Who Feels the Pressure?

Demographic and Career-Stage Variation in Workplace Pressure Among Engineers

Jennifer R. Ayres[1a], Ian May[b], Rosmina Bustami [2a], Jethro H Adam[a], Sithara H.P.W. Gamage [3c]

[a]UNIMAS Water Centre (UWC) Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, 94300, Malaysia. [b]Cranfield University, College Rd, Cranfield, Wharley End, Bedford, United Kingdom, MK43 0AL. [c]Adelaide University, Mawson Lakes Blvd, SA 5095, Australia.

ORCID IDs: [1] 0000-0002-4538-6512 | [2] 0000-0002-8438-8932 | [3] 0000-0001-9209-9110

Abstract

Workplace pressure in engineering is widely acknowledged but unevenly understood. While structural demands are routinely cited as features of engineering work, the extent to which their impact varies across demographic and career-stage subgroups remains underexamined. This paper addresses that gap using survey data from 335 engineering and construction professionals across 22 countries across six continents.

Structural workplace pressure — unrealistic expectations, role expansion, extended hours — is broadly pervasive, with limited differentiation by age or gender but meaningful variation by sector and employment type. The oil and gas sectors exhibit significantly elevated pressure profiles; contractors report longer pressure durations. Where demographic differences emerge, they are concentrated in psychological responses and career outcomes rather than structural exposure.

Age emerged as the clearest correlate of psychological outcomes: younger engineers report significantly higher anxiety, overwhelm, and reduced autonomy despite equivalent structural exposure. The 25–34 career bracket shows the highest organisational leaving intention after adjustment (OR = 2.29, p = .029); profession-leaving intention was elevated in bivariate analysis but attenuated after controlling for sector and employment type. Gender differences are concentrated in working hours and organisational culture rather than pressure exposure. These findings suggest that workforce interventions targeted at structural pressure alone will be insufficient: the psychological and career-stage dimensions of pressure require distinct responses.

Keywords: workplace pressure; construction management; engineering workforce; career retention; gender in engineering; age effects; employment type; psychological wellbeing; sector variation

1. Introduction

Engineering work is widely characterised as demanding. Extended hours, role expansion beyond formal scope, and exposure to unrealistic project expectations have been documented across engineering and construction disciplines and project delivery contexts (Kaming et al., 1997; Lingard et al., 2010; Turner et al., 2009). Yet the aggregate characterisation of engineering as a high-pressure profession conceals a question of practical and policy significance: does everyone experience that pressure in the same way, and do its effects fall equally across career stages, genders, sectors, and employment arrangements?

This question matters for several reasons. If structural pressure is uniform but psychological response varies — if younger engineers internalise the same demands more intensely than senior practitioners — then workforce interventions targeting structural conditions alone will be insufficient. If women and men experience equivalent pressure but differ in how that pressure varies with working hours and organisational culture, the relevant policy levers are different again. And if the 25–34 career bracket represents a specific retention risk, as the present data suggest, the case for stage-specific career support becomes empirically grounded. These questions are particularly salient for project-based industries, where workforce capability and retention directly affect delivery performance and organisational risk.

Research on workplace pressure in engineering has grown considerably over the past two decades, with particular attention to working hours and work–life balance (Lingard et al., 2012a; Turner et al., 2009), safety-critical decision-making under time pressure (Flin et al., 2017), and the gendered dimensions of engineering workplace culture (Fouad et al., 2017; Starr, 2018). However, much of this literature examines pressure either as a uniform sector-level characteristic or through a single demographic lens. Studies that simultaneously examine age, gender, sector, and employment type within the same dataset — allowing multiple demographic and structural variables to be examined and partially adjusted for one another — are less common. This paper contributes such an analysis.

The paper draws on a cross-sectional survey of 335 engineering professionals from 22 countries across six continents (Ayres et al., 2026b). Ten pressure and outcome items, measured on a five-point Likert scale, were analysed across four demographic and structural variables: age group, gender, sector, and employment type. Categorical career outcome data — job satisfaction, work–life balance, working hours, and intention to leave — supplement the continuous measures. The study is perception-based and non-causal; it documents how engineering professionals report their workplace experiences, not the structural determinants of those reports.

2. Literature Review

2.1 Workplace Pressure in Engineering: Structural Features

Engineering and construction project delivery is structurally associated with conditions that generate workplace pressure. Compressed schedules, resource constraints, and the sequential dependency of project phases create conditions in which time pressure, role expansion, and extended hours become normalised features of practice rather than exceptional events (Kaming et al., 1997; Love et al., 2012). Research on major infrastructure projects consistently documents the prevalence of unrealistic deadline setting as a strategic and

commercial practice — schedule compression is used to secure project approval and funding, with the consequences borne by the workforce during delivery (Flyvbjerg, 2014).
The normalisation of extended hours in engineering has been documented across multiple jurisdictions and sectors. Lingard and Turner (2007) found that a substantial proportion of Australian construction professionals routinely worked beyond contracted hours, with working time encroachment into personal and family time among the most consistently reported sources of dissatisfaction. Role expansion — working beyond formal job scope as a matter of expectation rather than exception — has been identified as a related but distinct pressure source, linked to unclear role boundaries in project-based organisations (Turner et al., 2009).

A central question in this literature is whether these structural pressures are experienced uniformly or whether their psychological impact varies. The conservation of resources theory (Hobfoll, 1989) predicts that individuals with greater personal, social, and professional resources are better positioned to manage resource-depleting demands without psychological cost—a prediction that aligns with the career-stage hypothesis examined in this paper. A complementary prediction emerges from the Job Demand-Control-Support model (Johnson et al., 1989; Karasek, 1979) (Karasek, 1979; Johnson et al., 1989), widely applied in construction management research, which posits that high demands combined with low control and low support produce the most damaging strain effects—a framework consistent with the present finding that early-career engineers report equivalent structural demands but higher psychological distress.

2.2 Age, Career Stage, and Psychological Buffering

Career development theory suggests that the relationship between structural demands and psychological response changes across working life. Early-career professionals face challenges specific to occupational socialisation — learning professional norms, establishing credibility, navigating institutional authority — that are superimposed on the structural pressures experienced by all practitioners (Schein, 1978; Super, 1980). The concept of professional identity formation, particularly in technical disciplines characterised by strong occupational cultures, identifies the early career as a period of heightened vulnerability to normative pressure and conformity demand (Ibarra, 1999).

