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Innovating on Borrowed Time: How Work–Family Conflict Erodes Work–Life Balance and When Organisational Support Makes Innovation Pay Off in Chinese Public Universities

Xiaomei Wang [1], Weixiang Gan [2,*], Tara Ahmed Mohammed [1], Mengfei Xiao [2]

[1] Graduate School of Business, SEGi University, Petaling Jaya 47810, Malaysia

[2] Post-Doctorate Researcher, Lincoln University College, Petaling Jaya 47301, Malaysia

*** Correspondence:**

Weixiang Gan

pdf.weixiang@lincoln.edu.my

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Abstract

Performance-oriented governance has intensified academic work in Chinese public universities, and the resulting pressure crosses the boundary between work and family life in both directions. This study examines how work-to-family conflict and family-to-work conflict shape work-life balance among academics in Shanxi Province, China, and asks two questions that prior research has left open: whether conflict erodes balance partly by suppressing innovative work behaviour, the behavioural capability through which academics improve their own work processes, and whether perceived organisational support governs the extent to which such behaviour converts into balance. The model integrates Conservation of Resources theory with the Job Demands-Resources framework and was tested with partial least squares structural equation modelling on survey data from 402 full-time academics screened under pre-specified quality rules. Both directions of conflict reduced balance directly and indirectly through weakened innovative behaviour, with the family-originating direction the stronger constraint on the capability pathway; innovative behaviour supported balance, and its payoff strengthened as organisational support rose. Balance therefore emerges from a conditional resource process rather than from individual coping alone. The findings direct universities toward workload governance, protection of process-improving innovation, and support that is enacted rather than merely declared.

Keywords: Work-to-Family Conflict; Family-to-Work Conflict; Innovative Work Behaviour; Perceived Organisational Support; Work-Life Balance

1. Introduction

Public universities in China operate under an evaluation regime that ties institutional standing and funding to measurable output. The Double First-Class strategy places research productivity at

the centre of higher-education governance, and the metrics attached to promotion and income convert institutional ambition into individual working hours (Gao & Wang, 2024; Liang et al., 2025). These demands are added to, not substituted for, existing teaching, supervision, and administrative obligations. Shanxi Province, the setting of this study, employs 30,237 full-time teachers in its ordinary undergraduate institutions (Ministry of Education of the People's Republic of China, 2024), a workforce large enough that the sustainability of its working conditions is a governance question rather than a private matter.

The pressure does not stay at the office. Work-related communication outside standard hours predicts higher work-to-family conflict, distress, and sleep problems (Choi et al., 2022; Schieman & Young, 2013), mobile connectivity erodes the stopping rules around academic work (Mazmanian et al., 2013), and academics who perceive their work as unbounded report lower balance even under comparatively high support (Johnston et al., 2022). Conflict also runs the other way: child rearing under intensive parenting norms and filial obligations to ageing parents interrupt the concentration that research and course development require (Greenhaus & Beutell, 1985). Both directions of inter-role conflict predict strain, dissatisfaction, and impaired well-being (Allen et al., 2000; Amstad et al., 2011; Byron, 2005), and the downstream costs run through impaired recovery and sleep to burnout and turnover (Crain et al., 2014; Sonnentag & Fritz, 2015; Swider & Zimmerman, 2010; Watts & Robertson, 2011).

Innovative work behaviour enters this picture as a candidate adaptive strategy rather than as one more performance metric. Academic work leaves substantial discretion over how tasks are done: course materials can be made reusable, assessment routines redesigned, feedback standardised, supervision and committee workflows streamlined. Behaviour of this kind, defined as generating, promoting, and implementing improvements to one's own work processes (Scott & Bruce, 1994), is a plausible means by which academics under pressure recover time and perceived control, the two resources conflict most directly consumes. The same behaviour is also effortful, uncertain, and dependent on colleagues and administrators for implementation, so it could equally deepen depletion where the institution leaves innovators to carry its costs alone.

What the accumulated record does not explain is the behavioural route from conflict to imbalance. Work–family research has concentrated on affective outcomes, while innovation research treats innovative work behaviour (IWB), the generation, promotion, and implementation of improvements to one's own work (Scott & Bruce, 1994), as an outcome of leadership and climate rather than as a casualty of role conflict (Anderson et al., 2014; de Jong & den Hartog, 2010). Whether conflict undermines balance partly by draining the very capability through which academics might recover time and control remains untested: Bao et al. (2025) showed that family-to-work conflict suppresses IWB among Chinese university teachers but omitted the work-to-family direction and did not connect reduced innovation to balance. A second open question concerns context. Innovative effort is costly and implementation-dependent, so its payoff plausibly depends on whether the institution recognises, coordinates, and resources it (Johnston et al., 2022; Rhoades & Eisenberger, 2002); the conditions under which innovation is balance-enhancing rather than an added burden remain underspecified.

This study answers both questions with data from 402 academics in Shanxi public universities, modelling work-to-family conflict (WFC) and family-to-work conflict (FWC) as parallel antecedents of work–life balance (WLB), IWB as the mediating capability, and perceived organisational support (POS) as a second-stage moderator, within a Conservation of Resources frame complemented by the Job Demands–Resources model (Bakker & Demerouti, 2007; Hobfoll, 1989, 2001). Five confirmatory questions structure the analysis: whether WFC and FWC reduce WLB; whether they reduce IWB; whether IWB improves WLB; whether IWB mediates the conflict–balance relationships; and whether POS strengthens the IWB–WLB link. A sixth, exploratory question asks whether these relationships differ between female and male academics. The contribution is threefold. Theoretically, capability impairment is identified as a distinct pathway from conflict to imbalance, and resource loss, resource investment, and resource conversion are separated within COR theory. Empirically, full-model evidence is supplied from a provincial Chinese university system, a setting where evaluation reform, administrative accountability, and boundary-crossing digital communication intersect, rather than extrapolated from Western or first-tier-city samples (Marginson, 2011). Practically, the model locates the levers that university governance actually holds: workload rules that reduce avoidable interference, protected conditions for process improvement, and support practices that convert innovative effort into recovered time rather than unpaid overtime. The remainder of the paper reviews the literature and derives the hypotheses, describes the survey design and analytical strategy, reports the empirical results in full, and closes with the theoretical, practical, and methodological implications.

2. Literature Review and Theoretical Framework

2.1. Theoretical Foundations: Conservation of Resources and Job Demands-Resources

Conservation of Resources (COR) theory explains stress and adaptation through the acquisition, protection, and investment of valued resources: time, energy, emotional stability, social support, and perceived control (Hobfoll, 1989). Three of its mechanisms carry the present model. The first is the loss spiral. Resource loss is more potent than equivalent gain, and individuals who lose resources become less able to meet subsequent demands efficiently, which accelerates further loss; repeated cross-domain interference is exactly the kind of chronic, low-grade drain that sets such spirals in motion (Halbesleben et al., 2014; Hobfoll, 1989). In Shanxi public universities, where output targets and compliance routines run in parallel with full teaching loads, the practical risk is persistent leakage of time and emotional energy rather than stable replenishment.

The second mechanism is resource investment. COR does not treat proactive behaviour as cost-free: individuals invest resources to gain resources, and the same investment that yields net gains under sufficiency can deepen exhaustion under scarcity, a caution Hobfoll (2001) states explicitly. Innovative work behaviour is a paradigmatic resource investment. Generating an idea consumes slack attention; championing it consumes social energy and relational capital; implementing it demands sustained persistence through the friction of changed routines, with no guarantee of success. Whether the investment ends as gain or loss is therefore an empirical question about the conditions surrounding it, not a property of the behaviour itself.

The third mechanism is the resource caravan passageway. Resources do not operate in isolation; they cluster and travel together, and environmental conditions determine whether clustering is encouraged or blocked (Hobfoll, 2012). Organisational conditions that share the cost of employee initiative, through legitimacy, coordination, and recognition, convert individual effort into additional resources; conditions that withhold such support leave the effort stranded. Perceived organisational support (POS), the employee's global belief that the organisation values their contributions and cares about their well-being (Eisenberger et al., 1986; Rhoades & Eisenberger, 2002), is the passageway examined in this study.

The Job Demands-Resources (JD-R) model complements this process account with a work-design classification: job demands consume energy and generate strain through a health-impairment process, while job resources protect functioning and feed a motivational process (Bakker & Demerouti, 2007; Demerouti et al., 2001). The model's dual-process architecture matters for the present design: demands and resources do not merely add up, they interact, and resources buffer the strain that demands generate while enabling the motivational gains that demands alone cannot produce (Bakker & Demerouti, 2007). Mapped onto the present constructs, WFC and FWC operate as demand-related pressures that disrupt recovery; IWB expresses a proactive personal capability; POS is a job resource; and WLB is a well-being outcome indicating whether performance can be sustained without chronic depletion. The two theories are used in sequence rather than in competition: COR supplies the process explanation, in which conflict depletes resources, depletion constrains innovative behaviour, and investment pays only when it can generate returns, while JD-R supplies the intervention grammar of reducing excessive demands and strengthening resources. The resulting specification is a conditional resource process, not a simple demand-outcome model: conflict reduces resources, innovative behaviour is an attempted investment, and POS determines whether that investment produces net gain. IWB captures what academics attempt to do; POS captures whether the environment makes those attempts practically viable.

2.2. Work-Life Balance: Concept and Evidence

The construct's lineage runs from role theory, in which incompatible role pressures generate strain (Kahn et al., 1964), through boundary and border theories, which explain how permeable work-home borders let pressures cross domains (Ashforth et al., 2000; Clark, 2000), with segmentation-integration fit determining how costly that permeability is for a given person (Kreiner, 2006). Within this lineage, definitions of balance have ranged from equal time allocation across roles to satisfaction-based and effectiveness-based formulations; Kalliath and Brough (2008) reviewed the competing versions and settled on the summary-appraisal definition adopted here: WLB is the individual's overall appraisal that work and non-work roles are compatible, manageable, and sustainable (Brough et al., 2014; Greenhaus & Allen, 2011; Haar et al., 2014). Balance is distinct from, and more than the absence of, conflict: Carlson et al. (2009) showed empirically that balance carries explanatory power for job satisfaction, organisational commitment, and family performance beyond conflict and enrichment combined, which justifies modelling it as a separate outcome rather than as the inverse of conflict.

The definitional choice carries measurement implications. A summary-appraisal construct requires reflective indicators that sample the overall judgement rather than domain-specific time

budgets, which is why the four-item scale of Brough et al. (2014), validated longitudinally across Australian and New Zealand workers, anchors the operationalisation in Section 3; conflict, by contrast, is measured directionally so that work-originating and family-originating interference remain analytically separable rather than folded into a single stress score (Netemeyer et al., 1996).

Balance earns its position as the focal outcome through its consequences. Across seven cultures it predicts job satisfaction, life satisfaction, and mental health (Haar et al., 2014); among Chinese college teachers it tracks lower emotional exhaustion and better well-being (Wei & Ye, 2022). The costs of its erosion are equally documented, and they concentrate in academia. Sustained job demands and weak work-life boundaries predict psychological strain among United Kingdom academics (Kinman & Jones, 2008); burnout among university teaching staff is an established outcome of chronic overload (Watts & Robertson, 2011); impaired recovery is the connecting mechanism, because employees who cannot detach during non-work time fail to replenish the resources the next working day requires (Sonnentag & Fritz, 2007, 2015); and work-family conflict degrades sleep, one of the least substitutable of those resources (Crain et al., 2014). Burnout in turn travels with withdrawal and turnover (Swider & Zimmerman, 2010). Recent academic-specific work extends this picture: Johnston et al. (2022) found that academics who perceived their work as unbounded reported lower balance even when institutional support was comparatively high; Quinn and Hartland-Grant (2026) show balance operating as a lived, identity-laden accomplishment rather than a static allocation; and the bibliometric review of Siem et al. (2025) identifies work-family conflict as one of the most consistently documented antecedents of reduced balance across international academic populations, with stronger effects where support is weak and roles unbounded.

