

# What Engineers Actually Say: A Qualitative Analysis of Workplace Pressure in a Global Engineering Survey

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## Abstract

Quantitative survey instruments constrain responses to researcher-defined categories, risking omission of emergent pressures and the relational texture through which they are experienced. This paper reports a qualitative analysis of open-text responses from a global engineering workplace survey (N = 335), providing a ground-level account of how engineering professionals describe workplace pressure in their own words. Of 335 respondents, 187 provided substantive responses (55.8%), yielding 180 codeable entries after exclusion of seven uninformative responses. A five-theme, 23-code framework was developed through an abductive process: initial open coding was conducted inductively and subsequently refined through comparison with established literature on engineering workplace pressure. Code frequency and co-occurrence patterns were analysed, and inter-rater reliability was assessed using Cohen's kappa on a randomly selected subsample (n = 35,  $\kappa = 0.836$ ), indicating good agreement.

Schedule compression (S1, 18.9%) was the most frequently coded pressure, followed by positive or protective experiences (PPF, 13.9%), resource shortage (S4, 13.3%), workload excess (C4, 13.3%), and health and well-being impact (C5, 10.6%). Five thematic clusters emerged: Structural and Systemic Pressures, Professional Identity and Recognition, Interpersonal and Cultural Pressures, Consequences and Outcomes, and Positive and Protective Factors. The qualitative responses extend and contextualise quantitative findings, revealing informal pressure mechanisms, unrecorded labour, and the coexistence of high engagement with structural difficulty that structured survey items alone do not capture. The findings identify informal pressure mechanisms—unrecorded hours, unofficial instruction channels, and hierarchy override—that fall outside standard survey instruments and represent governance gaps with implications for engineering workforce management and safety culture. This study provides one of the few large-scale qualitative analyses of open-text workplace pressure descriptions in engineering and offers a structured analytical framework for future mixed-methods investigations.

**Keywords:** *workplace pressure; engineering workforce; qualitative coding; open-text analysis; mixed methods; schedule compression; safety culture; engineering governance*

## 1. Introduction

While quantitative studies have increasingly documented the prevalence of workplace pressure across engineering roles, less attention has been given to how engineers themselves describe and interpret these conditions in practice. Understanding this practitioner language is important because organisational pressures are often transmitted informally and may not align neatly with predefined survey constructs (Agar, 1996).

This paper reports the qualitative analysis of open-text responses collected as the final item of a global engineering workplace survey conducted in January–February 2026 (Ayres et al., 2026a). The survey was administered to engineering professionals across 22 countries across six continents (N = 335); 187 of 335 respondents (55.8%) provided substantive open-text responses.

## 2. Background and Rationale

### 2.1 The limits of closed-item survey instruments

Survey instruments measuring workplace pressure in engineering typically employ Likert-scale or frequency-based items anchored to researcher-defined constructs. However, closed-item instruments constrain responses to pre-specified categories, risking the omission of emergent pressures, underrepresenting those that are difficult to formalise, and failing to capture the relational or contextual texture through which pressure is experienced. Research on normalisation of deviance in high-pressure environments has consistently found that the most consequential conditions are precisely those that resist formal articulation (Vaughan, 2016).

Mixed-method approaches that embed open-text items within structured surveys address this limitation without sacrificing the comparative advantages of quantitative data (Bryman, 2006). Open-text responses also occupy the evidential space of invisible work and shadow systems, where informal practices shape outcomes but remain unrecorded in formal organisational processes (Star and Strauss, 1999). These patterns are consistent with organisational silence dynamics, where hierarchical structures inhibit upward voice and constrain the reporting of emerging risks (Detert and Edmondson, 2011).

### 2.2 Qualitative methods in engineering workplace research

Qualitative and mixed method approaches to engineering workplace conditions remain less common than quantitative surveys, yet they have produced foundational insights into the social and relational dimensions of engineering work. Research on voice behaviour, credibility negotiation, tacit knowledge, and informal learning in engineering contexts has extensively drawn on interviews, observation, and discourse-analytic methods (Collins, 2013; Trevelyan, 2014).

The engineering safety literature has similarly identified the importance of practitioner narrative as a source of evidence for conditions that incident reporting systems do not capture (Hollnagel, 2018). Near-miss reporting, safety voice research, and investigations into

normalisation of deviance have all highlighted the gap between formally recorded and experientially understood risk (Hollnagel, 2018; Reason, 2016).

### 3. Method

#### 3.1 Survey design and sample

A global cross-sectional survey of engineering professionals was conducted in January–February 2026 (Ayres et al., 2026b). A total of 336 survey initiations were recorded. After exclusion of one respondent at the screening stage, the analytical sample comprised 335 respondents.

The survey comprised universal modules covering demographics, structural pressure, psychological outcomes, peer pressure dynamics, and organisational culture, supplemented by role-specific modules administered via skip-logic branching. The final universal item asked: 'Please describe any experiences of workplace pressure you feel are important for this study.'

Of 335 respondents, 187 (55.8%) provided responses to the open-text item. Seven responses were excluded as uninformative (single words, “N/A” variants, or text with no codeable content), yielding a codeable sample of  $n = 180$  responses for analysis. The median response length was 14 words (range 4–229, mean = 18.6, SD = 20.4), indicating that while most responses were concise, a substantial minority provided extended accounts.

#### 3.2 Coding framework development

A five-theme, 23-code framework was developed through an iterative inductive process (Dey, 1999). Initial open coding was conducted on all 180 responses, with codes assigned to segments representing distinct pressure types, experiences, or protective conditions. The resulting framework comprises five higher-order themes — Structural and Systemic Pressures, Professional Identity and Recognition, Interpersonal and Cultural Pressures, Consequences and Outcomes, and Positive and Protective Factors — and 23 constituent codes. Table 1 presents the full framework with code definitions and example responses.

Codes were applied at the response level rather than the segment level, as responses were typically short and analytically coherent units (Elo and Kyngäs, 2008); each response could receive multiple codes where the text contained evidence of more than one pressure type. Responses ranged from 1 to 5 codes ( $M = 1.47$ ). Most responses (62%) received a single code, 33% received two codes, and 5% received three or more.

#### 3.3 Inter-rater reliability

To assess coding reliability, two independent coders applied the thematic coding framework to 35 long-form survey responses across 22 coding categories (all pressure-related codes; the PPF category was excluded because it represents a positive condition rather than a pressure mechanism), yielding 770 individual coding decisions per coder. The first coder identified 53 coded instances, and the second identified 59, with disagreement on 5 instances from Coder 1

and 6 additional instances identified only by Coder 2. Cohen's Kappa was calculated using the full contingency matrix ( $\kappa = 0.836$ ), indicating good inter-rater agreement (Landis and Koch, 1977). Final coding decisions on disputed instances were made by the lead researcher through adjudication, in accordance with standard qualitative reliability practices.