By contrast, research on mid-to-senior career professionals in high-demand occupations identifies experience-based regulatory resources — what has been described in this study's qualitative data as 'pressure calibration' — that reduce the psychological cost of equivalent structural exposure. In engineering specifically, senior practitioners have been found to report lower burnout and higher perceived autonomy despite equivalent or greater objective workload (Lingard et al., 2012b).

The retention implications of this age gradient have been examined in what the engineering workforce literature terms the 'second-stage departure problem' (Fouad et al., 2017): the tendency for engineers who have entered the workforce and completed initial training to reassess career viability at approximately five to ten years into practice. This reassessment period aligns with the 25–34 age bracket, where the present study identifies the highest intention to leave the profession and is consistent with findings from multiple national workforce studies showing disproportionate mid-early attrition in engineering occupations (Cardador, 2017).

2.3 Gender, Working Hours, and Engineering Culture

Research on gender in engineering has documented a persistent attrition gap: women leave engineering at higher rates than men across career stages, and the explanatory factors include both structural features of engineering work and cultural dimensions of engineering organisations (Cech and Blair-Loy, 2019; Fouad et al., 2017). The structural arguments centre on working hours, geographic mobility, and the incompatibility of engineering project delivery norms with domestic and caring responsibilities that fall disproportionately on women (Lingard et al., 2012b). The cultural arguments centre on masculine workplace norms, exclusionary practices, and the persistence of gendered assumptions about technical competence and leadership suitability (Faulkner, 2007; Fouad et al., 2012).

An important distinction in this literature is between pressure exposure and pressure experience. Several studies have found that women in male-dominated professions do not report higher overall workplace pressure than men, but they experience the same pressures differently due to the additional social and identity-management demands they navigate (Cech and Blair-Loy, 2019). The present paper examines both the quantitative pressure profile of men and women in engineering and the qualitative texture of their experiences, finding a pattern that the aggregate data does not fully capture.

The hours dimension of gender difference in engineering has a specific structural explanation in the composition of the engineering workforce by role and setting: women are more likely to be in office-based, consulting, and professional services roles than in site-based and operational roles (Lingard et al., 2012b), which carry different hours expectations. Controlling for role and setting in gender analyses is therefore important for distinguishing structural from preference-based explanations of differences in hours.

2.4 Sector and Employment Type

Sector-level variation in workplace pressure within engineering has received less systematic attention than gender or career-stage effects. The structural characteristics of different sectors — capital intensity, project scale, regulatory environment, workforce composition, and the proportion of site-based versus office-based work — create conditions for substantial variation in experienced pressure even within a single professional designation. The oil and gas and petrochemical sectors are characterised by complex interdependencies, high capital intensity, and remote deployments that concentrate schedule and cost risks (Merrow, 2011). Consulting and professional services typically involve more varied portfolios, greater role autonomy, and less sustained site-based pressure.

Employment type — direct employment versus contractor or consultant engagement — represents a structural variable with theoretical implications for pressure experience. Contractors in project-based industries are engaged under deliverable-based commercial terms that may render hours pressure commercially implicit rather than organisationally negotiated. Unlike salaried employees who can raise overwork concerns through employment protections, contractors may experience extended hours as a condition of commercial viability (Kalleberg, 2009). Research on precarious employment more broadly suggests that the psychological consequences of employment insecurity and performance pressure are distinct from those of permanent employment, though not uniformly more severe (Quinlan et al., 2001).

3. Methodology

3.1 Study Design

Data are drawn from a cross-sectional survey of engineering professionals conducted across 22 countries across six continents as part of a broader programme of research into workplace conditions in engineering and construction project delivery (Ayres et al., 2026b). The study is perception-based and non-causal; all measures reflect self-reported experience rather than objectively observed conditions. Recruitment was conducted through professional engineering networks and targeted association outreach. Ethical approval was obtained through the University of Malaysia, and all participants provided informed consent. The analytical sample comprised 335 respondents with complete data on the variables examined here.

3.2 Measures

Ten items measuring workplace pressure and psychological outcomes were rated on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree), spanning structural pressure conditions and psychological responses. Four organisational culture items used the same response scale. Five categorical career outcome items captured job satisfaction, work–life balance, weekly working hours, and intention to leave the profession and current organisation. Open-text fields accompanied each question set, and selected responses are used illustratively throughout; these are presented as texture rather than as part of a formal qualitative analytic procedure.

The four demographic variables examined in this paper are age group (18–24, 25–34, 35–44, 45–54, 55+), gender (man/woman), sector (construction/infrastructure, energy/utilities, mining/resources, oil and gas/petrochemical, water, consulting/professional services), and employment type (full-time employed versus contractor/consultant).

3.3 Analytical Approach

Kruskal-Wallis tests were used to compare three or more groups (age, sector) on continuous items, given the non-normal distributions typical of Likert-scale data. Mann-Whitney U tests were used for two-group comparisons (gender, employment type). Post-hoc pairwise comparisons following significant Kruskal-Wallis tests used Mann-Whitney U with Bonferroni correction. Effect sizes are reported as r (= $Z / \sqrt{N}$) for Mann-Whitney comparisons, interpreted as: small r = .10–.29, medium r = .30–.49, large r ≥ .50. Chi-square tests were used for categorical outcome variables, with effect sizes reported as Cramér's V. All tests were conducted at $\alpha = .05$. The study is cross-sectional and non-causal; analyses describe demographic variation in reported experience, not causal pathways.

Means are reported throughout for interpretive readability; all statistical inference is based on nonparametric rank-based tests. All pairwise post-hoc contrasts were tested following significant Kruskal-Wallis results, with only significant results reported. Given the exploratory and descriptive purpose of the subgroup analyses, findings were interpreted using p values alongside effect sizes and pattern consistency rather than p values alone. All analyses were conducted in JASP (Version 0.96.0). The supplementary regression models described in Section 3.4 provide a complementary check on whether key bivariate findings survive mutual adjustment.