The governance context matters for how these findings travel to China. Audit culture and metric-driven management have reorganised academic labour across systems (Lorenz, 2012; Muller, 2018; Shore & Wright, 2015), and global rankings competition has intensified output pressure (Hazelkorn, 2015). Chinese public universities add their own layer: evaluation reform under the Double First-Class framework couples institutional funding to measurable performance (Gao & Wang, 2024), reform implementation reshapes assessment practice inside universities (Liang et al., 2025), and hindrance-type stressors erode job satisfaction and teaching engagement among Chinese university teachers (Xu et al., 2023). Provincial systems such as Shanxi absorb national expectations while operating with uneven resources, which makes them a theoretically meaningful setting rather than a mere sampling site (Marginson, 2011).

2.3. Work-Family Conflict and Work-Life Balance

Greenhaus and Beutell (1985) defined inter-role conflict as arising when role pressures from work and family domains are mutually incompatible, distinguished its time-based, strain-based, and behaviour-based forms, and established its two directions: work interfering with family and family interfering with work. The directional distinction is measurable and consequential: Frone et al. (1992) modelled the two directions as reciprocally related but distinct, and Netemeyer et al. (1996) developed the separate scales used here. Meta-analytic evidence confirms that both directions carry adverse consequences for satisfaction, strain, and well-being (Allen et al., 2000; Amstad et al., 2011; Byron, 2005), with cross-domain effects that reach beyond the originating role

(Amstad et al., 2011). The content-analytic review of Eby et al. (2005) already identified this bidirectional architecture as the field's central organising frame.

The three forms of conflict translate directly into academic work. Time-based conflict appears when grading, grant deadlines, and evening meetings occupy hours committed to family; strain-based conflict appears when the fatigue and irritability generated in one role degrade functioning in the other; behaviour-based conflict appears when the critical, task-focused style that research rewards travels poorly into family interaction (Greenhaus & Beutell, 1985). For academics the work-to-family direction is amply documented. Unbounded work with weak stopping rules predicts lower balance (Johnston et al., 2022); out-of-hours connectivity lowers balance through telepressure, the felt compulsion to respond immediately (Barber & Santuzzi, 2015; Barber et al., 2019; Tedone, 2022); and work-related communication outside standard hours predicts higher WFC, distress, and sleep problems in large-scale survey data (Choi et al., 2022; Schieman & Young, 2013). Mobile connectivity institutionalises the "autonomy paradox" in which professionals extend work into all hours precisely because they can (Mazmanian et al., 2013), and pandemic-era evidence showed how quickly home-work boundaries collapse under institutional pressure (Leal Filho et al., 2021).

The family-to-work direction deserves equal standing in the Chinese context. Intensive parenting norms, filial obligations to ageing parents, and a gendered division of household labour generate family demands that intrude on preparation time, concentration, and research continuity (Allen et al., 2000; Bao et al., 2025). Treating FWC as the negligible direction, an assumption common in professional samples (Byron, 2005), would therefore be premature here. Each direction of interference depletes the time and energy that the summary appraisal of balance registers as loss (Hobfoll, 1989). Two hypotheses follow.

H1. Work-to-family conflict is negatively associated with work–life balance.

H2. Family-to-work conflict is negatively associated with work–life balance.

2.4. Work-Family Conflict and Innovative Work Behaviour

Innovative work behaviour denotes the intentional generation, promotion, and implementation of new ideas that improve work processes, practices, or outcomes (de Jong & den Hartog, 2010; Scott & Bruce, 1994). The three stages carry a rising resource gradient: generating an idea requires slack attention; promoting it requires social energy and a willingness to spend relational capital; implementing it requires persistence through the friction of changed routines. Implementation is therefore the stage most readily abandoned when time and energy run short. The behaviour's resource sensitivity is well established: innovative behaviour is amplified by autonomy, support, and psychological safety (Amabile & Pratt, 2016; Edmondson & Lei, 2014; Messmann & Mulder, 2015) and suppressed by demands that deplete attention and energy (Anderson et al., 2014; Janssen & Van Yperen, 2004).

COR theory predicts the suppression mechanism. Under loss spirals, individuals protect remaining resources rather than risk them in effortful, uncertain activity (Hobfoll, 1989; Halbesleben et al., 2014); role conflict drains precisely the discretionary time, cognitive flexibility, and emotional availability that idea work consumes. The Chinese evidence traces this process

directly: Bao et al. (2025) found family-to-work conflict suppressing IWB among university teachers through work stress, with the association differing by gender; and Shang (2022) documented stress-to-burnout transmission among Chinese teaching staff under pandemic-era workloads. Family-originating interference may be especially corrosive because it fragments attentional continuity through interruptions to concentration, unscheduled caregiving, and emotional carry-over, whereas work-originating interference depletes time and energy while leaving work-focused attention comparatively intact.

H3. Work-to-family conflict is negatively associated with innovative work behaviour.

H4. Family-to-work conflict is negatively associated with innovative work behaviour.

2.5. Innovative Work Behaviour and Work-Life Balance

Why should innovative behaviour improve balance rather than merely consume effort? The answer lies in what academics innovate about. Process-directed innovation, from reusable teaching materials and redesigned assessment routines to standardised feedback and streamlined coordination, reduces repeated inefficiencies and recovers exactly the resources whose loss conflict inflicts: time and perceived control (Hobfoll, 2001). Lukes and Stephan (2017) found that innovation supports individual flourishing most clearly when directed at improving work processes rather than producing novel outputs for their own sake, and incremental improvements accumulate into meaningful performance and sustainability effects (Anderson et al., 2014; Janssen, 2000).

The positive expectation must be stated with its counter-case in view, because innovative behaviour has a dual nature under strain. Where effort-reward fairness is absent, higher demands paired with innovative activity feed strain rather than relieve it (Janssen, 2000), and demands experienced as hindrances rather than challenges convert extra effort into exhaustion (Cavanaugh et al., 2000). H5 therefore states the expected net effect in this population, while the boundary condition developed in Section 2.7 governs its size.

H5. Innovative work behaviour is positively associated with work–life balance.

2.6. The Mediating Mechanism: From Conflict to Capability

Combining H3/H4 with H5 yields a behavioural chain: conflict depletes resources; depletion reduces innovative behaviour; reduced innovative behaviour forecloses the efficiency and control gains through which balance might have been defended. Conflict thereby becomes self-reinforcing, because it removes the adaptive capacity that would otherwise counteract its own consequences (Halbesleben et al., 2014; Hobfoll, 1989).

The expectation is partial, not full, mediation. Conflict damages balance through several simultaneous channels, among them time scarcity, strain transmission, and disrupted recovery, of which capability impairment is one (Hobfoll, 1989, 2001). Full mediation would imply that conflict leaves balance untouched whenever innovative behaviour is held constant, which is implausible under a multi-channel resource account. The specification also differs deliberately from prior mediation work, which has relied almost entirely on affective and cognitive mediators such as exhaustion, satisfaction, and burnout (Amstad et al., 2011; Maslach et al., 2001). Those mediators share a logic of progressive incapacitation: conflict wears the person down, and the worn-down

state degrades outcomes. A proactive behavioural mediator tests a different logic, interrupted capability: conflict removes the room for adaptive manoeuvre before exhaustion ever sets in. The two logics are complementary, and specifying the behavioural one is the theoretical novelty of the model.

H6. Innovative work behaviour mediates the negative relationship between work-to-family conflict and work–life balance.

H7. Innovative work behaviour mediates the negative relationship between family-to-work conflict and work–life balance.

2.7. Perceived Organisational Support as the Conversion Condition

Organisational support theory holds that employees form a global perception of how much the organisation values their contributions and cares about their well-being, and reciprocate accordingly (Eisenberger et al., 1986); the meta-analytic record ties POS to commitment, performance, and reduced strain (Rhoades & Eisenberger, 2002). The present model assigns POS a sharper role than favourable climate: it is the resource caravan passageway that governs whether invested effort returns resources (Hobfoll, 2012). When the organisation shares implementation costs through legitimacy, responsiveness, coordination help, and recognition in workload models, innovative effort converts into time savings and restored control; when it does not, the same effort remains invisible labour performed outside formal recognition. Moderation is therefore predicted at the second stage of the mediated pathway, on the IWB to WLB link, rather than on the conflict paths.

The Chinese organisational context sharpens the prediction. Among teachers in Chinese higher education, the path from institutional conditions to innovative behaviour runs through psychological resources such as work engagement (Zhou et al., 2025), and coordination and endorsement travel through guanxi, the relational networks whose development Chen and Chen (2004) describe as gradual, reciprocal, and obligation-laden. Where endorsement and relational sponsorship set the price of initiative, the payoff of innovative behaviour should depend all the more on whether the institution visibly backs it.

H8. Perceived organisational support moderates the positive relationship between innovative work behaviour and work–life balance, such that the relationship is stronger when perceived organisational support is higher.

2.8. Research Gap

Read together, the literatures reviewed above leave a four-part gap. First, integration: work-family scholarship and innovation scholarship have developed along separate lines, the former oriented to strain and well-being outcomes (Allen et al., 2000; Amstad et al., 2011; Byron, 2005), the latter to leadership, climate, and performance antecedents (Anderson et al., 2014; de Jong & den Hartog, 2010), so whether conflict constrains the behavioural capacity to improve one's own work remains underdeveloped; Bao et al. (2025) reach only from FWC to IWB and stop there. Second, mechanism: prior work documents conflict-outcome associations more thoroughly than it explains how conflict becomes sustained imbalance, and the mediators that have been tested are affective rather than behavioural (Amstad et al., 2011; Maslach et al., 2001). Third, boundary

conditions: the circumstances under which innovative effort yields net balance gains rather than added burden are underspecified, despite direct evidence that innovation without fairness or support feeds strain (Cavanaugh et al., 2000; Janssen, 2000; Rhoades & Eisenberger, 2002). Fourth, context: China-based studies increasingly document evaluation reform and its pressures (Gao & Wang, 2024; Liang et al., 2025; Xu et al., 2023), but province-level public university systems are rarely treated as theoretically meaningful settings in full structural models. The present study addresses all four parts with one specification: WFC and FWC as parallel antecedents, IWB as the mediating capability, POS as the second-stage moderator, and WLB as the sustainability outcome, tested among academics in Shanxi Province.

2.9. Exploratory Gender Proposition and Conceptual Model

Social role theory and role accumulation theory imply gendered salience of conflict: communal expectations concentrate caregiving on women (Eagly, 1987; Sieber, 1974), academic housework imposes an invisible tax on women's professional time (Misra et al., 2011), and women's contributions are disproportionately undervalued or attributed to team effort (Sarsons et al., 2021). Yet the meta-analytic record is mixed: women report higher family-to-work conflict, but conflict-outcome relationships are not uniformly stronger for women (Byron, 2005; Michel et al., 2011). The question is therefore stated as an exploratory proposition, deliberately not numbered as a hypothesis: the relationships in H1–H8 may differ in salience between female and male academics. It is examined through within-group estimation only, because the achieved subgroup sizes do not support the measurement-invariance assessment and formal between-group tests that a confirmatory heterogeneity claim would require (Cheah et al., 2023; Henseler et al., 2016).