### 3.4 Analysis approach

Frequency counts were calculated for each code across all 180 responses. Percentages are reported relative to the codeable sample ( $n = 180$ ) rather than the full survey sample ( $N = 335$ ), as the open-text item was voluntary and response rates varied. Open-text responses are presented largely verbatim as submitted. Minor edits were made where necessary to remove identifying information, including phrases or wording that could reveal individual or organisational identity. Code co-occurrence was examined to identify which pressure types were frequently reported together. Co-occurrence patterns were analysed descriptively to identify structural clusters rather than to infer causal relationships (Auerbach and Silverstein, 2003).

**Table 1. Qualitative coding framework: five-theme, 23-code structure with definitions and example responses.**

Higher-Order Theme	Name	Code	Definition	Example Response(s)
1. Structural systemic pressure	SCHEDULE_COMPRESSION	S1	Time allocated to commissioning/work is reduced while deadlines remain fixed. Includes concertina effect.	"Commissioning start date moves but completion date never does"; "Often milestones do not change so commissioning gets less time"
1. Structural systemic pressure	DOCUMENTATION_DEFICIT	S2	Missing, incomplete, or outdated documentation (P&IDs, redlines, vendor docs, test packs) that impedes work.	"Poor documentation is the biggest issue"; "Not having vendor or up to date construction drawings makes the job almost impossible"
1. Structural systemic pressure	DESIGN_CONSEQUENCE	S3	Design errors, omissions, or decisions that only become visible during commissioning/construction/operations.	"Incomplete design all the way through projects come to light in commissioning when the project won't work as expected"
1. Structural systemic pressure	RESOURCE_SHORTAGE	S4	Insufficient staff, budget, equipment, or materials to deliver the work expected.	"Not enough people to keep the place running"; "Having to commission with half of the documentation missing vendor equipment not working and no budgets"
1. Structural systemic pressure	SCOPE_AMBIGUITY	S5	Unclear, shifting, or informally changed scope of work. Includes scope creep and informal additions.	"Operations are often not told of downgrades to projects and commissioning get blamed for not supplying the original scope"
1. Structural systemic pressure	CLIENT_DRIVEN_PRESSURE	S6	Pressure originating from clients, asset owners, or regulators that flows down through the project.	"The client culture drives the way the work is done more than the organisation doing the work. Bad clients get bad work"
1. Structural systemic pressure	PREMATURE_HANDOVER	S7	Systems, equipment, or projects handed over before completion, readiness, or proper validation.	"There is disparity between project handover and project completion, projects are often handed over before they are complete"
2. Professional Identity & Recognition	PROFESSIONAL_INVISIBILITY	P1	Work, role, or contribution is unseen, unacknowledged, or misunderstood by wider organisation. Combines recognition deficit with devaluation of the role itself.	"Commissioning is never thanked for what we do, just blamed for delays as we are visible at the end"; "Commissioning tends to be invisible to everyone unless it goes wrong"
2. Professional Identity & Recognition	MANAGEMENT_DISCONNECT	P2	Senior or non-technical management lack understanding of what the role involves, leading to unrealistic expectations or poor decisions.	"Senior managers don't even recognise commissioning and don't know what we do"; "Management have no clue what we do and expect us to deliver constantly"

2. Professional Identity & Recognition	BLAME_ABSORPTION	P3	Being held accountable for problems caused upstream (design, construction, procurement) because the role is the visible endpoint.	"We always end up with the problems construction don't want to fix"; "Just blamed for delays as we are visible at the end"
2. Professional Identity & Recognition	ROLE_BOUNDARY_TENSION	P4	Ambiguity about role boundaries, authority, or where responsibility sits. Includes being expected to work beyond formal role.	"We are seen as an extension of ops and never recognised for the work we do"; "There are too many supervisors and middle managers we never know who has more dominance"
2. Professional Identity & Recognition	COMPETENCE_DOUBT	P5	Self-doubt, uncertainty about decisions, or feeling inadequately trained for what is expected.	"As a new engineer I sometimes feel uncertain about whether my decisions are correct"; "I am new to the industry and never sure when to question things"
3. Interpersonal & Cultural Pressures	BULLYING_HARASSMENT	I1	Direct intimidation, verbal aggression, demeaning behaviour, or harassment in the workplace. Includes gendered forms.	"I have experienced bullying and intimidation and harassment from management"; "Males use indirect verbal demeaning to often tune down or control women"
3. Interpersonal & Cultural Pressures	COMMUNICATION_FAILURE	I2	Poor, blocked, or dishonest communication between teams, disciplines, or levels of hierarchy.	"Poor communication between teams causes most of the problems"; "Getting honest information from site is difficult and they often try to hide delays"
3. Interpersonal & Cultural Pressures	HIERARCHY_OVERRIDE	I3	Decisions or pressure imposed through positional authority regardless of technical merit. Includes being overruled, shouted at, or micromanaged.	"Often shouted when meeting room superiors it makes me scared making mistake at site"; "Micromanaging is killing morale and employee productivity"
3. Interpersonal & Cultural Pressures	INFORMAL_PRESSURE	I4	Pressure applied through unofficial channels — phone calls, unminuted meetings, site visits — avoiding formal record.	"A lot of the pressure is unofficial, phone calls, site visits and not minuted meetings"
3. Interpersonal & Cultural Pressures	UNRECORDED_HOURS	I5	Expectation to work hours beyond what is recorded or compensated.	"We get pressured to work longer hours than is recorded"; "Staff shortages mean overtime is not as voluntary as people think"
Consequences & Outcomes	QUALITY_COMPROMISED	C1	Work quality reduced, shortcuts taken, or standards lowered as a direct result of pressure.	"Deadlines mean we have to work around issues to get the systems online in time"
Consequences & Outcomes	SAFETY_COMPROMISED	C2	Safety processes bypassed, shortened, or undermined due to schedule, cost, or peer pressure.	"Lack of documentation, red lines etc it's a major issue and often has safety implications"; "Project Engineer asked me to ignore a client's requirement on a remote site"