3.4 Supplementary Regression Models

To assess whether key bivariate findings held after mutual adjustment, binary logistic regression models were fitted for three outcomes: considering leaving the profession (yes/no),

working 50+ hours per week (yes/no), and considering leaving the current organisation (yes/no). Predictors in each model were age group (reference: 35–44), gender (reference: man), employment type, and sector. A linear regression model was fitted for the continuous item ‘feel overwhelmed’ using the same predictors. These models do not replace the bivariate analyses but provide a robustness check against confounding, particularly the concern that demographic effects may partly reflect sector composition. The targeted comparison of 25–34-year-olds with other age groups on profession-leaving intention (Section 5.1.4) was motivated by the second-stage departure literature (Fouad et al., 2017), not by a post-hoc inspection of the data.

4. Sample Description

The sample was drawn from 22 countries across six continents, with eight national groups each contributing more than 8% of responses (led by Australia, the United Kingdom, and Canada) and the remainder distributed across 14 further countries. Role representation was broad across the project lifecycle, with commissioning and start-up engineers the largest single group (24.2%), reflecting the survey's origins in the study of late-stage project pressures; all other individual role groups contributed 10% or less. Sector distribution was broadly balanced, with no sector exceeding 17% of respondents. The sample was predominantly male, with women comprising approximately one in three respondents. Age was distributed across career stages, with the largest cohort in the 35–44 bracket and meaningful representation from early career (18–24) through to late career (55+). The majority were in full-time employment, though contractors and consultants represented just over one in four respondents. Nearly half worked in predominantly site-based settings. The four analytical subgroups examined in this paper — age group, gender, sector, and employment type — are described within each results section as they become relevant.

5. Results

Results are presented in four sections corresponding to the primary demographic variables: age (Section 5.1), gender (Section 5.2), sector (Section 5.3), and employment type (Section 5.4). A cross-cutting summary is provided in Section 5.5.

5.1 Age-Related Differences in Workplace Pressure

Kruskal-Wallis tests across the five age groups identified significant differences on four items, all in the psychological outcomes cluster. No structural pressure item showed significant age variation. Table 1 presents the full results.

Table 1. Kruskal-Wallis tests: pressure and outcome items by age group (mean Likert scores, 1–5 scale).

Item	18–24 (n=47)	25–34 (n=83)	35–44 (n=84)	45–54 (n=63)	55+ (n=58)	H	p
PSYCHOLOGICAL OUTCOMES							
Feel overwhelmed	3.57	3.43	3.20	3.19	3.10	11.14	.025 *
Anxiety – team expectations	3.57	3.39	3.11	3.13	2.97	15.40	.004 **
Lack of autonomy	3.66	3.07	3.05	2.84	2.86	18.41	.001 **
Pressure to conform	3.53	3.21	3.08	2.89	3.24	13.28	.010 **
STRUCTURAL PRESSURE (no significant age differences)							
Unrealistic expectations	3.55	3.42	3.39	3.27	3.52	2.92	.571 ns
Pressure – longer hours	3.49	3.73	3.69	3.76	3.62	1.84	.766 ns
Beyond formal role	3.77	3.72	3.60	3.63	3.67	0.84	.933 ns
Peer pressure – wellbeing	3.38	3.22	3.08	2.83	2.95	9.43	.051 ns
Judged by peers	3.51	3.22	3.04	3.10	3.34	8.35	.080 ns
Mistakes treated harshly	2.83	2.67	2.58	2.57	2.53	3.47	.482 ns

Note. * p < .05; ** p < .01. Scores are means on a 1 (Strongly disagree) to 5 (Strongly agree) scale. Structural pressure items (lower panel) showed no significant age differences.

5.1.1 Anxiety and Overwhelm: A Consistent Decline with Age

Finding: Both anxieties related to team expectations and feeling overwhelmed showed a clear monotonic decline from youngest to oldest age group — the highest scores recorded by the 18–24 group, the lowest by the 55+ group — with significant Kruskal-Wallis results for both items.

Effect sizes: Post-hoc Mann-Whitney testing confirmed the youngest-versus-oldest contrast for anxiety (18–24 mean 3.57 vs 55+ mean 2.97; U = 1,895, p < .001, r = .36, medium effect) and for overwhelm (18–24 mean 3.57 vs 55+ mean 3.10; U = 1,797, p = .006, r = .29, small-to-medium effect).

Interpretation: This pattern is consistent with career socialisation theory (Schein, 1978) and the concept of coping maturity (Lachman, 2001). Early-career engineers are still learning professional norms, have less experience navigating institutional dynamics, and may experience their professional standing as more precarious. Senior practitioners appear to develop what the qualitative data terms 'pressure calibration' — the ability to contextualise structural demands without internalising them as psychological threat. Qualitative responses illustrate both ends of this gradient:

> *"I am new to the industry and never sure when to question things so I tend not to."*
>
> *"My time in the defence industry was always driven by pressure and unrealistic deadlines. These days, whether age or wisdom, I don't particularly care about other people's deadlines or agendas."*

The second response, from a senior practitioner, illustrates decoupling of structural demands from psychological distress — a pattern the quantitative data captures across the full age distribution (Ayres et al., 2026a).

5.1.2 Lack of Autonomy: Largest Age Effect

Finding: The lack of autonomy item produced the largest Kruskal-Wallis statistic among the age-group comparisons ($H = 18.41$, $p = .001$).
Effect size: The strongest post-hoc contrast was between the youngest and oldest groups (18–24 mean 3.66 vs 55+ mean 2.86; $U = 1{,}912$, $p < .001$, $r = .37$, medium effect). This is the largest effect size among the age-group comparisons.
Interpretation: Early-career engineering roles typically involve supervised, bounded work, with autonomy expanding as expertise and seniority develop—a pattern consistent with occupational development trajectories in technical professions (Super, 1990). The medium effect size indicates the autonomy gap is not trivial. Sustained constraint without corresponding developmental framing is consistent with the career dissatisfaction and elevated leaving intention observed in the 25–34 bracket (Section 5.1.4).