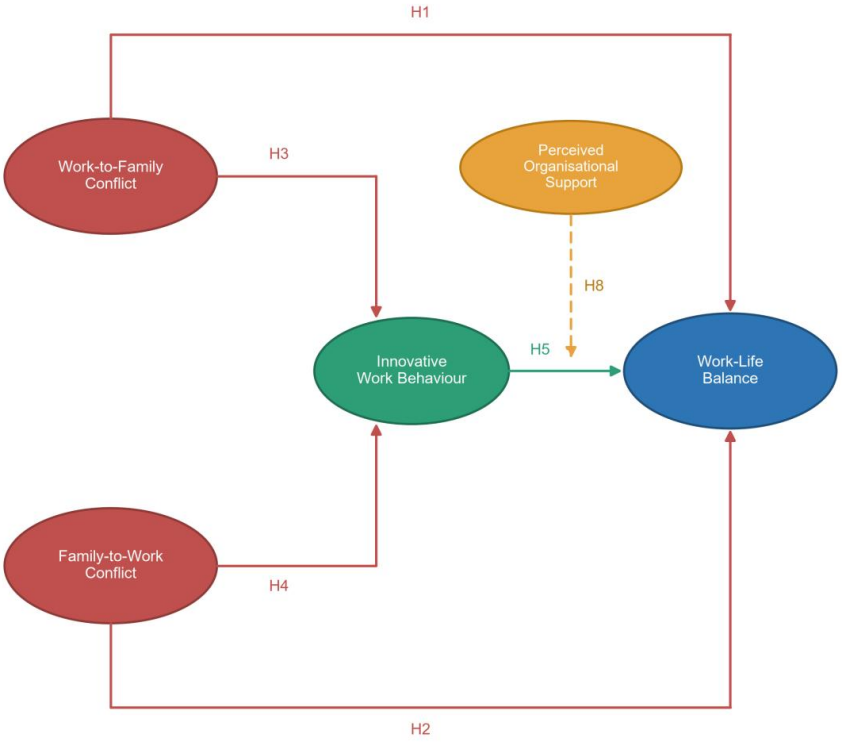


Figure 1. Conceptual model of work–family conflict, innovative work behaviour, perceived organisational support, and work–life balance

As shown in Figure 1, WFC and FWC carry direct paths to WLB (H1, H2) and to IWB (H3, H4); IWB carries a direct path to WLB (H5) and transmits the two indirect effects (H6, H7); the dashed arrow denotes the moderation of the IWB → WLB path by POS (H8). Demographic and career variables served sample description and the exploratory gender split only; the estimated model contains WFC, FWC, IWB, POS, and the IWB × POS interaction. Table 1 summarises the hypothesised paths, expected directions, and test procedures.

Table 1. Hypothesised paths, expected directions, and test procedures

Hypothesis	Path / relationship	Expected direction	Test procedure
H1	WFC → WLB	Negative	Path coefficient; bootstrapped CI
H2	FWC → WLB	Negative	Path coefficient; bootstrapped CI
H3	WFC → IWB	Negative	Path coefficient
H4	FWC → IWB	Negative	Path coefficient
H5	IWB → WLB	Positive	Path coefficient
H6	WFC → IWB → WLB	Negative (indirect)	Bootstrapped indirect effect; CI
H7	FWC → IWB → WLB	Negative (indirect)	Bootstrapped indirect effect; CI
H8	IWB × POS → WLB	Strengthening	Interaction term; simple slopes
Exploratory	Female vs male, within group	Not directional	Within-group only; no between-group test

3. Methods

3.1. Design, Population, and Sample Size

The study used a quantitative, cross-sectional, hypothesis-testing survey design within a post-positivist orientation: WFC, FWC, IWB, POS, and WLB were treated as real phenomena accessed as latent variables through validated self-reports, and results are interpreted as theory-consistent associations rather than causal proof (Creswell & Creswell, 2022; Maxwell & Cole, 2007). The reasoning was deductive, moving from COR and JD-R theory to hypotheses H1–H8, then to measurement with established scales and statistical testing. The target population was full-time academic staff in public universities in Shanxi Province, China, a workforce of 30,237 full-time teachers in ordinary undergraduate institutions (Ministry of Education of the People's Republic of China, 2024); the unit of analysis was the individual academic. Inclusion required full-time academic employment in the province, current engagement in teaching, research, supervision, or

academic service, age 25 or above, and informed voluntary participation; administrative-only, part-time, adjunct, temporary, postdoctoral, and visiting appointments were excluded. Because no complete sampling frame of eligible academics exists, non-probability stratified quota sampling structured recruitment across university type, disciplinary grouping, academic rank, gender, and age category, through faculty networks and departmental contacts at multiple universities. The achieved sample is a structured analytical sample suited to theory testing, not a random representation of the provincial academic population.

The minimum sample size was fixed before fieldwork (Table 2). The primary criterion was the inverse square root method (Kock & Hadaya, 2018), which requires

$$n_{\min} > \left(\frac{2.486}{|\beta_{\min}|}\right)^2 \quad (1)$$

where $n_{\min}$ is the minimum sample size at a 5% significance level and 80% power and $\beta_{\min}$ is the smallest standardised path coefficient the design intends to detect. Anticipating $|\beta_{\min}| = 0.13$, a typical magnitude for direct effects in work–family models containing a mediator, Eq. (1) returns 366; an F-test power analysis for the WLB equation returns 263; and the ten-times rule returns an uninformative floor of 50 (Hair et al., 2022). The larger figure was adopted and the recruitment target set near 400. The achieved sample of 402 implies a smallest detectable coefficient of 0.124 at 80% power, and the weakest significant path in the estimated model (FWC → WLB, β = −0.127) sits just above that threshold.

Table 2. A priori minimum sample size under three criteria

Criterion	Parameters	Minimum n	Status
Ten-times rule	Max arrows into a construct = 5	50	Rejected
Inverse square root method	α = .05; power = .80; |β_min| = 0.13	366	Adopted
F-test power analysis (WLB)	5 predictors; α = .05; power = .80; f² = 0.05	263	Secondary check
Recruitment target	A priori minimum + margin	400	Planned
Achieved analytical sample	After screening (Section 4.1)	402	Adequate

3.2. Measures

All constructs were measured with established multi-item scales on a five-point Likert format (1 = strongly disagree, 5 = strongly agree), 24 substantive items in total, all reflective (Hair et al., 2022). WFC and FWC used the bidirectional five-item conflict scales of Netemeyer et al. (1996); IWB used six items adapted from Scott and Bruce (1994), covering idea generation, promotion, and implementation (de Jong & den Hartog, 2010); POS used four items from the Survey of Perceived Organisational Support tradition (Eisenberger et al., 1986; Rhoades & Eisenberger, 2002), with one negatively worded item reverse-coded; WLB used the four-item scale of Brough et al. (2014). Wording adaptations were limited to context (e.g., “my university”). The questionnaire

opened with screening and consent items, followed by demographics (gender, age, marital status, number of children, academic rank, years of service) and the substantive blocks; predictor, mediator/moderator, and outcome blocks were separated by neutral headings and transition screens to reduce hypothesis cueing in a single-source design (Podsakoff et al., 2003). English items were translated into Chinese by a bilingual researcher, checked by a second bilingual reviewer, and reviewed against the source items for shifts in meaning (Brislin, 1970; DeVellis & Thorpe, 2021).

3.3. Pre-test and Pilot Study

After expert review, a pre-test (5–12 September 2025, n = 12, two universities) identified five wording and presentation issues, all corrected; median completion time was 17.4 minutes, one third of which later set the minimum completion-time screening rule. A pilot study (18–30 September 2025, n = 45, four universities) returned Cronbach's alpha between 0.755 and 0.903 for all constructs and corrected item-total correlations of 0.382 to 0.863; the single item below 0.40 was reworded rather than deleted and performed adequately in the main study (Table 3). All 24 items entered the main survey.

Table 3. Pilot study reliability and item performance

Construct	Items	M	SD	Cronbach's α	Corrected item–total r	Decision
WFC	5	3.453	0.766	0.845	0.534–0.813	Retained
FWC	5	2.929	0.657	0.755	0.382–0.634	FWC3 reworded
IWB	6	3.874	0.732	0.903	0.642–0.863	Retained
POS	4	3.694	0.659	0.821	0.592–0.711	Retained
WLB	4	3.511	0.653	0.763	0.493–0.651	Retained

3.4. Data Collection and Ethics

The main survey ran on the Questionnaire Star platform from 10 October to 10 November 2025 in three weekly waves with reminders (Dillman et al., 2014). Platform controls limited repeated submissions per device and IP address and recorded completion time; all substantive items were mandatory, so the exported data contained no missing values, and the minimum completion-time rule derived from the pre-test median could be applied mechanically rather than by impression. Of 700 returned questionnaires, 402 survived the pre-specified screens in Section 4.1. Participation was voluntary and anonymous with informed consent; screening decisions were logged case by case against the pre-specified rules, preserving an audit trail. The protocol was approved by the Faculty Research Ethics Committee, Graduate School of Business, SEGi University (reference GSB-2026-088).

3.5. Analytical Strategy

SPSS handled screening, descriptives, and exploratory factor diagnostics; SmartPLS estimated the PLS-SEM models. PLS-SEM was preferred over covariance-based SEM on four grounds: the variance-based algorithm imposes no distributional assumption on the indicators (Ringle et al.,

2020); the sample of 402 is comfortable for the specified model but modest for a covariance-based moderated-mediation specification; the research objective is prediction and explanation of target constructs, for which PLS-SEM is the recommended method (Hair et al., 2022); and interaction estimation plus exploratory subgroup analysis are natively supported (Henseler et al., 2015). The analysis proceeded in four stages: data screening, including careless-response rules (Meade & Craig, 2012), outlier diagnostics ($|z| > 3.29$; Mahalanobis distance at $p < .001$; Tabachnick & Fidell, 2019), distributional checks, and collinearity; reflective measurement-model assessment; structural-model evaluation with 5,000 bias-corrected and accelerated bootstrap subsamples (two-tailed), including mediation through bootstrapped specific indirect effects (Zhao et al., 2010) and moderation through a two-stage IWB × POS interaction term probed with simple slopes; and an exploratory within-group gender comparison, reported without between-group tests because measurement invariance of composites was not established (Cheah et al., 2023; Henseler et al., 2016). Demographic variables served description and the gender split only, so the estimated model contains WFC, FWC, IWB, POS, and the interaction. Common method bias was addressed procedurally and diagnosed with Harman's screen (Podsakoff et al., 2003) and the full-collinearity criterion (Kock, 2015). The formulas for each assessment criterion are reported at first use in Section 4.

4. Results

4.1. Data Screening

Structural coefficients can be interpreted with confidence only when the quality of the dataset has first been demonstrated, so screening preceded all substantive analysis and applied rules fixed before the data were examined; 402 of 700 returned questionnaires survived, and every subsequent analysis uses this same case base. Because every substantive item was mandatory, the 24 indicators each recorded 402 valid responses with 0.00% missing, so no imputation was required (Table 4).