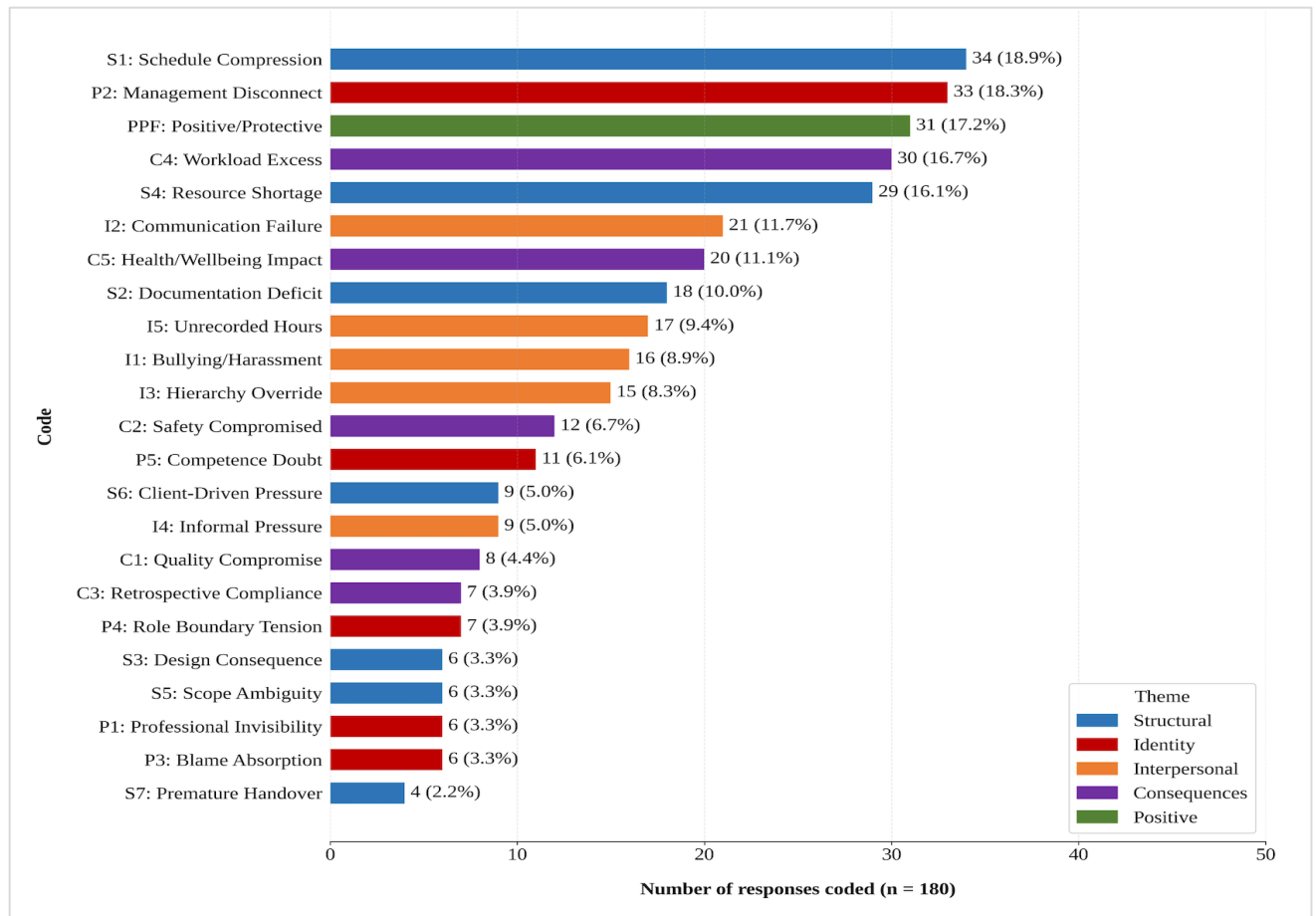
Consequences & Outcomes	RETROSPECTIVE_COMPLIANCE	C3	Paperwork, checks, or verification completed after the fact to align documentation with what actually happened.	Captured in quantitative data: 65.8% of commissioning engineers report this often/very often
Consequences & Outcomes	WORKLOAD_EXCESS	C4	Unsustainable hours, volume of work, or intensity during critical periods.	"You cannot turn on a chemical system for the first time and walk away so some days are very long"
Consequences & Outcomes	HEALTH_WELLBEING_IMPACT	C5	Physical or mental health consequences of workplace pressure. Includes stress, anxiety, fear, low morale.	"Often this made me ill and hating going to work"; "Bullying is a big part of my job but I need the money"
5. Positive/Protective factors	POSITIVE_EXPERIENCE	PPF	Supportive management, good team culture, wellbeing initiatives, or satisfying work.	"My workplace is supportive of its members and has extensive mental health & well-being initiatives"; "My employees is very supportive although we work long days"

## 4. Results

### 4.1 Response rates and code frequency

Of the 335 survey respondents, 187 (55.8%) provided open-text responses. The 180 codeable responses generated 264 coding instances across 23 codes and five themes, with a mean of 1.47 codes per response. Schedule compression (S1) co-occurred with workload excess (C4) in 17.6% of S1-coded responses and with resource shortage (S4) in 14.7% of S1-coded responses, indicating that structural pressures cluster rather than occur in isolation.

Figure 1 presents the frequency distribution across all 23 codes. Schedule compression (S1) was the most frequently coded pressure overall, appearing in 34 responses (18.9%). Positive or protective experiences (PPF;  $n = 25$ , 13.9%) were the second-most-frequent code. Resource shortage (S4,  $n = 24$ , 13.3%) and workload excess (C4,  $n = 24$ , 13.3%) followed, with health and well-being impact (C5,  $n = 19$ , 10.6%). The prominence of PPF indicates that a meaningful proportion of respondents used the open-text space to describe supportive rather than adverse conditions.



**Figure 1. Code frequency distribution across 180 codeable responses (264 total coding instances).**

## 4.2 Theme 1: Structural and systemic pressures

Structural and systemic pressures were the most frequently represented theme across the codeable sample, with schedule compression (S1, n = 34, 18.9%) the dominant code. Respondents described compression not as an exceptional event but as an embedded feature of how projects are governed:

*"Commissioning start date moves but completion date never does and it gets hard to meet the dates."* [Man, 45-54, Commissioning]

Resource shortage (S4, n = 24, 13.3%) was the second most frequent structural code, with responses ranging from staff shortages to supply chain failures, equipment unavailability, and budget constraints. Several respondents noted that resource constraints operated in combination with schedule compression, producing compound pressure:

*"Having to commission with half of the documentation missing, vendor equipment not working and no budgets."* [Man, 35-44, Commissioning]

Documentation deficit (S2, n = 14, 7.8%) and client-driven pressure (S6, n = 12, 6.7%) were also present.

*"The client culture drives the way the work is done more than the organisation doing the work. Bad clients get bad work."* [Man, 35-44, Design Engineering]

S3 responses highlight latent design issues that manifest only during commissioning, while C3 responses align with quantitative evidence of after-the-fact documentation practices.