5.1.3 Structural Pressure: Limited Demographic Differentiation

Finding: No structural pressure item — including pressure to work longer hours, working beyond formal role, unrealistic expectations, or peer pressure affecting wellbeing — showed significant variation across age groups. Mean scores on structural items were broadly elevated and consistent, ranging from 3.3 to 3.8 across all age groups.
Interpretation: This null finding is substantively important. Structural workplace pressure in engineering was reported at broadly similar levels across career stages, rather than being concentrated in early career. Younger engineers do not face greater structural demands — they experience equivalent demands with fewer psychological resources to manage them.

5.1.4 Career Retention: The 25–34 Inflection Point

Finding: Engineers in the 25–34 age group reported the highest intention to leave the engineering profession (24%), compared with 10–12% across all other age groups. A targeted chi-square test comparing 25–34-year-olds with all other age groups confirmed this as significant ($\chi^2 = 7.92$, $p = .005$). This group also reported the highest organisational leaving intention (34%). Table 2 presents the full career outcome distribution.

Table 2. Career outcomes by age group.

Outcome	18–24 (n=47)	25–34 (n=83)	35–44 (n=84)	45–54 (n=63)	55+ (n=58)	χ^2	p
Job satisfied / very satisfied	79%	77%	90%	87%	79%	7.42	.115 ns
WLB good / very good	71%	74%	76%	70%	79%	1.88	.758 ns
Working 50+ hours/week	46%	50%	48%	38%	50%	2.53	.640 ns
Considering leaving profession *	13%	24%	12%	11%	10%	—	—
Considering leaving organisation	23%	34%	18%	22%	19%	—	.118 ns

Note. * Targeted comparison only: 25–34 vs all other age groups combined, $\chi^2 = 7.92$, $p = .005$. Overall chi-square across five age groups was not significant for any career outcome item. The organisation-leaving row overall χ^2 is not reported separately; see regression results (Table 8) for adjusted estimates.

Interpretation: This descriptive inflexion in the 25–34 bracket is consistent with the second-stage departure problem documented in engineering retention research (Fouad et al., 2017): a career reassessment period in which professionals who have entered the workforce and encountered real conditions face a decision about long-term viability. The organisational

leaving effect for this bracket is the more robust finding, surviving adjustment in the regression models (OR = 2.29, p = .029; see Section 5.6). The profession-leaving effect, while notable in bivariate analysis, attenuated after controlling for sector and employment type and should be interpreted as a descriptive signal rather than a confirmed independent effect. Qualitative responses from this group describe the texture of this pressure:

> *"Project managers try to satisfy the clients by any means and push engineers to do jobs with unrealistic budget and/or scope of work. They interrupt the engineering process."*
>
> *"Micromanaging is something common in the workplace which slows down my own work."*

5.2 Gender Differences in Workplace Pressure and Career Outcomes

Mann-Whitney U tests compared men (n = 229) and women (n = 105) across ten continuous pressure items; chi-square tests examined five categorical career outcomes. Gender differences were selective rather than pervasive: absent on almost all psychological pressure items but clearly present on working hours and, unexpectedly, on organisational culture.

5.2.1 Pressure Items: Convergence Between Men and Women

Finding: No significant gender differences emerged on most pressure items. Men and women reported near-identical mean scores on unrealistic expectations, working beyond formal role, overwhelm, anxiety, autonomy, peer pressure affecting wellbeing, judgement by peers, and conformity pressure — means within 0.1 scale points on every item. The sole significant difference on structural pressure was that men reported marginally higher rates of mistakes being treated harshly (men mean 2.74, women mean 2.50; p = .037, r = .13, small effect). Interpretation: Women in this engineering sample experience levels of psychological pressure equivalent to those of their male counterparts. This convergence is not buffering — women are not protected from pressure. Rather, the relevant gender differences lie elsewhere: in working conditions, hours, and qualitative experiences of organisational culture, as the following sections examine.

5.2.2 Working Hours: A Significant and Persistent Gender Gap

Finding: The most pronounced quantitative gender difference was in working hours. Men worked 50 or more hours per week at 53%, compared with 32% of women ($\chi^2 = 11.99$, $p < .001$, Cramér's V = .19, moderate effect). This gap was consistent across age groups, as shown in Table 3, though most pronounced in the 25–34 bracket (men 62%, women 27%).

Table 3. Proportion working 50+ hours per week by gender and age group.

Age group	Men (% working 50+ hrs)	Women (% working 50+ hrs)	n (Men)	n (Women)
18–24	56%	32%	27	19
25–34	62%	27%	53	30
35–44	50%	44%	50	34
45–54	43%	24%	46	17
55+	53%	20%	53	5
Full sample	53%	32%	228	106

Interpretation: This hour gap does not reflect lower structural pressure exposure — women and men report equivalent pressure to work beyond contracted hours. The difference in actual hours worked likely reflects multiple contributing factors: the higher proportion of women in office-based and consulting roles (which carry different hours norms than site-based roles), flexible and part-time working arrangements, and domestic and caring responsibilities that fall disproportionately on women (Lingard et al., 2012). The structural pressure is shared; the hours worked are not. This distinction matters for intervention: addressing gender-based pay inequality requires engagement with role-type distribution, flexible working structures, and domestic responsibilities, not only workplace pressure norms.

5.2.3 Organisational Culture: A Counterintuitive Finding

Finding: Women rated three of four organisational culture items more favourably than men — leadership support (women mean 3.60, men mean 3.34; p = .033, r = .14), encouragement of independence and initiative (women mean 3.52, men mean 3.26; p = .017, r = .16), and mistakes treated as learning opportunities (women mean 3.66, men mean 3.38; p = .023, r = .15). All effects were small. Open communication showed no significant gender difference. Table 4 presents these results.

Table 4. Gender differences in organisational culture items (Mann-Whitney U test; mean scores 1–5).

Item	Men (n=229)	Women (n=105)	p	r
Leadership in my organisation is supportive	3.34	3.60	.033	.14 *
Organisation encourages independence and initiative	3.26	3.52	.017	.16 *
Communication is open and transparent	2.99	3.15	.183	.09 ns
Mistakes treated as learning opportunities	3.38	3.66	.023	.15 *

Interpretation: This counterintuitive finding warrants careful reading. Three explanations are plausible, though the data cannot adjudicate between them: survivorship selection into more supportive environments, lower baseline expectations in a male-dominated sector inflating relative ratings, or substantial within-group heterogeneity obscured by aggregate means. The qualitative data support the heterogeneity reading. Responses from women span the full range:

> *"Being female, males use indirect verbal demeaning to often tune down or control women in decision making or important positions."*
>
> *"Often shouted at in meeting rooms by superiors — it makes me scared making mistakes at site."*
>
> *"I am not sure I want to be on a mainly male mine site forever."*
>
> *"This is a very supportive company."*
>
> *"My workplace is a supportive environment — I think I put pressure on myself to establish my career goals."*

Aggregate culture comparisons likely obscure this within-group variation. Larger female subsamples and qualitative follow-up would be needed to characterise it.