Table 4. Missing-value audit of the measurement items

Construct	Item range	Items	Valid N	Missing n	Missing %	Decision
WFC	WFC1–WFC5	5	402	0	0.00	Retained
FWC	FWC1–FWC5	5	402	0	0.00	Retained
IWB	IWB1–IWB6	6	402	0	0.00	Retained
POS	POS1–POS4	4	402	0	0.00	Retained
WLB	WLB1–WLB4	4	402	0	0.00	Retained
Total	-	24	402	0	0.00	-

Four pre-specified gates were applied in fixed order, so the exclusion counts are mutually exclusive (Table 5; Figure 2): 98 ineligible respondents; 77 duplicate submissions sharing IP address and device signature; 23 cases completed in under 360 seconds (one third of the pre-test

median) or straight-lining 20 or more of the 24 items; and 100 cases breaching contradiction rules (a reverse-item discrepancy of four or more scale points, an impossible demographic combination, or a cyclical response pattern across three or more blocks). Each excluded case was tagged with the rule it breached and retained with the raw data for audit. The 57.43% retention rate is consistent with studies that filter a professionally defined population and then screen on response effort.

Table 5. Sequential case screening and final sample retention

Screening stage	Criterion	n removed	n remaining	% of returns
Questionnaires returned	All submissions, 10 Oct–10 Nov 2025	-	700	100.00
Eligibility screening	Not full-time academic staff at a Shanxi public university	98	602	86.00
Duplicate / technical	Repeat submission: same IP and device signature	77	525	75.00
Duration / straight-lining	Completion < 360 s, or identical response on ≥ 20 of 24 items	23	502	71.71
Response-quality review	Reverse-item discrepancy ≥ 4 points; impossible demographics; cyclical pattern ≥ 3 blocks	100	402	57.43
Final valid cases	Cases entering all analyses	-	402	57.43

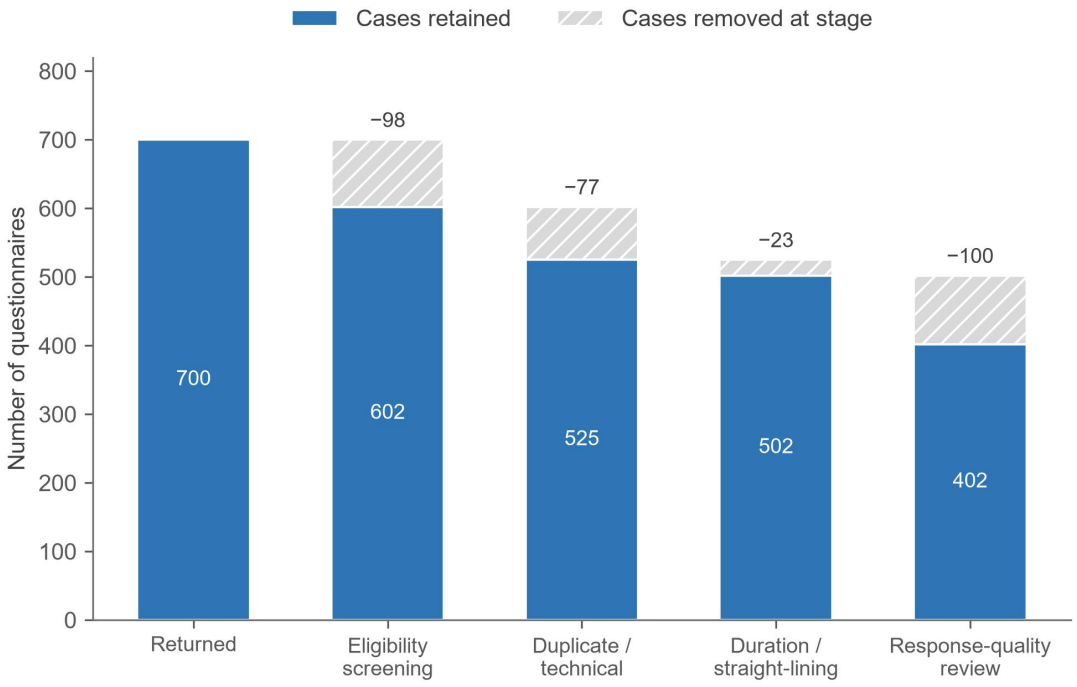


Figure 2. Sequential case screening and retention of returned questionnaires

Outlier diagnostics warranted no deletion (Table 6; Figure 3). No composite exceeded |z| > 3.29 (largest 3.246, on POS); the five observations above |z| > 3.00 showed internally consistent answering and were retained. The largest Mahalanobis distance on the five composites was 17.030 (M = 4.988), below the $\chi^2(5)$ criterion of 20.515 at $p < .001$.

Table 6. Univariate and multivariate outlier diagnostics (N = 402)

Construct	Max |z|	n |z| > 3.00	n |z| > 3.29	Decision
WFC	2.494	0	0	Retained
FWC	2.868	0	0	Retained
IWB	3.244	3	0	Retained
POS	3.246	2	0	Retained
WLB	2.379	0	0	Retained
Mahalanobis D^2 (5 df)	17.030	3	0	Retained

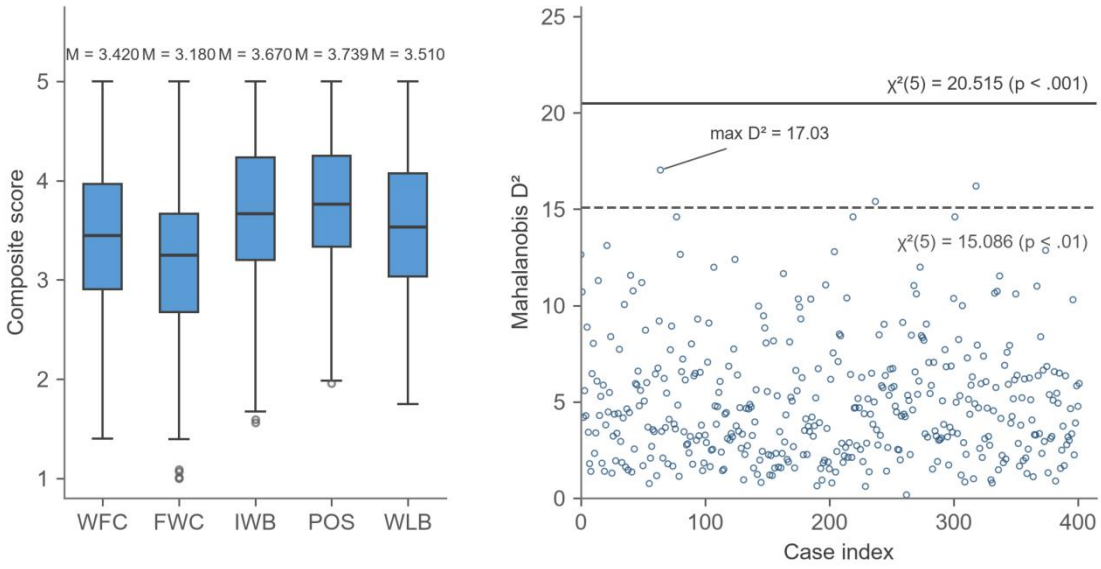


Figure 3. Distribution of composite scores and Mahalanobis distances

PLS-SEM imposes no normality requirement, so the distributional review was diagnostic. Across the 24 items skewness ranged from −0.451 to 0.091 and excess kurtosis from −0.671 to −0.116 (Table 7); at construct level skewness ranged from −0.233 to −0.039 and kurtosis from −0.485 to −0.210 (Table 8), all inside the |skewness| < 2 and |kurtosis| < 7 limits (Curran et al., 1996). The Kolmogorov–Smirnov and Shapiro–Wilk rejections in Table 8 reflect statistical power at N = 402 rather than substantive departure (Ghasemi & Zahediasl, 2012), as the histograms in Figure 4 and the Q-Q plots in Figure 5 confirm.

Table 7. Item-level descriptive statistics and distributional indices (N = 402)

Item	Min	Max	M	Mdn	SD	Skewness	Kurtosis
WFC1	1	5	3.684	4.0	0.825	−0.213	−0.326
WFC2	1	5	3.306	3.0	1.013	−0.179	−0.441
WFC3	1	5	3.346	3.0	1.049	−0.298	−0.442
WFC4	1	5	3.296	3.0	1.030	0.029	−0.671
WFC5	1	5	3.468	4.0	1.057	−0.373	−0.384
FWC1	1	5	3.211	3.0	0.898	0.091	−0.201
FWC2	1	5	3.109	3.0	0.983	0.064	−0.434
FWC3	1	5	3.326	3.0	0.961	−0.133	−0.441
FWC4	1	5	3.107	3.0	0.966	−0.066	−0.190
FWC5	1	5	3.147	3.0	1.002	−0.028	−0.353
IWB1	1	5	4.022	4.0	0.800	−0.451	−0.205
IWB2	1	5	3.527	4.0	0.896	−0.239	−0.348
IWB3	1	5	3.517	4.0	0.902	−0.144	−0.392
IWB4	1	5	3.726	4.0	0.913	−0.203	−0.612
IWB5	1	5	3.677	4.0	0.923	−0.289	−0.475
IWB6	1	5	3.550	4.0	0.893	−0.256	−0.116
POS1	1	5	3.786	4.0	0.844	−0.278	−0.390
POS2	1	5	3.652	4.0	0.898	−0.337	−0.236
POS3	1	5	3.838	4.0	0.815	−0.305	−0.270
POS4	2	5	3.682	4.0	0.782	−0.130	−0.389
WLB1	1	5	3.619	4.0	0.875	−0.122	−0.460
WLB2	1	5	3.455	3.0	1.003	−0.219	−0.394
WLB3	1	5	3.448	3.0	0.898	−0.092	−0.601
WLB4	1	5	3.517	4.0	0.916	−0.169	−0.367

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Table 8. Construct-level distributional diagnostics and normality tests (N = 402)

Construct	Min	Max	M	SD	Skewness	Kurtosis	K-S D	K-S p	S-W W	S-W p
WFC	1.40	5.00	3.420	0.810	−0.209	−0.479	0.066	0.060	0.983	<.001
FWC	1.00	5.00	3.180	0.760	−0.039	−0.388	0.079	0.013	0.990	0.008
IWB	1.33	5.00	3.670	0.720	−0.233	−0.210	0.058	0.123	0.983	<.001
POS	1.50	5.00	3.739	0.690	−0.228	−0.271	0.092	0.002	0.977	<.001
WLB	1.75	5.00	3.510	0.740	−0.116	−0.485	0.075	0.021	0.981	<.001