## 4.3 Theme 2: Professional identity and recognition

Professional identity pressures were distributed across five codes, with management disconnect (P2, n = 10, 5.6%) and competence doubt (P5, n = 11, 6.1%) the most frequent within the theme. Professional invisibility (P1, n = 6, 3.3%) appeared at a lower rate. Competence doubt responses were concentrated among early-career respondents, reflecting uncertainty about technical judgements in novel or high-pressure situations:

*"I like my work and I am motivated, but as a new engineer I sometimes feel uncertain about whether my decisions are correct."* [Man. 25-34, Commercial]

*"I am new to the industry and never sure when to question things so I tend not to."* [Woman, 18-24, Design Engineering]

Management disconnect responses described a specific structural condition in which senior managers lacked understanding of the technical role and its demands, generating unrealistic expectations and misallocated accountability:

*"My immediate management is supportive, but senior managers don't even recognise commissioning and don't know what we do."* [Man, 25-34, Commissioning]

Blame absorption (P3, n = 5, 2.8%) — though less frequent — was substantively significant. Blame absorption responses described a pattern in which commissioning and end-of-project roles absorbed accountability for failures originating upstream:

*"We always end up with the problems construction don't want to fix."* [Man, 35-44, Commissioning]

*"Commissioning is never thanked for what we do, just blamed for delays as we are visible at the end."* [Woman, 25-34, Commissioning]

#### 4.4 Theme 3: Interpersonal and cultural pressures

Interpersonal and cultural pressures were distributed across five codes. Hierarchy override (I3, n = 16, 8.9%) and communication failure (I2, n = 10, 5.6%) were the most frequent interpersonal codes. Communication failure responses described breakdowns across teams, disciplines, and hierarchical levels that generated pressure due to misalignment and information withholding. Bullying and harassment (I1, n = 9, 5.0%), informal pressure (I4, n = 2, 1.1%), and unrecorded hours (I5, n = 1, 0.6%) appeared at lower rates. Unrecorded hours responses described expectations to work beyond contracted time that were not formally recorded or compensated:

*"Staff shortages mean overtime is not as voluntary as people think."* [Man, 55-64, Manufacturing]

Informal pressure (I4) described the use of unofficial channels — phone calls, unminuted site meetings, verbal instructions — to convey expectations that would not withstand formal documentation:

*"A lot of the pressure is unofficial, phone calls, site visits and not minuted meetings."* [Woman, 35-44, Operations]

Hierarchy override (I3, n = 16, 8.9%) described decisions or instructions imposed through positional authority regardless of technical merit, including micromanagement, shouting, and overruling without engagement:

*"Often shouted when meeting room superiors it makes me scared making mistake at site."* [Woman, 35-44, Commissioning]

*"Micromanaging is killing morale and employee productivity and retention. All corporations do is double down on micromanaging instead of altering strategies."* [Man, 55-64, Operations]

Bullying and harassment (I1, n = 9, 5.0%) responses described direct intimidation and demeaning behaviour, with several respondents identifying gendered forms of interpersonal pressure:

*"I have experienced bullying and intimidation and harassment from management."* [Man, 55-64, Leadership]

*"Being a female, males use indirect verbal demeaning to often tune down or control women in decision making or important positions. Indirect verbal"*

*harrasements are impacting efficient operations and professionalism ."*  
[Woman, 45-54 QA/QC]

#### 4.5 Theme 4: Consequences and outcomes

The consequences theme captured the downstream effects of sustained pressure rather than the pressures themselves. Workload excess (C4, n = 24, 13.3%) was the most frequent code in this theme, with responses describing unsustainable hours and work intensity as outcomes of structural and client-driven pressure:

*"Constant pressure for overtime, people sacked for simple mistakes."* [Man, 18-24, Construction]

Health and well-being impact (C5, n = 19, 10.6%) was among the most frequent codes overall. Responses described physical illness, anxiety, fear, and low morale as consequences of sustained workplace pressure, with several responses explicitly connecting physical health impacts to specific workplace conditions:

*"My time was driven by pressure and unrealistic deadlines....Often this made me ill and hating going to work."*[Man, 55-64, Technical Specialist]

*"Bullying is a big part of my job but I need the money."* [Man, 25-34, Maintenance]

Safety compromised (C2, n = 10, 5.6%) responses described safety processes being bypassed, shortened, or undermined due to schedule, cost, or peer pressure, and provided independent qualitative validation of the commissioning-specific quantitative findings reported in the survey series:

*"Lack of documentation, red lines etc — it's a major issue and often has safety implications."* [Man, 35-44, Commissioning]

#### 4.6 Theme 5: Positive and protective factors

Positive and protective experiences (PPF, n = 25, 13.9%) appeared in more than 1 in 7 responses, indicating that supportive management and good team culture are salient enough to warrant spontaneous mention alongside or in contrast to structural pressure:

*"My workplace is supportive of its members and has extensive mental health and well-being initiatives."* [Man, 35-44, Project Management]

Several PPF responses described the coexistence of structural pressure and organisational support, consistent with the satisfaction paradox identified in the quantitative data: high structural pressure does not preclude high job satisfaction where leadership and team culture are experienced as supportive.

#### 4.7 What the qualitative data adds to the quantitative findings

Three substantive contributions of the qualitative data to the quantitative picture warrant specific discussion.

First, informal and unrecorded pressure mechanisms. The quantitative survey included items on working hours, role expansion, and unrealistic expectations, but did not include items

specifically capturing informal instruction channels or unrecorded labour. The I4 and I5 codes — appearing in 1.1% and 0.6% of responses, respectively — identify these as pressure mechanisms that structured instruments missed. The deliberate avoidance of formal documentation described in I4 responses represents a governance concern that frequency scales cannot easily measure.

Second, the interpersonal texture of structural pressure. Quantitative items on schedule compression and the prevalence of resource shortage register, but not the mechanism. Open-text responses reveal how structural pressures are transmitted through interpersonal channels — through informal instructions, hierarchical override, and client relationships — providing explanatory context for the statistical patterns observed across the survey series.

Third, the spontaneous salience of positive experience. The quantitative survey included four items on organisational culture, but PPF responses were not prompted by any item. The frequency with which respondents volunteered supportive experiences (13.9% of codeable responses) suggests that protective conditions are experientially salient and may function as meaningful moderators of structural pressure, consistent with job demands-resources theory (Bakker and Demerouti, 2017).

## 5. Demographic Cross-Tabulations

The voluntary nature of the open-text item means that demographic cross-tabulations must be interpreted as patterns within the 180 respondents who provided codeable responses, not as representative of the full sample. Chi-square and Fisher's exact tests (when expected cell counts were < 5) were used to identify statistically significant differences in code frequency by gender, age group, and role. Given small cell sizes for many code-group combinations, results are reported with appropriate caution and descriptive patterns are presented alongside inferential statistics. These analyses are exploratory and should be interpreted as descriptive pattern detection rather than hypothesis testing.