5.2.4 Career Outcomes

Finding: Women showed a directionally higher intention to leave the engineering profession (20% vs 12% for men, p = .100, Cramér's V = .09), falling short of conventional significance in this sample. Job satisfaction and work–life balance were statistically equivalent between men and women. Table 5 presents the full gender career outcome comparison.

Table 5. Gender differences in categorical career outcomes.

Outcome	Men (n=229)	Women (n=105)	χ^2	p
Job satisfied / very satisfied	82%	84%	0.03	.854 ns
WLB good / very good	75%	72%	0.35	.553 ns
Working 50+ hours per week	53%	32%	11.99	< .001 ***
Considering leaving the profession	12%	20%	2.70	.100 ns
Considering leaving current organisation	24%	23%	0.03	.874 ns

Interpretation: The non-significant leaving intention difference warrants note rather than dismissal. An 8 percentage-point differential across national engineering workforces represents substantial cumulative attrition. The finding is consistent with the broader gender attrition literature (Fouad et al., 2017; Cech & Blair-Loy, 2019), even though it did not reach statistical significance in this sample.

5.3 Sector-Level Differences in Workplace Pressure

Kruskal-Wallis tests across the six largest sectors identified significant differences on three pressure items, with oil and gas and petrochemical consistently showing the highest scores and consulting and professional services consistently the lowest. Table 6 presents these results.

Table 6. Kruskal-Wallis tests: key pressure items by sector (mean scores, 1–5 scale).

Item	Construction (n=56)	Energy (n=53)	Mining (n=47)	Oil & Gas (n=47)	Water (n=42)	Consulting (n=40)	H	p
Feel overwhelmed ***	3.25	3.30	3.13	3.77	3.29	2.88	24.92	< .001
Anxiety – team expectations *	3.29	3.21	3.02	3.57	3.14	2.92	12.88	.025
Pressure – longer hours *	3.73	3.75	3.60	4.11	3.76	3.33	11.80	.038
Unrealistic expectations ns	3.32	3.47	3.34	3.68	3.55	3.17	9.24	.100

Note. * p < .05; *** p < .001. Only items with at least one significant comparison shown in full; unrealistic expectations included for context.

Finding: Oil and gas and petrochemical respondents reported the highest means for feeling overwhelmed (3.77), anxiety related to team expectations (3.57), and pressure to work longer hours than contracted (4.11—the highest mean score of any item across any demographic

subgroup in the dataset). Post-hoc testing confirmed that oil and gas respondents reported significantly greater overwhelm than consulting respondents (oil and gas mean 3.77 vs consulting mean 2.88; $p < .001$, $r = .57$, large effect).
Interpretation: These sector differences reflect structural characteristics of the sectors themselves. Oil and gas and petrochemical projects are typically characterised by complex interdependencies, high capital intensity, and contractual arrangements that concentrate schedule and cost risk on the delivery workforce (Merrow, 2011). Consulting contexts involve more varied portfolios and greater role autonomy. The large effect size for the oil and gas versus consulting contrast ($r = .57$) indicates that sector is not a marginal moderator of workplace pressure — it represents a substantively different working environment within the same professional designation. Single-variable demographic analyses that do not control for sector composition should be interpreted with this in mind, given that demographic groups are not evenly distributed across sectors.

5.4 Employment Type: Contractor Versus Full-Time Employee

Finding: One significant and substantial difference emerged between contractors and consultants (n = 88) and full-time employees (n = 226): contractors reported significantly greater pressure to work longer hours than contracted (mean 4.11 vs 3.54; $p < .001$, $r = .28$, small-to-medium effect). No significant differences emerged on psychological outcome items, including overwhelm, anxiety, unrealistic expectations, peer pressure affecting wellbeing, or lack of autonomy. Table 7 presents these results.

Table 7. Employment type differences on continuous pressure items (Mann-Whitney U, mean scores 1–5).

Item	Contractor (n=88)	Employee (n=226)	p	r
Pressure to work longer hours than contracted ***	4.11	3.54	< .001	.28
Feel overwhelmed	3.27	3.31	.547	.04 ns
Anxiety – team expectations	3.31	3.21	.463	.05 ns
Unrealistic expectations	3.56	3.38	.069	.12 ns
Peer pressure – wellbeing	3.17	3.06	.425	.06 ns
Lack of autonomy	3.13	3.08	.540	.04 ns

Note. *** p < .001. r = effect size (small = .10–.29, medium = .30–.49).

Interpretation: The hours finding is consistent with the structural features of contract employment. Contractors are typically engaged on deliverable-based terms where extended hours may be commercially implicit rather than organisationally negotiated (Kalleberg, 2009). The absence of corresponding differences in psychological outcomes suggests that contractors may engage in psychological detachment from structural demands, consistent with the psychological contracts literature (Rousseau, 1989).

5.5 Summary and Integrated Interpretation

Four patterns emerge consistently across the demographic analyses. First, structural workplace pressure is pervasive and shows limited demographic differentiation. Unrealistic expectations, role expansion, and extended hours are common across age groups, genders,

and employment types in engineering work. The exceptions are the oil and gas sector (which shows substantially elevated pressure) and contractor hours pressure.
Second, psychological response to pressure declines with career stage. Younger engineers experience significantly higher anxiety, overwhelm, and reduced autonomy despite equivalent structural demands, a pattern consistent with experience-based psychological buffering that early-career support structures might accelerate.
Third, the 25–34 career bracket represents a specific retention risk. The clearest adjusted signal concerns organisational leaving intention (OR = 2.29 after adjustment). Profession-leaving intention showed a notable bivariate spike (24% vs 10–12% in all other groups) but attenuated after controlling for sector and employment type.
Fourth, gender differences are concentrated in working hours and organisational culture rather than pressure exposure. Women experience equivalent psychological pressure but work significantly fewer extended hours and describe qualitative experiences of workplace hostility that aggregate data does not capture.