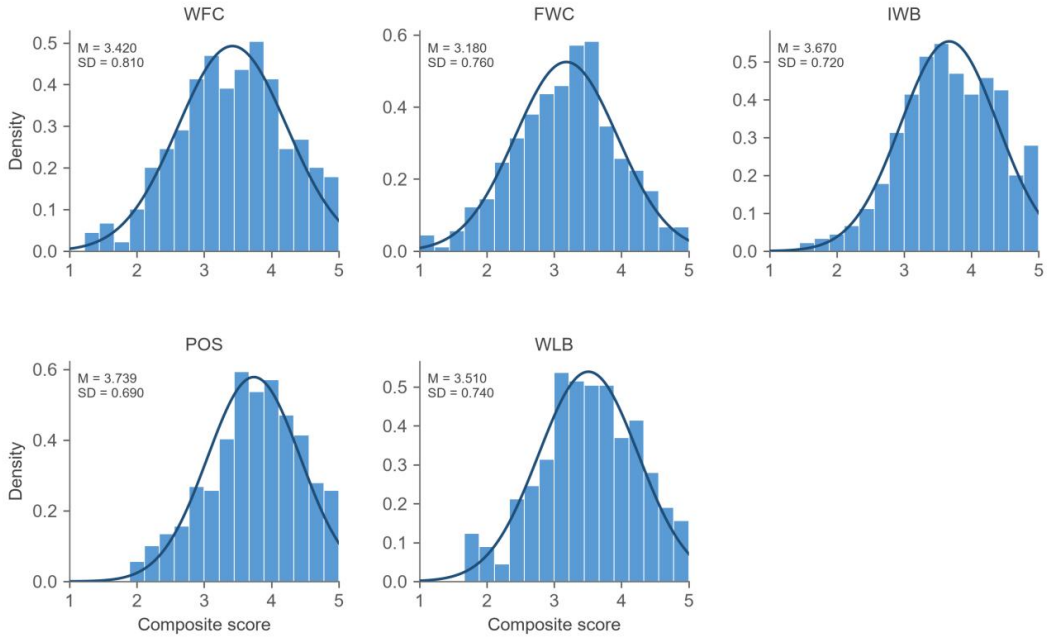


Figure 4. Frequency distributions of the composite scores with fitted normal curves

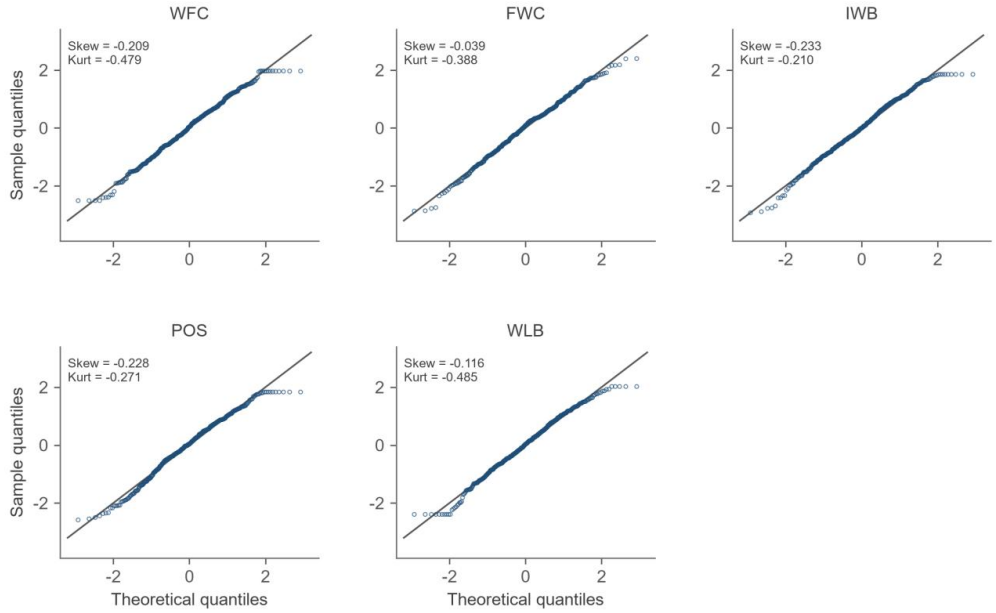


Figure 5. Normal Q-Q plots of the composite scores

Collinearity was quantified with the variance inflation factor,

$$\mathrm{VIF}_j = \frac{1}{1-R_j^2} \quad (2)$$

where R_j^2 is the variance in indicator or construct j explained by the remaining indicators or constructs. Item-level values from Eq. (2) ranged from 1.777 to 2.768 and construct-level values from 1.376 to 1.825 (Table 9; Figure 6), below the conservative 3.30 benchmark and the 5.00 ceiling (Hair et al., 2022; Kock, 2015).

Table 9. Item-level and construct-level variance inflation factors

Construct	Item range	VIF min	VIF max	VIF mean	Construct VIF
WFC	WFC1–WFC5	1.864 (WFC2)	2.426 (WFC1)	2.139	1.376
FWC	FWC1–FWC5	1.797 (FWC2)	2.160 (FWC1)	1.912	1.533
IWB	IWB1–IWB6	1.951 (IWB3)	2.768 (IWB1)	2.298	1.703
POS	POS1–POS4	1.795 (POS4)	2.327 (POS1)	2.041	1.614
WLB	WLB1–WLB4	1.777 (WLB3)	1.951 (WLB1)	1.871	1.825

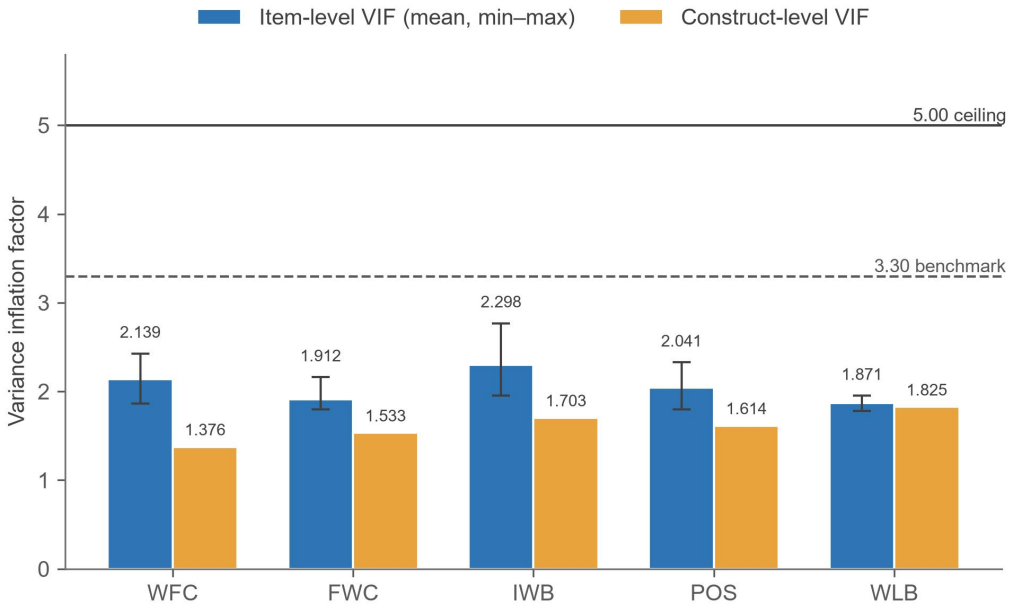


Figure 6. Item-level variance inflation factors against diagnostic thresholds

4.2. Respondent Profile

The sample profile appears in Table 10 and Figure 7: 59.20% women; 58.46% aged 40 or below; lecturers (35.57%) and associate professors (30.35%) the largest ranks; 69.15% married; the one-child family modal (46.77%); and 61.69% with ten or fewer years of service. This life-stage and career-stage heterogeneity serves the analysis, while very small cells in some categories (three widowed respondents, seven academics with more than 30 years of service) confine defensible subgroup analysis to gender, treated as exploratory in Section 4.9.

Table 10. Demographic and career profile of the respondents

Variable	Category	n	%	Cum. %
Gender	Male	164	40.80	40.80
	Female	238	59.20	100.00
Age (years)	< 30	91	22.64	22.64
	30–40	144	35.82	58.46
	41–50	103	25.62	84.08
	51–60	64	15.92	100.00
Academic rank	Assistant lecturer	72	17.91	17.91
	Lecturer	143	35.57	53.48
	Associate professor	122	30.35	83.83
	Professor	65	16.17	100.00
Marital status	Single	104	25.87	25.87
	Married	278	69.15	95.02
	Divorced	17	4.23	99.25
	Widowed	3	0.75	100.00
Children	0	108	26.87	26.87
	1	188	46.77	73.63
	2	71	17.66	91.29
	≥ 3	35	8.71	100.00
Service (years)	≤ 5	127	31.59	31.59
	6–10	121	30.10	61.69
	11–20	86	21.39	83.08
	21–30	61	15.17	98.26
	> 30	7	1.74	100.00
Total		402	100.00	

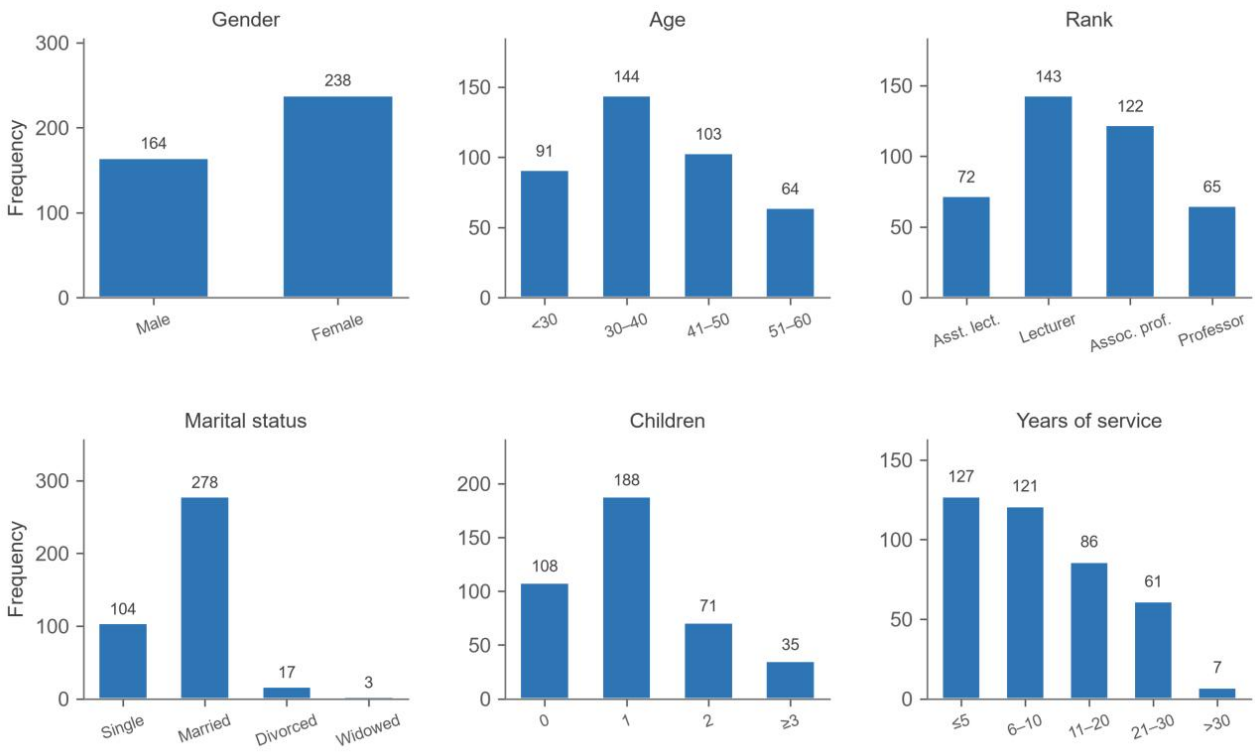


Figure 7. Distribution of the sample across demographic and career categories

4.3. Descriptive Statistics and Correlations

Construct descriptives appear in Table 11 and Figure 8, and the profile is informative before any model is estimated. WFC (M = 3.420, SD = 0.810) sits in the upper-middle range of the scale: for a substantial share of respondents, teaching preparation, research obligations, administrative reporting, and digital responsiveness routinely encroach on family time. FWC is lower (M = 3.180, SD = 0.760), matching the directional asymmetry reported for full-time professional samples (Byron, 2005; Michel et al., 2011) and plausibly reflecting the greater structural permeability of work-into-family time boundaries under institutional schedules and after-hours digital norms; it remains mid-scale rather than negligible, so family-generated interference is a present concern, not a marginal one. IWB (M = 3.670) shows that idea generation, championing, and implementation are present as recognisable behavioural tendencies even under role conflict, with dispersion indicating that some academics are considerably more engaged in innovation than others. POS (M = 3.739) reflects mixed rather than uniformly favourable perceptions of institutional care, exactly the contextual variability the moderation test requires. WLB (M = 3.510) indicates arrangements experienced as only marginally manageable rather than securely sustainable. Coefficients of variation between 0.18 and 0.24 rule out the range restriction that would attenuate structural estimates.