### 5.1 Gender differences in qualitative pressure descriptions

Of the 180 codeable respondents, 120 identified as men (66.7%) and 59 as women (32.8%), with one respondent preferring not to say. No statistically significant gender differences were found for any code. Several directional patterns were consistent with broader quantitative findings across the survey series. Men described resource shortage (S4) at a higher rate than women (16.7% vs 7.0%), and reported higher workload excess (C4) at 15.8% compared with 8.5% among women. Women described professional invisibility (P1) at 1.7% compared with 3.3% of men, hierarchy override (I3) at 11.9% compared with 7.5%, and communication failure (I2) at 8.5% compared with 4.2%. These patterns are directional only and should be interpreted with caution given small cell sizes.

**Table 2. Gender differences in code frequency among qualitative respondents**

Code	Description	Men % (n=120)	Women % (n=59)	Test	p
S4	Resource Shortage	16.7%	5.1%	Fisher's exact	.101
P1	Professional Invisibility	1.7%	6.8%	Fisher's exact	.106
I3	Hierarchy Override	7.5%	11.9%	Fisher's exact	.380
I2	Communication Failure	4.2%	8.5%	Fisher's exact	.239
C4	Workload Excess	15.8%	8.5%	Fisher's exact	.183

(*n* = 180). \* *p* < .05.

The directional pattern in men's higher descriptions of resource shortage is contextually plausible: men in this sample were disproportionately represented in commissioning, construction, and operations roles — site-intensive environments where equipment availability, staff levels, and supply chain reliability are operationally proximate concerns. The descriptive elevation in women's descriptions of professional invisibility and hierarchy override is consistent with gendered dynamics documented across the survey series and with existing literature on women's experiences in male-typed technical environments (Riley et al., 2022), though neither pattern reached statistical significance.

### 5.2 Age differences in qualitative pressure descriptions

Respondents were grouped into three career-stage categories: early career (18–34, *n* = 75), mid-career (35–54, *n* = 77), and senior (55+, *n* = 28). One statistically significant age group difference emerged. Documentation deficit (S2) varied significantly across career stages: early-career engineers reported S2 at 2.7%, compared with 14.3% among mid-career and 3.6% among senior respondents ( $\chi^2 = 7.88$ , *p* = .019). No other codes showed statistically significant age group differences. Directional patterns included higher health and wellbeing impact (C5) among early-career (13.3%) and senior (17.9%) respondents compared with mid-career (5.2%), though this did not reach significance (*p* = .103).

**Table 3. Age group differences in code frequency among qualitative respondents.**

Code	Description	Early % (n=75)	Mid % (n=77)	Senior % (n=28)	$\chi^2$	p
P5	Competence Doubt	0.0%	13.0%	3.6%	4.95	.083
C5	Health/Wellbeing Impact	13.0%	5.2%	17.9%	3.12	.103
S1	Schedule Compression	18.7%	19.5%	14.3%	0.59	.743
I3	Hierarchy Override	13.3%	5.2%	7.1%	1.82	.403
C4	Workload Excess	12.0%	13.3%	17.9%	0.46	.793

*Note: small expected cell counts in several comparisons; results should be interpreted with caution.*

The inverse relationship between career stage and positive experience descriptions is striking, though not statistically significant. Early career engineers are simultaneously the most exposed to health and well-being impacts in the quantitative data (consistent with the B4 findings across the survey series) and the most likely to notice and articulate supportive conditions when they exist. This pattern suggests that protective factors are salient precisely

because they are experienced against a backdrop of pressure — and that their salience diminishes as senior engineers normalise both the pressure and the absence of support over time.

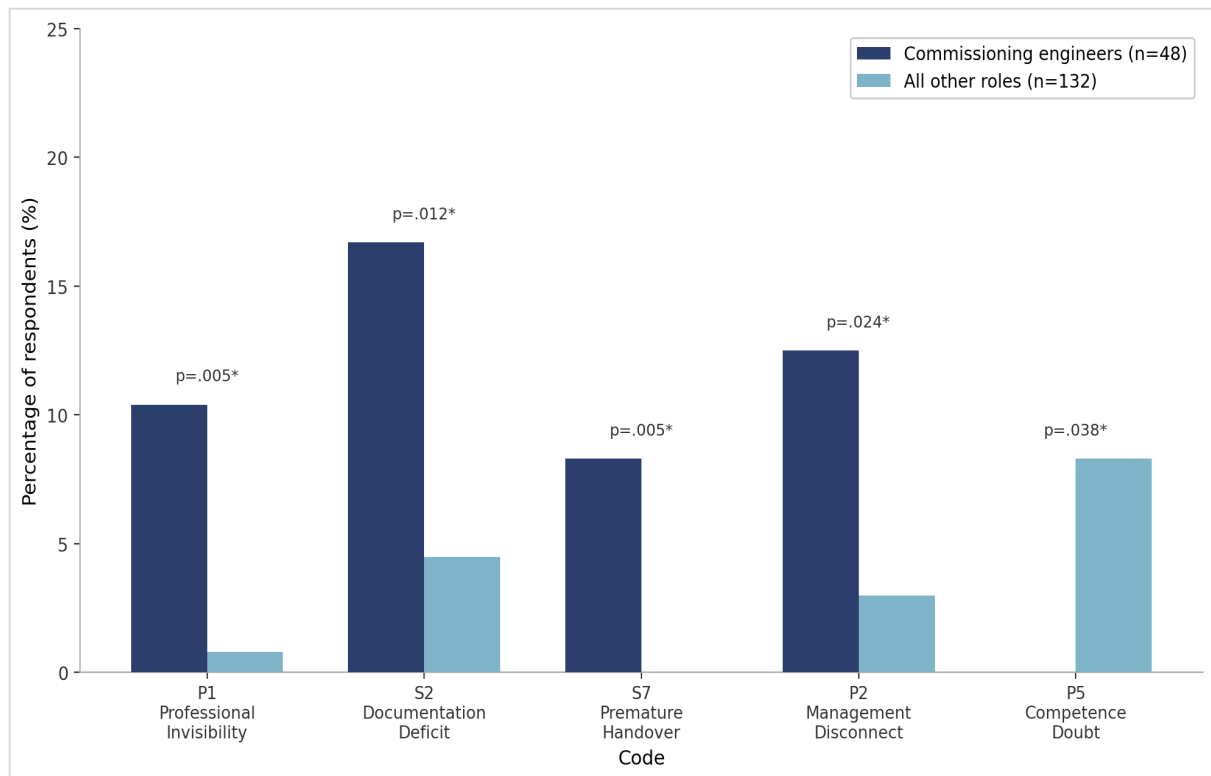
### 5.3 Role differences in qualitative pressure descriptions

Commissioning engineers (n = 48) were compared with all other respondents (n = 132). Statistically significant differences emerged for five codes. Professional invisibility (P1) was reported by 10.4% of commissioning engineers compared with 0.8% of other roles (Fisher’s exact, p = .005) — the largest proportional difference of any code. Documentation deficit (S2) was reported at 16.7% among CX, compared with 4.5% among others (Fisher’s exact test, p = .012). Premature handover (S7) appeared in 8.3% of CX responses and 0.0% of others (Fisher’s exact, p = .005). Management disconnect (P2) was reported at 12.5% among CX, compared with 3.0% among others (Fisher’s exact test, p = .024). Conversely, competence doubt (P5) was absent among CX respondents compared with 8.3% among others (Fisher’s exact, p = .038).

