance (IOGP, 2017). Corrective actions are deferred rather than SMART and lack clear accountability and evaluation criteria. Closing the gap between espoused safety values and operational priorities is critical if investigations are to serve as instruments for redesign and sustained safety improvement rather than as retrospective explanations. Consequently, the investigation largely supports single-loop learning, with limited evidence of double-loop learning.

Across the fall-accident cases, a consistent pattern emerges: outsourcing increases interfaces and variability; assurance degrades when verification becomes documentation-driven rather than field-based; and weak psychological safety suppresses escalation of early warning signals. The resulting failure modes—insufficient job-specific planning, degraded stop-work effectiveness, incomplete competence verification, and drift in WAD under production pressure persist despite formal management systems.

5. Final remarks and conclusion

The cases indicate a misalignment between espoused safety ambitions and the values-in-use that govern how safety, production, and cost trade-offs are managed in practice across operator–contractor interfaces.

Across four Equinor cases, a consistent pattern emerges: outsourcing increases interfaces and variability; assurance mechanisms become document-driven rather than operational; and weak psychological safety suppresses escalation of early warning signals. The result is repeated failure modes despite the presence of mature management systems. The findings indicate that the primary challenge is not a lack of knowledge or investigative capability, but rather prioritizing HF knowledge, translating learning into durable organizational change, and sustaining accountability without blame, even when mistakes are revealed in hindsight. Corrective actions often remain within single-loop learning, emphasizing procedures and training while

leaving underlying governance assumptions and design unchallenged. Gaps between espoused safety values and real values-in-use persist when production pressure, cost control, and contractual incentives dominate.

Avoiding repetition requires strengthening the operator’s “see-to responsibility” through explicit scope definition, design, verification of outsourced WAD, and structured HF analysis in investigations. Psychological safety must be actively cultivated across operator–contractor boundaries so that stopping work and reporting weak signals are supported in practice. Without these changes, similar incidents are likely to reappear, despite continued investment in systems, procedures, and investigations.

5.1 Practical recommendations

Based on the cross-case analysis, we propose:

Strengthen contract lifecycle assurance: Apply IOGP-aligned verification, validation, and monitoring from contract initiation through execution, including systematic field verification of barrier performance in WAD.

Govern interface risk explicitly: Treat operator–contractor boundaries as safety-critical interfaces requiring explicit design, active monitoring, and periodic stress testing.

Integrate Human Factors expertise: Include HF/HFE competence in accident investigations to support structured analysis of situation awareness, performance-shaping factors, and interface communication failures, and ensure findings are fed back into design and governance practices.

Apply SMART corrective actions with verification: require corrective actions to have clear owners, deadlines, and be specific, measurable, achievable, relevant, and verifiable in WAD, rather than closed administratively.

Enhance psychological safety across boundaries: Assess psychological safety within and between organizations; protect speaking-up and stop-work authority; and reinforce leadership behaviors and joint operator–contractor learning focused on improvement (especially in contracts) rather than blame.

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