Table 11. Descriptive statistics of the five focal constructs

Code	Construct	Items	M	SD	CV	Skewness	Kurtosis
WFC	Work-to-Family Conflict	5	3.420	0.810	0.237	−0.209	−0.479
FWC	Family-to-Work Conflict	5	3.180	0.760	0.239	−0.039	−0.388
IWB	Innovative Work Behaviour	6	3.670	0.720	0.196	−0.233	−0.210
POS	Perceived Organisational Support	4	3.739	0.690	0.185	−0.228	−0.271
WLB	Work–Life Balance	4	3.510	0.740	0.211	−0.116	−0.485

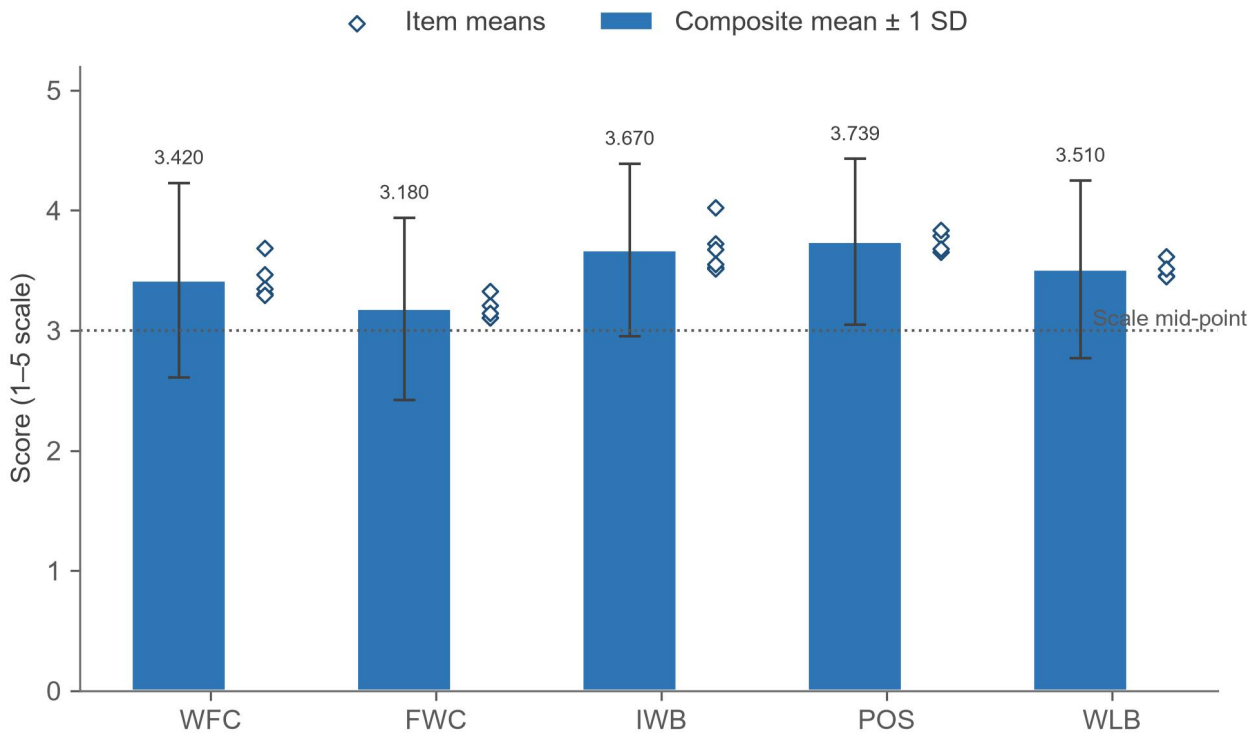


Figure 8. Construct means with one standard deviation and underlying item means

Pearson correlations appear in Table 12 and Figure 9. WFC and FWC correlate positively yet moderately ($r = .361$, $p < .01$), confirming separability. Both correlate negatively with WLB at near-equal magnitudes (−.464 and −.474), supporting their treatment as parallel antecedents; IWB correlates positively with WLB (.506); POS shows the largest WLB correlation (.564), the empirical warrant for modelling it as a boundary condition rather than a control (Bakker & Demerouti, 2007). The conflict-IWB correlations are asymmetric (FWC −.525 vs WFC −.426), an ordering that recurs in the structural estimates. Coefficients marked with two asterisks are significant at $p < .01$ (two-tailed); composite-level coefficients are attenuated relative to the latent-variable correlations in Table 18.

Table 12. Means, standard deviations, and Pearson correlations among the composite scores

Construct	M	SD	1	2	3	4	5
WFC	3.420	0.810	1	-	-	-	-
FWC	3.180	0.760	.361**	1	-	-	-
IWB	3.670	0.720	−.426**	−.525**	1	-	-
POS	3.739	0.690	−.356**	−.417**	.483**	1	-
WLB	3.510	0.740	−.464**	−.474**	.506**	.564**	1

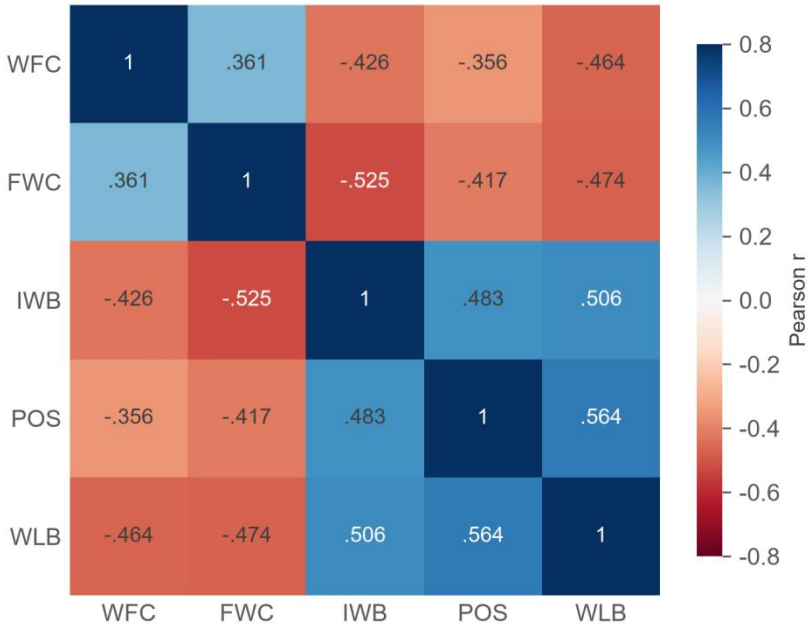


Figure 9. Correlation structure of the five composite scores

4.4. Measurement Model Assessment

Because the model is estimated with reflective constructs, structural interpretation is meaningful only if the measures first demonstrate adequate reliability and validity; weak indicators or insufficient discriminant validity can distort path estimates in either direction. Factorability was confirmed before confirmatory estimation. The Kaiser–Meyer–Olkin measure was 0.937 with no item below 0.909, and Bartlett's test rejected the identity hypothesis, $\chi^2(276) = 4869.112$, $p < .001$ (Table 13). Principal component analysis with varimax rotation extracted five components with eigenvalues above unity explaining 66.220% of total variance; the scree plot shows a clear break after the fifth component (Figure 10). Every indicator loads most strongly on its intended component (primary loadings ≥ 0.658; largest cross-loading 0.307) with communalities of 0.583 to 0.744 (Table 14; Figure 11). In Table 14, loadings below |.10| are suppressed and the cells left blank; the final row gives the sums of squared loadings after rotation. No item was deleted.

Table 13. Kaiser–Meyer–Olkin measure and Bartlett's test of sphericity

Test	Statistic	Value
KMO measure of sampling adequacy	KMO	0.937
	Minimum item MSA	0.909 (WFC4)
	Maximum item MSA	0.954
Bartlett's test of sphericity	Approx. χ^2	4869.112
	df	276
	Sig.	<.001
Correlation matrix	Determinant	4.05e-06

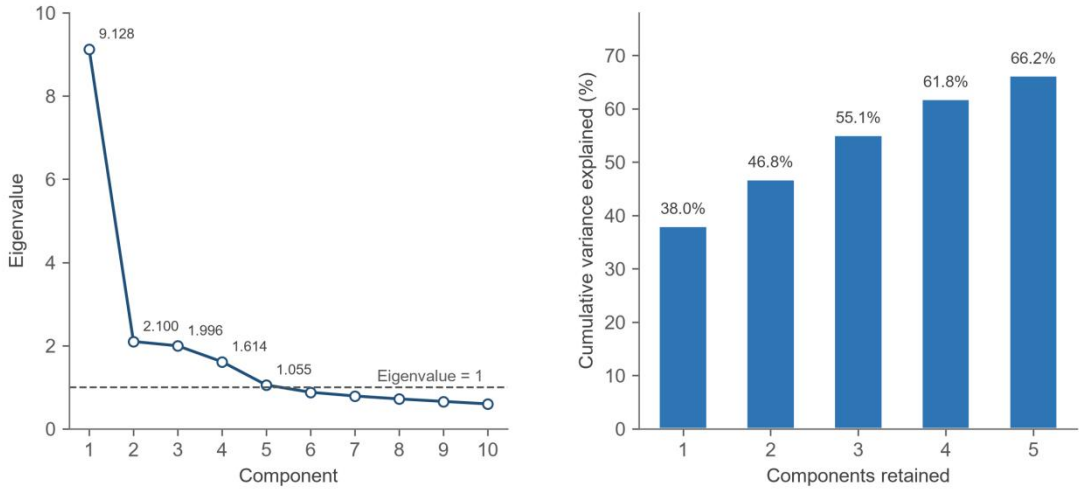


Figure 10. Scree plot and cumulative variance explained

Table 14. Rotated component matrix and communalities

Indicator	1 (WFC)	2 (FWC)	3 (IWB)	4 (POS)	5 (WLB)	Communality
WFC1	0.810	0.149	−0.141	−0.134	−0.106	0.727
WFC2	0.725	0.185	−0.160		−0.138	0.605
WFC3	0.761	0.102	−0.190	−0.131	−0.137	0.661
WFC4	0.802		−0.103	−0.127		0.677
WFC5	0.776		−0.157	−0.122	−0.180	0.679
FWC1	0.141	0.772	−0.180	−0.142	−0.154	0.693
FWC2	0.194	0.689	−0.185	−0.136	−0.137	0.583