**Table 4. Role differences: commissioning engineers vs all other roles.**

Code	Description	CX % (n=48)	Others % (n=132)	Test	p
S2	Documentation Deficit	16.7%	4.5%	Fisher's exact	.012 *
P1	Professional Invisibility	10.4%	0.8%	Fisher's exact	.005 *
S1	Premature Handover	8.3%	0.0%	Fisher's exact	.005 *
P2	Management Disconnect	12.5%	3.0%	Fisher's exact	.024 *
P5	Competence Doubt	0.0%	8.3%	Fisher's exact	.038 *
I3	Hierarchy Override	18.9%	19.7%	Fisher's exact	.207

\*  $p < .05$ .



**Figure 2. Key code differences: commissioning engineers vs all other roles (\*  $p < .05$ , Fisher’s exact test).**

The documentation deficit finding for commissioning engineers provides independent qualitative corroboration of the quantitative finding that 98.8% of commissioning engineers reported proceeding with incomplete documentation at least sometimes (Ayres et al., 2026b). The premature handover finding (S7: 8.3% vs 0.0%) is notable: no non-commissioning respondent used this frame, suggesting that the experience of systems being handed over before they are ready is specific to those responsible for commissioning delivery. The absence of competence doubt (P5) among commissioning engineers — compared with 8.3% among other roles — aligns with professional identity research suggesting that experienced practitioners in high-stakes roles develop confident role schemas that absorb structural difficulty without triggering self-doubt (Trevelyan, 2014). This pattern is consistent with the satisfaction paradox identified quantitatively: commissioning engineers may frame structural failure as external and systemic rather than as a reflection of personal inadequacy.

Among non-commissioning roles, graduate and early career engineers (n = 6; note small sample) reported health and wellbeing impacts at 33.3% — the highest rate of any role group — consistent with the early career vulnerability pattern documented across the survey series. Graduate responses were also distinctive in their relational framing: early-career engineers described feeling unseen, being left alone, and navigating organisational environments without guidance, rather than the structural and systemic pressures that dominated among more experienced respondents (Blickenstaff, 2005).

#### 5.4 Jurisdictional and cultural variation in qualitative responses

Although the survey was global in scope, qualitative responses revealed localised pressures that structured survey items could not capture. A small number of responses referenced jurisdiction-specific industrial relations mechanisms — including union right-of-entry provisions and site escort obligations under Australian industrial law — that represent genuine operational pressure in certain national contexts but would be invisible to a globally standardised instrument. Similarly, references to casual and day-hire employment arrangements reflected labour market structures specific to particular jurisdictions, where employment insecurity intersects with the pressure patterns documented elsewhere in this dataset.

Two responses used grammatical constructions consistent with non-native English expression — already cited in Section 6.2 — and are analytically notable precisely because their directness may reflect cultural norms around schedule misrepresentation and patronage that Anglophone respondents are less likely to articulate explicitly. The responses “People do not tell true — make schedule look better” and “If friend with manager you get better job” describe pressures that the coding framework captures under informal pressure (I4) and scope ambiguity (S5), but the framing suggests these are experienced as culturally normalised rather than exceptional conditions.

Gender-related pressures also surfaced in a small number of responses describing the experience of working in male-dominated site environments, consistent with the directional patterns in Section 5.1. These responses described not discrete incidents but sustained environmental conditions — the accumulated difficulty of professional positioning in contexts where gender minority status is routine rather than exceptional (Faulkner, 2007).

Taken together, these patterns suggest that the qualitative data carry a latent geographic and cultural signal that the current analysis has not fully exploited. Future analysis linking open-text responses to respondent country would enable systematic examination of jurisdictional variation in pressure type and expression — a direction the current cross-sectional design does not support, but which the dataset could accommodate.

#### 6. Close Reading: What the Language Reveals

The excerpts presented below are analysed descriptively to illustrate mechanisms evident in the coded results rather than to extend theoretical interpretation, which is addressed in the Discussion.

Coding frameworks and frequency counts describe the distribution of pressure types across the sample. This section presents a close reading of the most analytically significant responses — examining not only what respondents reported but how they reported it, and what that language reveals about engineering workplace culture that structured instruments cannot reach. The following subsections, therefore, examine representative excerpts that illuminate the mechanisms underlying the coded patterns identified in Sections 4 and 5.

## 6.1 The language of blame and invisibility

Several of the most revealing responses described professional positioning rather than discrete pressure events. Three responses from commissioning engineers capture a structural pattern with particular precision:

*"Commissioning is never thanked for what we do, just blamed for delays as we are visible at the end."* [Woman, 25–34, Commissioning]

*"Operations are often not told of downgrades to projects and commissioning get blamed for not supplying the original scope."* [Man, 55+, Commissioning]

*"Commissioning is not seen, controls not seen together — invisible feeling."* [Man, 45–54, Commissioning]

Responses across roles consistently described commissioning visibility linked to downstream accountability.

## 6.2 The language of safety and compliance under pressure

A cluster of responses described the relationship between pressure and safety compliance with a directness that survey frequency scales cannot reproduce:

*"Everyone says they follow safety until I ask for paperwork, then I'm the problem or bad guy. No team wants to work with us — they fight us — and it's too much to cope with every day."* [Man, 55+, Construction]

*"Project Engineer asked me to ignore a client's requirement on a remote site to get work signed off."* [Woman, 55+, Commissioning]

*"It's the pushback from subcontractors that causes the issues and stress — it's never ending."* [Man, 18–24, HSE]

*"I am often pressured to speed up the safety process, but there are regulations I have to work to."* [Man, 45–54, HSE]

Together, these responses indicate that delivery pressure frequently intersects with safety and compliance decisions, particularly when engineers are required to proceed despite incomplete documentation or pressure to sign off early (Hinze et al., 2013).