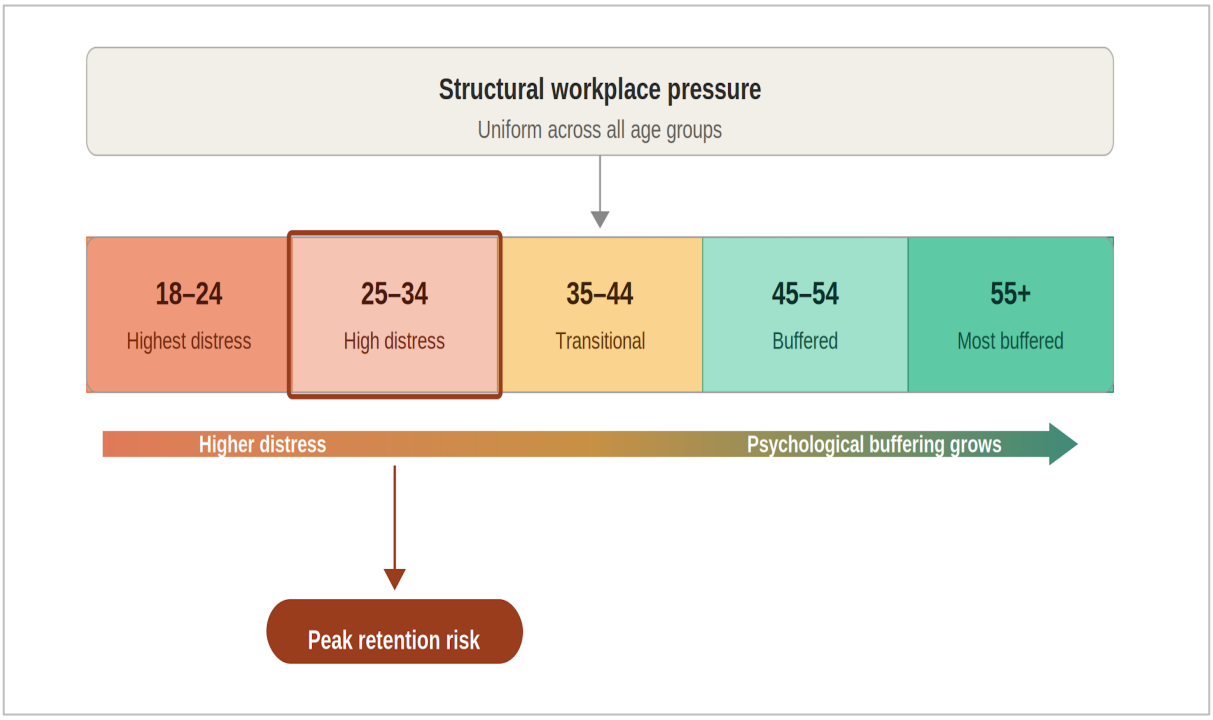

Figure 1. Structural pressure, psychological response, and retention risk across age groups in engineering

Figure 1 shows that workplace pressure (top bar) is shared uniformly across age groups. Psychological distress declines monotonically with age group (gradient bar): anxiety, overwhelm, and reduced autonomy are highest in the youngest group and lowest in the oldest, despite equivalent structural exposure. The 25–34 bracket (highlighted) shows the highest retention risk, with organisational leaving the strongest adjusted signal (OR = 2.29, p = .029). Profession-leaving was elevated in bivariate analysis but attenuated after adjustment.

5.6 Regression Results

Table 8 presents the binary logistic regression results for three career and hours outcomes, and the linear regression for overwhelm. All models included age group, gender, employment type, and sector as predictors.

Table 8. Regression models: key predictors of career and pressure outcomes (N = 335).

Predictor	Leave prof. (OR)	Leave org. (OR)	50+ hours (OR)	Overwhelmed (B)
Age (ref: 35–44)				
18–24	0.83	1.22	1.18	0.31*
25–34	2.11†	2.29*	1.32	0.28*
45–54	0.92	1.28	0.68	0.00
55+	0.93	0.98	0.93	−0.07
Female	1.62	0.85	0.38***	0.03
Contractor	0.35*	0.47*	2.86***	0.07
Sector (ref: Water)				
Oil & Gas	0.53	0.58	3.84**	0.46**
Consulting	1.18	0.30*	0.39†	−0.37*
Model fit				
$\Delta\chi^2$ (p)	24.75 (.053)	—	80.10 (<.001)	F=3.20 (<.001)
McFadden / Adj R^2	.089	.053	.173	.073

Note. OR = odds ratio. B = unstandardised coefficient. †p < .10; *p < .05; **p < .01; ***p < .001. Reference categories: age 35–44, men, employee, Water sector. Only selected sector contrasts shown. — indicates model fit $\Delta\chi^2$ not reported; McFadden R^2 reported instead.

The 25–34 age effect on retention was partially attenuated after adjustment. The clearest adjusted retention signal concerns organisational leaving: the 25–34 bracket showed significantly elevated odds relative to the 35–44 reference group (OR = 2.29, p = .029). For profession-leaving, the odds ratio was directional (OR = 2.11) but did not reach conventional significance after adjustment (p = .093), indicating that the bivariate profession-leaving effect is at least partly confounded by sector or employment type composition.

The gender hours gap survived adjustment: women had 62% lower odds of working 50+ hours after controlling for sector and employment type (OR = 0.38, p < .001). Gender was not significantly associated with leaving intention or overwhelm in the adjusted models.

Contractor status was the strongest predictor of working 50+ hours (OR = 2.86, p < .001) and was inversely associated with both leaving outcomes, suggesting that contractors — despite higher hours pressure — are less likely to consider leaving. Oil and gas were significantly associated with both 50+ hours (OR = 3.84, p = .007) and overwhelm (B = 0.46, p = .004) after adjustment. Consulting was protective for overwhelm (B = −0.37, p = .033) and organisational leaving (OR = 0.30, p = .034).