Indicator	1 (WFC)	2 (FWC)	3 (IWB)	4 (POS)	5 (WLB)	Communality
FWC3	0.110	0.742	−0.159		−0.135	0.616
FWC4	0.111	0.734	−0.233	−0.149	−0.117	0.642
FWC5		0.714	−0.238	−0.136	−0.122	0.602
IWB1	−0.182	−0.172	0.784	0.128	0.225	0.744
IWB2		−0.164	0.752	0.167	0.213	0.675
IWB3	−0.149	−0.114	0.744	0.168		0.623
IWB4	−0.206	−0.242	0.719	0.112	0.140	0.650
IWB5	−0.169	−0.192	0.772	0.113		0.681
IWB6	−0.100	−0.189	0.710	0.278	0.115	0.641
POS1	−0.150	−0.147	0.158	0.762	0.269	0.722
POS2	−0.152	−0.157	0.138	0.765	0.179	0.684
POS3	−0.143		0.256	0.754	0.134	0.676
POS4		−0.166	0.169	0.756	0.126	0.647
WLB1	−0.119	−0.135	0.244	0.258	0.732	0.695
WLB2	−0.226	−0.211	0.115	0.307	0.659	0.638
WLB3	−0.273	−0.129	0.194	0.207	0.658	0.605
WLB4	−0.133	−0.170	0.188	0.129	0.791	0.725
SS loadings	3.462	3.133	3.955	2.855	2.487	

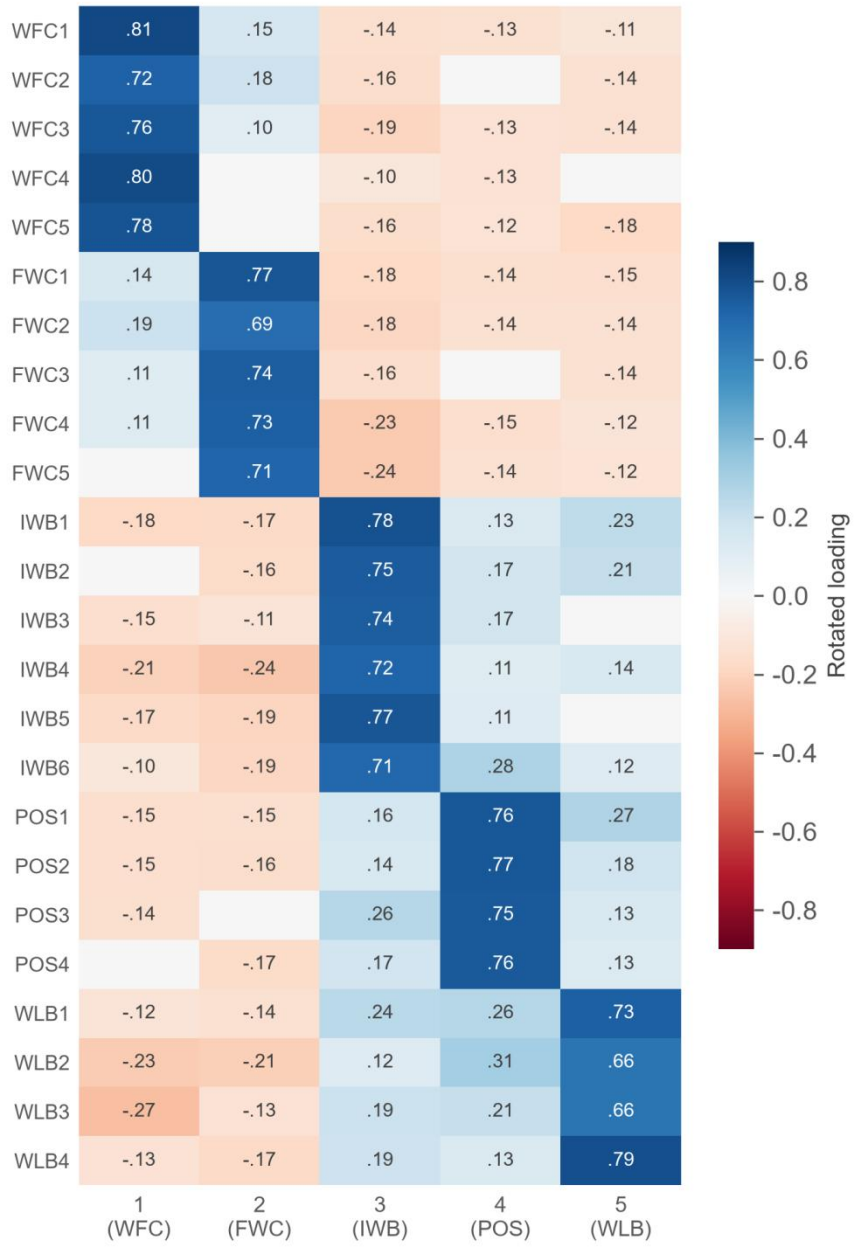


Figure 11. Rotated component loadings of the 24 measurement indicators

Item-level consistency was checked before construct-level coefficients: corrected item-total correlations range from 0.598 to 0.782, and deleting any item would lower the alpha of its scale (Table 15; Figure 12).

Table 15. Item-total statistics and internal consistency by construct (CITC = corrected item–total correlation)

Construct	Item	M if deleted	Var. if deleted	CITC	α if deleted	Scale α
WFC	WFC1	13.415	11.515	0.750	0.835	0.881
	WFC2	13.794	11.037	0.644	0.855	
	WFC3	13.754	10.525	0.701	0.841	

Construct	Item	M if deleted	Var. if deleted	CITC	α if deleted	Scale α
	WFC4	13.803	10.682	0.690	0.844	
	WFC5	13.632	10.408	0.714	0.838	
FWC	FWC1	12.689	9.671	0.712	0.806	0.842
	FWC2	12.791	9.647	0.629	0.827	
	FWC3	12.575	9.666	0.646	0.822	
	FWC4	12.794	9.491	0.676	0.814	
	FWC5	12.754	9.503	0.638	0.824	
IWB	IWB1	17.998	13.444	0.782	0.869	0.895
	IWB2	18.493	13.148	0.726	0.876	
	IWB3	18.502	13.383	0.678	0.883	
	IWB4	18.294	13.146	0.710	0.878	
	IWB5	18.343	12.964	0.730	0.875	
	IWB6	18.470	13.347	0.694	0.881	
POS	POS1	11.172	4.362	0.721	0.784	0.849
	POS2	11.306	4.268	0.685	0.801	
	POS3	11.119	4.594	0.675	0.805	
	POS4	11.276	4.804	0.642	0.818	
WLB	WLB1	10.420	5.337	0.657	0.755	0.815
	WLB2	10.585	4.962	0.624	0.771	
	WLB3	10.592	5.444	0.598	0.781	
	WLB4	10.522	5.188	0.654	0.755	

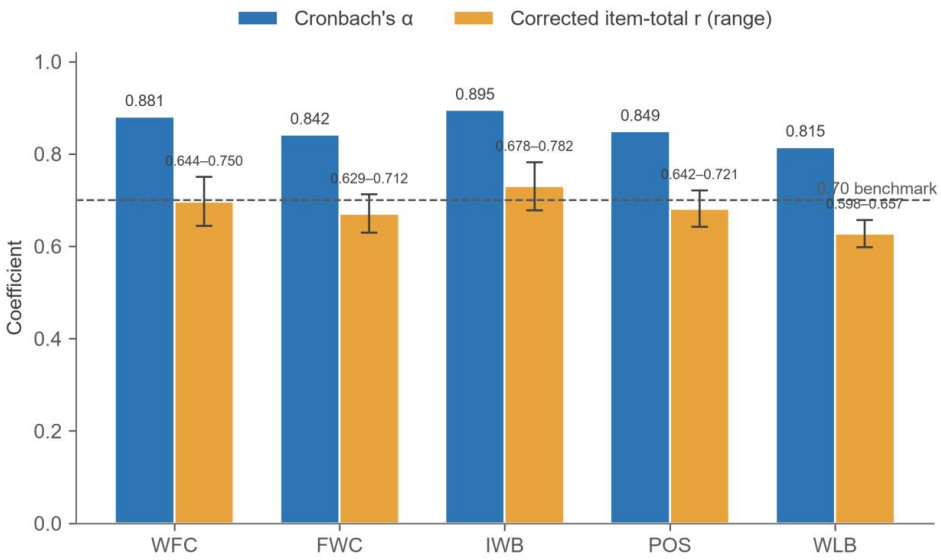


Figure 12. Cronbach's alpha and corrected item-total correlations by construct

Table 16. Construct reliability and convergent validity (PLS-SEM)

Construct	Cronbach's α	CR	AVE
FWC	0.842	0.845	0.614
IWB	0.895	0.897	0.658
POS	0.849	0.852	0.689
WFC	0.881	0.882	0.677
WLB	0.815	0.817	0.645

Internal consistency and convergent validity in the PLS-SEM measurement model were evaluated with three indices. Cronbach's alpha is

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} s_i^2}{s_t^2}\right) \tag{3}$$

where k is the number of items in a scale, s_i^2 the variance of item i, and s_t^2 the variance of the summed scale. Composite reliability is

$$\mathrm{CR} = \frac{\left(\sum_i \lambda_i\right)^2}{\left(\sum_i \lambda_i\right)^2 + \sum_i \left(1-\lambda_i^2\right)} \tag{4}$$

and average variance extracted is

$$\mathrm{AVE} = \frac{\sum_{i=1}^{k} \lambda_i^2}{k} \tag{5}$$

where λ_i is the standardised outer loading of indicator i. By Eqs. (3) to (5), alpha ranged from 0.815 to 0.895, CR from 0.817 to 0.897, and AVE from 0.614 to 0.689, clearing the 0.70 and 0.50 criteria for every construct (Table 16; Hair et al., 2022). All outer loadings exceeded the 0.708 threshold (0.743 to 0.889), so no indicator was removed (Table 17).

Table 17. Outer loadings of the reflective indicators

Indicator	FWC	IWB	POS	WFC	WLB
FWC1	0.848				
FWC2	0.786				
FWC3	0.749				
FWC4	0.788				
FWC5	0.743				
IWB1		0.889			
IWB2		0.803			
IWB3		0.775			
IWB4		0.786			
IWB5		0.810			
IWB6		0.797			
POS1			0.882		
POS2			0.803		
POS3			0.823		
POS4			0.810		
WFC1				0.857	
WFC2				0.788	
WFC3				0.801	
WFC4				0.834	
WFC5				0.834	
WLB1					0.865
WLB2					0.774
WLB3					0.770
WLB4					0.799

Discriminant validity was assessed with the Fornell–Larcker criterion and the heterotrait–monotrait ratio,

$$\mathrm{HTMT}_{ij} = \frac{\bar{r}_{ij}}{\sqrt{\bar{r}_{ii} \cdot \bar{r}_{jj}}} \quad (6)$$

where $\bar{r}_{ij}$ is the mean correlation between the indicators of constructs i and j and $\bar{r}_{ii}$, $\bar{r}_{jj}$ are the mean within-construct indicator correlations. The square roots of AVE (0.783 to 0.830) exceed all latent-variable correlations in their rows and columns (Table 18), and every HTMT value from Eq. (6) falls between 0.447 and 0.730, below the conservative 0.85 threshold (Table 19; Henseler et al., 2015). The five constructs belong to one resource-based nomological network yet remain empirically distinct, so the structural paths that follow are not artefacts of measurement overlap.