Several responses described the mechanisms through which pressure is transmitted rather than its content — specifically, the use of informal channels and positional authority to convey instructions that would not withstand formal documentation:

*"A lot of the pressure is unofficial — phone calls, site visits and not minuted meetings."* [Woman, 35–44, Operations]

*"If friend with manager you get better job."* [Man, 25–34, Commissioning]

*"People do not tell true — make schedule look better."* [Man, 18–24, Project/Planning]

*"Getting honest information from site is difficult and they often try to hide delays that will show up in the schedule."* [Man, 25–34, Project/Planning]

Responses indicate pressure is frequently transmitted through informal communication channels.

### 6.3 The language of early career experience

Early-career respondents frequently described workplace pressure from positions with limited decision authority, reflecting exposure to project tensions without corresponding control over outcomes (Cech, 2014). One junior project professional noted:

*"I am new to the role and in a junior position, so I don't make many decisions on my own yet. I have heard arguments about the schedule but it's never involved me."*  
[Man, 25–34, Project/Planning]

Similarly, an apprentice distinguished between technical challenge and interpersonal strain:

*"I am an apprentice and enjoy the pressure of the work but it does get hard when it's personal rather than work-related."* [Woman, 18–24,]

These responses suggest that early-career pressure is often experienced through organisational positioning and interpersonal dynamics rather than direct responsibility for delivery decisions (Edmondson, 1999). One HSE professional reported:

*"The anger by construction crews outweighs my job role and I am struggling and looking for a less pressured job. The weekend work is meant to be voluntary but it's not due to other team members being on the sick with stress, the company just brings in new inexperienced people."* [Man, 25–34, HSE]

Another respondent described operational adaptation under schedule constraint:

*"If we didn't take shortcuts the job would never get completed on time."* [Man, 25–34, Construction]

These accounts indicate that prolonged delivery pressure may shift responsibility for maintaining project progress onto individuals, sometimes resulting in personal strain or the normalisation of workaround practices.

### 6.4 The language of positive experience and what it reveals about pressure

The 25 responses coded PPF are analytically significant not only for their content but for their placement within the dataset. Several respondents described supportive management or team environments explicitly alongside ongoing structural pressure, using the open-text space to contextualise rather than simply report workplace conditions:

*"We are pushed to operate a plant that needs maintenance to its limits, but if it risks safety then we do stop — safety is not compromised, everything else is but not safety."*  
[Man, 55–64, Operations]

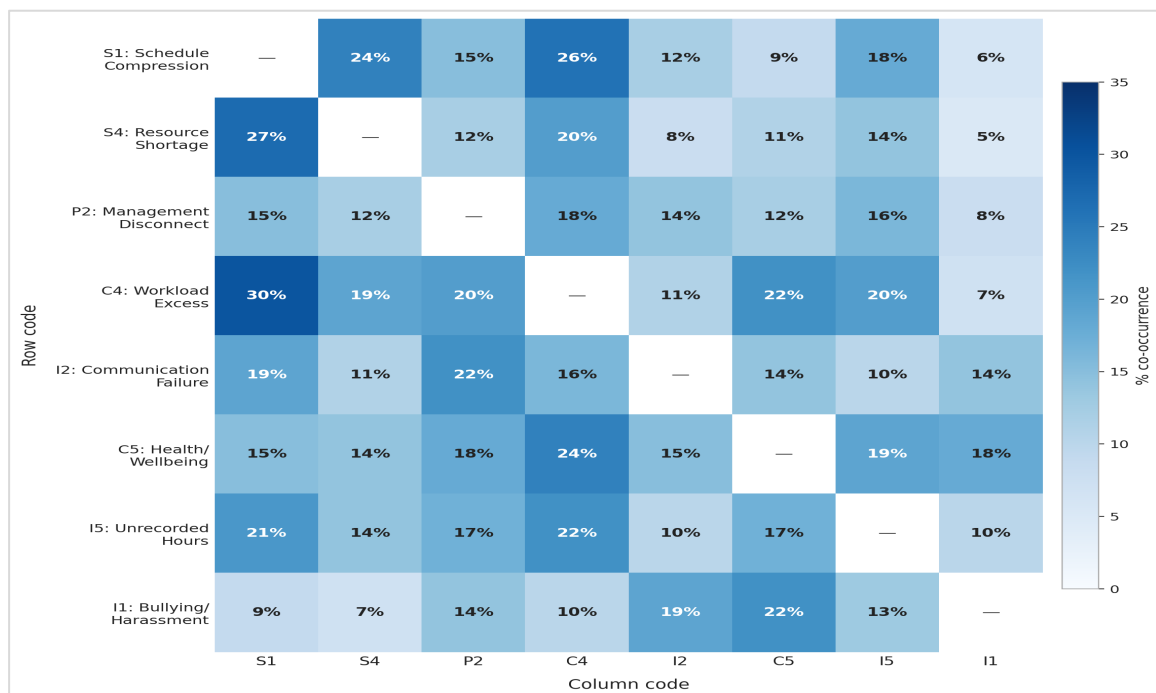
*"My management is very supportive — problems are with vendors, no documents, and labour shortage."* [Man, 25–34, Project/Planning]

*"The company has a strong employee assistance initiative to enhance junior staff and their well-being."* [Woman, 45–54, Leadership]

Rather than indicating the absence of pressure, these responses suggest that supportive local environments moderate how structural demands are experienced. Positive conditions, therefore, appear to coexist with rather than replace high delivery pressure in engineering project settings.

## 7. What the qualitative data reveals beyond quantitative measurement

The co-occurrence analysis highlights how certain pressures cluster in practice, offering contextual depth that single-item frequency counts cannot provide. Figure 3 shows the strongest pairings among the most frequent codes, illustrating how structural pressures such as schedule compression, resource shortages, and workload excess commonly co-occur, and how interpersonal mechanisms intersect with these conditions. These patterns provide a bridge between the coded results and the interpretive analysis developed in the Discussion.



**Figure 3. Code co-occurrence matrix: top eight codes (values = % of row code's responses also receiving column code).**

## 8. Discussion

The qualitative analysis of open-text responses from a global engineering workforce survey yields several findings that extend, contextualise, and in some cases challenge the quantitative picture. The language respondents use — projects that get shorter while deadlines remain fixed, equipment that isn't working and budgets that are absent, systems that

cannot be left alone when first commissioned — describes not abstract constructs but concrete operational realities.

These findings are directly relevant to engineering project delivery because commissioning, construction, and operational reliability depend not only on technical system performance but also on organisational factors that influence decision-making under schedule constraints.