6. Discussion

6.1 The Structural/Psychological Distinction and Its Implications

The most consistent finding across all four demographic analyses is that structural workplace pressure does not vary significantly across demographic subgroups, whereas psychological responses to that pressure do. This distinction has direct practical implications for project-based organisations that the aggregate ‘engineering is a high-pressure profession’ framing obscures.

The fact that younger engineers experience substantially higher anxiety and overwhelm despite equivalent structural exposure is consistent with psychological resources as a key moderating variable. Building autonomy support, mentoring, and realistic expectation-setting for early-career engineers may be more feasible than reducing structural features of

engineering and construction project delivery, though the efficacy of such interventions remains to be tested.

Conservation of resources theory (Hobfoll, 1989) provides a parsimonious account: junior engineers have fewer accumulated professional, relational, and reputational resources to buffer against resource-depleting demands. Organisations that understand this trajectory can design support structures to accelerate the accumulation of buffering resources — through mentoring, explicit autonomy grants, and destigmatisation of uncertainty expression — rather than waiting for career experience to do this work organically.

6.2 The 25–34 Retention Problem

The 25–34 retention pattern has practical implications for workforce retention strategy. After adjustment, this bracket shows significantly elevated organisational leaving intention (OR = 2.29) — the more robust of the two retention findings. Profession-leaving intention, while notably elevated in bivariate analysis, attenuated after controlling for sector and employment type, suggesting that part of the bivariate signal reflects the sector composition of this age group rather than an independent age effect. This pattern is consistent with the interpretation that the decision to leave engineering organisations in early-to-mid career is not primarily a response to structural overload — if it were, all age groups would show elevated leaving intention.

The engineering retention literature describes this as the second-stage departure problem (Fouad et al., 2017), but the present data add specificity: the risk is concentrated in a specific bracket. Engineers who reach 35–44 show substantially lower leaving intention (12%) and higher satisfaction (90%), suggesting that the 25–34 period represents a critical transition. Interventions targeted at this bracket — career pathway clarity, autonomy support, peer mentoring from those who have navigated this transition — have a more precisely defined target than broad early-career retention programmes. For project organisations, the loss of engineers at precisely the career stage where technical judgement matures represents a direct risk to delivery capability and institutional knowledge.

6.3 Gender: Where the Data Speak and Where They Don't

The gender findings illustrate the limitations of aggregate quantitative analysis for capturing lived workplace experience. Men and women report near-identical scores on anxiety, overwhelm, and role expansion — a convergence that could be misread as evidence that gender is irrelevant. The qualitative data make clear that this reading would be wrong.

The convergence is more plausibly read as indicating that women who remain in engineering experience the same structural conditions. Survivorship is a plausible contributor: women who report favourable culture scores may do so partly because those in hostile environments have already departed. The sample captures practising engineers, not all who entered the profession.

The non-significant but directionally robust profession-leaving intention gap (women 20%, men 12%) is consistent with this reading. At the scale of national engineering workforces, sustained differentials of this magnitude translate to substantial structural attrition over careers.

The working hours gap (men 53% working 50+ hours, women 32%) points to a different intervention target: not pressure norms but the distribution of role types, flexible working infrastructure, and the domestic context of engineering employment. That women experience equivalent pressure to work beyond contracted hours but do so for fewer hours suggests structural barriers, rather than preference, are driving this difference.

6.4 Sector as a Confound

The large effect size for sector differences (oil and gas vs consulting, r = .57 for overwhelm) indicates that sector is not a minor moderating variable in engineering workplace pressure analyses — it represents a substantively different working environment. Single-variable demographic analyses that do not account for sector composition risk misattribute sector effects to demographic characteristics.

The demographic composition of sectors in this sample is not random: site-based, extractive, and energy sectors have different gender, age, and employment-type profiles from consulting and professional services. Analyses that examine gender or age differences without controlling for sector may partially reflect sector composition differences rather than true demographic effects. This is a limitation of the present analysis that future work with larger samples and multilevel modelling approaches could address.

6.5 Limitations

Several limitations apply. The cross-sectional design does not permit causal inference. Perception-based self-report measures are subject to social desirability effects and recall bias. Recruitment via professional networks introduces self-selection, and the over-representation of commissioning professionals (24.2%) may influence findings. The female subsample (n = 105) is sufficient for aggregate comparisons but limits the power of gender interaction analyses; several directionally consistent findings did not reach significance. The survivorship bias inherent in sampling practising engineers means the sample cannot speak to the experiences of those who have already left.

The study conducts multiple bivariate tests without formal correction for family-wise error rate. The supplementary regression models provide a partial robustness check, but small subgroup cells limit some estimates, and residual confounding cannot be ruled out. Gender was measured as man/woman; the survey did not include non-binary options, representing an important gap. Findings at marginal significance should be interpreted in the context of these constraints.

7. Conclusion

This paper has examined how workplace pressure is experienced across demographic and career-stage subgroups in a cross-national sample of engineering and construction professionals. The central finding — that structural pressure showed limited demographic differentiation while psychological response varied with career stage — reframes the standard characterisation of engineering as a uniformly high-pressure profession. Pressure conditions are shared; the resources to manage them are not.

The 25–34 career bracket shows significantly elevated organisational leaving intention after adjustment (OR = 2.29), representing the clearest retention signal in the data. Profession-leaving intention was elevated in bivariate analysis but attenuated after controlling for sector and employment type. Together, these findings identify a career stage at which targeted interventions — autonomy support, career pathway clarity, peer mentoring — have the highest potential leverage.

Gender differences are concentrated in working hours and in the qualitative experience of organisational culture rather than in aggregate pressure exposure. The qualitative data and the directionally robust profession-leaving intention gap suggest that the relevant gender dynamics operate in registers that quantitative pressure scales do not fully capture.

For project-based industries, these findings underscore the need to treat workforce retention as a delivery risk variable, not only a human resources concern. Future research should examine the 25–34 retention problem with longitudinal designs, investigate within-group heterogeneity in women's organisational culture experiences with qualitative methods, and use multilevel or sector-stratified designs to disentangle the substantial sector effects identified here from demographic effects.

Acknowledgements

AI tools (Grammarly and Claude Anthropic) were used to support wording refinement and consistency checks during manuscript preparation. All analyses, coding decisions, interpretations, and the final text were developed and verified by the authors.

References

Ayres, J.R., May, I., Bustami, R., Adam, J., Gamage, S., 2026a. What Engineers Actually Say: A Qualitative Analysis of Workplace Pressure in a Global Engineering Survey. https://doi.org/10.31224/6614

Ayres, J.R., May, I., Bustami, R., Adam, J.H., Gamage, S.H., 2026b. Global Workplace Pressures in Engineering: A Cross-Sectional Survey of Role-Based Pressures, Peer Influence, and Psychological Outcomes. https://doi.org/https://doi.org/10.31224/6598

Cardador, M.T., 2017. Promoted Up But Also Out? The Unintended Consequences of Increasing Women's Representation in Managerial Roles in Engineering. Organ. Sci. 28, 597–617. https://doi.org/10.1287/orsc.2017.1132

Cech, E.A., Blair-Loy, M., 2019. The changing career trajectories of new parents in STEM. Proc. Natl. Acad. Sci. 116, 4182–4187. https://doi.org/10.1073/pnas.1810862116

Faulkner, W., 2007. `Nuts and Bolts and People': Gender-Troubled Engineering Identities. Soc. Stud. Sci. 37, 331–356. https://doi.org/10.1177/0306312706072175

Flin, R., O'Connor, P., Crichton, M., 2017. Safety at the Sharp End: A Guide to Non-Technical Skills, 1st ed. CRC Press. https://doi.org/10.1201/9781315607467

Flyvbjerg, B., 2014. What you Should Know about Megaprojects and Why: An Overview. Proj. Manag. J. 45, 6–19. https://doi.org/10.1002/pmj.21409

Fouad, N.A., Chang, W.-H., Wan, M., Singh, R., 2017. Women's Reasons for Leaving the Engineering Field. Front. Psychol. 8, 875. https://doi.org/10.3389/fpsyg.2017.00875

Fouad, N.A., Singh, R., Fitzpatrick, M.E., Liu, J.P., 2012. Stemming the Tide: Why Women Leave Engineering. UW Milwaukee.

Hobfoll, S.E., 1989. Conservation of resources: A new attempt at conceptualizing stress. Am. Psychol. 44, 513–524. https://doi.org/10.1037/0003-066X.44.3.513

Ibarra, H., 1999. Provisional Selves: Experimenting with Image and Identity in Professional Adaptation. Adm. Sci. Q. 44, 764–791. https://doi.org/10.2307/2667055

Johnson, J.V., Hall, E.M., Theorell, T., 1989. Combined effects of job strain and social isolation on cardiovascular disease morbidity and mortality in a random sample of the Swedish male working population. Scand. J. Work. Environ. Health 15, 271–279. https://doi.org/10.5271/sjweh.1852

Kalleberg, A.L., 2009. Precarious Work, Insecure Workers: Employment Relations in Transition. Am. Sociol. Rev. 74, 1–22. https://doi.org/10.1177/000312240907400101

Kaming, P.F., Olomolaiye, P.O., Holt, G.D., Harris, F.C., 1997. Factors influencing craftsmen's productivity in Indonesia. Int. J. Proj. Manag. 15, 21–30. https://doi.org/10.1016/S0263-7863(96)00019-1

Karasek, R.A., 1979. Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. Adm. Sci. Q. 24, 285. https://doi.org/10.2307/2392498

Lachman, M.E. (Ed.), 2001. Handbook of midlife development, Wiley series on adulthood and aging. Wiley, New York.

Lingard, H., Brown, K., Bradley, L., Bailey, C., Townsend, K., 2007. Improving Employees' Work-Life Balance in the Construction Industry: Project Alliance Case Study. J. Constr. Eng. Manag. 133, 807–815. https://doi.org/10.1061/(ASCE)0733-9364(2007)133:10(807)

Lingard, H., Francis, V., Turner, M., 2012a. Work–life strategies in the Australian construction industry: Implementation issues in a dynamic project-based work environment. Int. J. Proj. Manag. 30, 282–295. https://doi.org/10.1016/j.ijproman.2011.08.002

Lingard, H., Francis, V., Turner, M., 2012b. Work time demands, work time control and supervisor support in the Australian construction industry: An analysis of work-family interaction. Eng. Constr. Archit. Manag. 19, 647–665. https://doi.org/10.1108/09699981211277559

Lingard, H.C., Francis, V., Turner, M., 2010. Work–family enrichment in the Australian construction industry: implications for job design. Constr. Manag. Econ. 28, 467–480. https://doi.org/10.1080/01446190903511268

Love, P.E.D., Edwards, D.J., Irani, Z., 2012. Moving Beyond Optimism Bias and Strategic Misrepresentation: An Explanation for Social Infrastructure Project Cost Overruns. IEEE Trans. Eng. Manag. 59, 560–571. https://doi.org/10.1109/TEM.2011.2163628

Merrow, E.W., 2011. Industrial megaprojects: concepts, strategies, and practices for success. Wiley, Hoboke, N.J.

Quinlan, M., Mayhew, C., Bohle, P., 2001. The Global Expansion of Precarious Employment, Work Disorganization, and Consequences for Occupational Health: A Review of Recent Research. Int. J. Health Serv. 31, 335–414. https://doi.org/10.2190/607H-TTV0-QCN6-YLT4

Rousseau, D.M., 1989. Psychological and implied contracts in organizations. Empl. Responsib. Rights J. 2, 121–139. https://doi.org/10.1007/BF01384942

Schein, E.H., 1978. Career dynamics: matching individual and organizational needs, Organization development. Addison-Wesley, Reading, Mass.

Starr, C.R., 2018. "I'm Not a Science Nerd!": STEM Stereotypes, Identity, and Motivation Among Undergraduate Women. Psychol. Women Q. 42, 489–503. https://doi.org/10.1177/0361684318793848

Super, D.E., 1980. A life-span, life-space approach to career development. J. Vocat. Behav. 16, 282–298. https://doi.org/10.1016/0001-8791(80)90056-1

Turner, M., Lingard, H., Francis, V., 2009. Work-life balance: an exploratory study of supports and barriers in a construction project. Int. J. Manag. Proj. Bus. 2, 94–111. https://doi.org/10.1108/17538370910930536