The co-occurrence patterns across structural codes reveal a compound pressure condition that frequency counts alone do not convey. Schedule compression, resource shortage, and workload excess do not present as independent pressures but as a compound structural condition in which available time is shortened, resources are insufficient, and the resulting gap is absorbed through individual effort (Baccarini, 1999; Flyvbjerg et al., 2003). This clustering has direct governance implications: interventions targeting schedule compression in isolation are unlikely to be effective if the underlying resource and workload conditions remain unaddressed (Winch, 2010).

The interpersonal and informal pressure codes represent the most distinctive contribution of the qualitative data. Informal pressure (I4) and unrecorded hours (I5) describe mechanisms that sit beneath the threshold of formal documentation and are therefore systematically invisible to standard audit and governance processes. An engineering organisation can have exemplary formal procedures, compliant time recording systems, and documented approval chains while simultaneously operating a parallel informal system in which real instructions are delivered by phone, real hours are unrecorded, and real pressure is transmitted through channels that leave no trace (Feldman and Pentland, 2003). The qualitative responses describe this parallel system with sufficient specificity to constitute evidence of its existence and extent.

The prominence of positive and protective responses (PPF, 13.9%) warrants careful interpretation. The coexistence of high structural pressure and high job satisfaction — documented in the quantitative data across the commissioning subsample and consistent with job demands-resources theory — is reflected qualitatively in responses that simultaneously acknowledge demanding conditions and describe supportive management or team culture. This pattern suggests that protective factors operate as genuine moderators rather than artefacts of social desirability bias: respondents who describe bullying, overwork, and health impacts in adjacent responses are unlikely to artificially inflate positive assessments.

The findings suggest that organisational risk management frameworks that focus solely on documented processes may overlook pressure transmission through informal coordination practices. Incorporating mechanisms for recognising undocumented delivery pressure may therefore improve commissioning reliability and workforce sustainability outcomes. Positive and protective factors appear to operate as localised buffers rather than systemic mitigations, which helps explain their coexistence alongside great structural difficulty (Cooper, 2000; De Jonge and Dormann, 2006).

### 8.1 The commissioning satisfaction paradox

The most theoretically significant finding in the role comparison data concerns commissioning engineers specifically. The five statistically significant code differences tell a

coherent story: commissioning engineers are more likely to describe documentation failure (S2: 16.7% vs 4.5%,  $p = .012$ ), premature handover (S7: 8.3% vs 0.0%,  $p = .005$ ), professional invisibility (P1: 10.4% vs 0.8%,  $p = .005$ ), and management disconnect (P2: 12.5% vs 3.0%,  $p = .024$ ) — all structural and organisational failures rather than personal inadequacy. The inverse finding is equally revealing: competence doubt (P5) was entirely absent among commissioning engineers compared with 8.3% among other roles ( $p = .038$ ). The qualitative evidence suggests that commissioning engineers tend to locate the source of difficulty in the system rather than in themselves. Yet the quantitative findings across this survey series consistently show that commissioning engineers report higher job satisfaction than other role groups—a pattern that constitutes a genuine paradox requiring explanation. A plausible interpretation is that commissioning engineers have externalised structural pressure as an expected feature of the role rather than as a personal burden. The zero rate of competence doubt, alongside elevated invisibility and management disconnect, is consistent with a professional identity that has absorbed structural difficulty as role normal (Stevens et al., 2008). This pattern is consistent with challenge appraisal in job demands-resources theory (Bakker and Demerouti, 2007) and may help explain the coexistence of high structural pressure and sustained professional commitment. At the same time, this externalisation may perpetuate the professional invisibility identified by the Commissioning Visibility Deficit framework as the field's primary organisational problem. This interpretation should be considered provisional and requires further targeted investigation; the satisfaction paradox may itself be a symptom of normalised invisibility rather than evidence of genuine organisational wellbeing.

The health and well-being impact code (C5, 10.6%) is the finding with the most immediate human significance. Responses describing physical illness, anxiety, and the calculation of whether the financial need outweighs the personal cost represent a category of workplace experience that engineering governance frameworks rarely address directly. Engineering organisations are required to manage physical safety risk; the management of psychological and health risk from sustained workplace pressure receives comparatively less systematic attention, and the qualitative data suggests this gap is experienced by a non-trivial proportion of the engineering workforce.

## 9. Limitations

Several limitations should be noted. The open-text item was voluntary, and the 54.9% response rate, while consistent with similar items in professional surveys, introduces self-selection bias: respondents who chose to provide qualitative data may differ systematically from those who did not, potentially overrepresenting those with particularly salient pressure experiences. The coding framework was developed by the first author through an abductive process: initial open coding was conducted inductively, followed by refinement through systematic comparison with established frameworks (Braun and Clarke, 2006). Drawing on 25 years of practice-based experience provides substantial domain grounding but introduces the possibility that the framework reflects a practitioner's interpretive perspective. This reflexive position is acknowledged as both a strength and a limitation; the inter-rater

reliability assessment with a second coder addresses this concern but does not eliminate it. Finally, the cross-sectional survey design means that causal relationships between pressure types and outcomes cannot be established from these data. Open-text responses also differ from interview data in depth and in the degree of dialogic probing, limiting the granularity with which individual experiences can be interpreted.

## 10. Conclusion

The qualitative analysis of open-text responses from a global engineering workplace survey confirms the structural pressure patterns identified quantitatively while adding three substantive contributions: the identification of informal and unrecorded pressure mechanisms that structured instruments do not capture, the interpersonal and relational texture through which structural pressures are transmitted, and the spontaneous salience of positive and protective factors as counterweights to structural difficulty. The 23-code, five-theme framework developed in this study provides a structured analytical framework for future mixed-method investigation of engineering workplace conditions.

Three governance implications follow from these findings. First, engineering organisations should establish structured narrative channels — anonymous reporting routes outside the formal incident management system — through which informal pressure can be named before it becomes a recordable event. Second, graduate induction frameworks should explicitly address positional vulnerability and escalation of authority, providing early-career engineers with legitimate channels to report interpersonal pressure before it normalises. Third, management development programmes should address the role cognition deficit identified in the management disconnect findings (P2): senior managers who misunderstand what engineering roles require cannot be expected to allocate resources, set schedules, or manage accountability appropriately. This is not a knowledge gap that resolves with time; it requires deliberate intervention in how non-technical managers are prepared for engineering-intensive environments.

The most significant practical implication concerns governance. Engineering organisations that rely exclusively on formal documentation, time recording, and incident reporting to monitor workplace conditions will systematically miss the informal pressure mechanisms — unrecorded instructions, unofficial channels, unlogged hours — that qualitative responses identify as consequential (Winch, 2010). Effective workforce governance requires channels through which informal pressure can be surfaced, named, and addressed without first becoming a formal incident. Conceptually, the study contributes a validated framework for categorising practitioner-defined pressure mechanisms, offering a transferable instrument for future mixed-method research in engineering governance.

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