Table 18. Discriminant validity: Fornell–Larcker criterion

Construct	FWC	IWB	POS	WFC	WLB
FWC	0.783				
IWB	−0.544	0.811			
POS	−0.421	0.458	0.830		
WFC	0.411	−0.460	−0.391	0.823	
WLB	−0.477	0.517	0.608	−0.460	0.803

Table 19. Discriminant validity: heterotrait–monotrait ratio of correlations

Construct	FWC	IWB	POS	WFC	WLB
FWC					
IWB	0.621				
POS	0.495	0.525			
WFC	0.471	0.512	0.447		
WLB	0.571	0.604	0.730	0.537	

The exploratory and confirmatory evidence are complementary rather than redundant: the SPSS diagnostics establish that the item pool is factorable, that the five-factor structure is recoverable without being imposed, and that no indicator is dispensable, while the PLS-SEM assessment establishes that the reflective constructs satisfy every reliability and validity criterion required before path coefficients may be interpreted. The largest HTMT value (0.730, for POS and WLB) sits well clear of the threshold, so even the most closely related pair of constructs remains empirically distinct.

4.5. Common Method Bias

Procedural remedies (anonymity, neutral wording, separated blocks) were combined with two diagnostics (Podsakoff et al., 2003). Harman's screen shows the first unrotated component at 38.034% of total variance, below the 50% benchmark (Table 20), and the maximum item-level VIF of 2.768 satisfies the full-collinearity criterion of 3.30 (Kock, 2015). Neither diagnostic can eliminate common-source influence entirely; the residual risk is acknowledged in the limitations.

Table 20. Total variance explained by the unrotated and rotated component solution

Component	Eigenvalue	% of var.	Cum. %	SS load. (rot.)	% of var. (rot.)	Cum. % (rot.)
1	9.128	38.034	38.034	3.955	16.479	16.479
2	2.100	8.748	46.782	3.462	14.426	30.905
3	1.996	8.317	55.099	3.133	13.055	43.960
4	1.614	6.726	61.825	2.855	11.896	55.856
5	1.055	4.395	66.220	2.487	10.364	66.220

4.6. Structural Model Assessment

The estimated structural model appears in Figure 13, with the two-stage interaction term drawn as a separate construct. Structural collinearity was unproblematic (VIF 1.203 in the IWB equation; 1.385 to 1.689 in the WLB equation). Predictive relevance was assessed by blindfolding (omission distance 7) with

$$Q^2 = 1 - \frac{\text{SSE}}{\text{SSO}} \tag{7}$$

where SSE is the sum of squared prediction errors for omitted data points and SSO the sum of squared observations. WFC and FWC explained 36.3% of the variance in IWB ($Q^2 = 0.234$); the full set of predictors explained 49.7% of the variance in WLB ($Q^2 = 0.310$), so both endogenous constructs clear the $Q^2 > 0$ criterion (Table 21).

Table 21. Explanatory power and predictive relevance of the endogenous constructs

Construct	R^2	Adjusted R^2	Q^2
IWB	0.363	0.360	0.234
WLB	0.497	0.490	0.310

The unique contribution of each predictor was quantified with the effect size

$$f^2 = \frac{R^2_{\text{incl}} - R^2_{\text{excl}}}{1 - R^2_{\text{incl}}} \tag{8}$$

where R^2_{incl} and R^2_{excl} are the explained variances with and without the predictor. Against the benchmarks of 0.02, 0.15, and 0.35 (Cohen, 1988), FWC → IWB ($f^2 = 0.238$) and POS → WLB

(f^2 = 0.231) approach medium importance, WFC → IWB (f^2 = 0.106) is smaller but meaningful, and the remaining paths are small: statistically reliable but modest unique contributions, coherent for an outcome shaped by several simultaneous forces (Table 22).

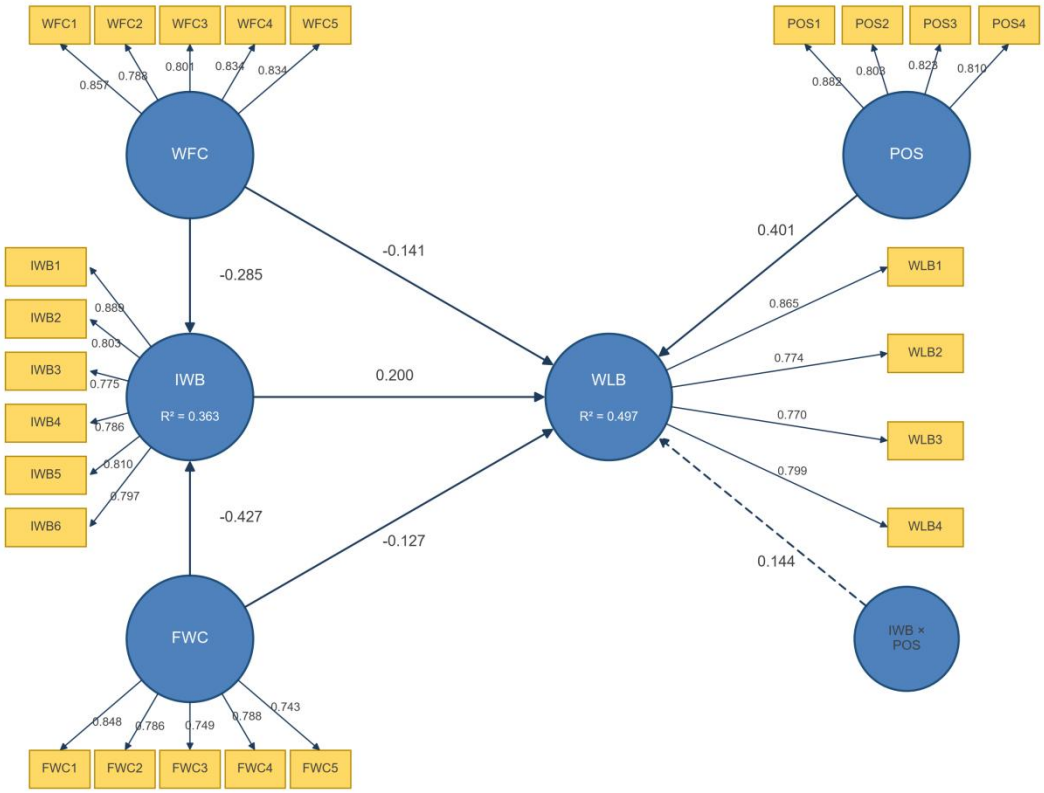


Figure 13. Estimated PLS-SEM structural model

Table 22. Effect sizes of the exogenous predictors

Path	f^2
FWC → IWB	0.238
FWC → WLB	0.021
IWB → WLB	0.047
POS → WLB	0.231
WFC → IWB	0.106
WFC → WLB	0.028

Every hypothesised direct path was significant in the predicted direction (Table 23). WFC lowered WLB (β = −0.141, t = 3.260, p = .001; H1) and FWC lowered WLB (β = −0.127, t = 2.847, p = .004; H2). Both conflict directions lowered IWB: WFC at β = −0.285 (t = 6.363, p < .001; H3) and FWC at β = −0.427 (t = 9.989, p < .001; H4). IWB raised WLB (β = 0.200, t = 4.278, p < .001;

H5), and POS carried the strongest positive direct effect on WLB (β = 0.401, t = 10.091, p < .001). Two features carry substantive weight: FWC constrains IWB half as much again as WFC does, and POS outweighs IWB as a direct predictor of balance, situating behavioural capability inside a broader institutional resource environment.

Read against the resource framework, the direct effects distribute the explanatory work across three distinct roles. The conflict paths to WLB show that imbalance follows immediately from strain, time pressure, and role incompatibility; it is not only a downstream consequence of reduced capability. The conflict paths to IWB carry the depletion argument: idea generation, promotion, and implementation draw on discretionary time, cognitive flexibility, persistence, and social coordination, and role conflict drains exactly these inputs. The positive paths from IWB and POS to WLB show that balance responds to the presence of behavioural and organisational resources, not only to the absence of conflict. Each hypothesised relationship is consistent in direction with the conceptual logic of Section 2, statistically supported, and of interpretable magnitude, which are the three conditions a theory-driven reading of path coefficients requires.

Table 23. Direct effects: path coefficients, bootstrapped t-values, p-values, and VIF

Path	β	Boot. M	Boot. SD	t	p	VIF
FWC → IWB	−0.427	−0.429	0.043	9.989	<.001	1.203
FWC → WLB	−0.127	−0.127	0.045	2.847	.004	1.562
IWB → WLB	0.200	0.200	0.047	4.278	<.001	1.689
POS → WLB	0.401	0.402	0.040	10.091	<.001	1.385
WFC → IWB	−0.285	−0.285	0.045	6.363	<.001	1.203
WFC → WLB	−0.141	−0.142	0.043	3.260	.001	1.402

4.7. Mediation Analysis

Each specific indirect effect is the product of its two constituent paths,

$$\beta_{\text{ind}} = \beta_a \times \beta_b \quad (9)$$

where β_a is the conflict → IWB path and β_b the IWB → WLB path, and the share of the total effect carried by the mediator is

$$\text{VAF} = \frac{\beta_{\text{ind}}}{\beta_{\text{ind}} + \beta_{\text{dir}}} \quad (10)$$

where β_{dir} is the remaining direct effect. Both indirect effects were significant (WFC → IWB → WLB: β = −0.057, t = 3.463, p = .001; FWC → IWB → WLB: β = −0.085, t = 4.071, p < .001) while the direct effects remained significant with the same sign, identifying complementary partial mediation (Zhao et al., 2010) and supporting H6 and H7 (Table 24). By Eq. (10), the capability pathway carries 28.8% of the total WFC effect (−0.198) and 40.1% of the total FWC effect (−0.212)

on balance: conflict undermines balance directly through strain and indirectly by disabling the innovative behaviour that might otherwise restore control.

Table 24. Direct and specific indirect effects in the mediation analysis

Effect	β	Boot. M	Boot. SD	t	p
WFC → WLB (direct)	−0.141	−0.142	0.043	3.260	.001
WFC → IWB → WLB (indirect)	−0.057	−0.057	0.016	3.463	.001
FWC → WLB (direct)	−0.127	−0.127	0.045	2.847	.004
FWC → IWB → WLB (indirect)	−0.085	−0.085	0.021	4.071	.001

4.8. Moderation Analysis

The moderation model estimates

$$\mathrm{WLB} = \beta_1\,\mathrm{IWB} + \beta_2\,\mathrm{POS} + \beta_3(\mathrm{IWB} \times \mathrm{POS}) + \varepsilon \qquad (11)$$

with the interaction term generated by the two-stage approach on standardised indicators, and the conditional slope of IWB is

$$\frac{\partial\,\mathrm{WLB}}{\partial\,\mathrm{IWB}} = \beta_1 + \beta_3\,\mathrm{POS} \qquad (12)$$

The interaction was positive and significant ($\beta_3 = 0.144$, $t = 3.792$, $p < .001$), supporting H8 (Table 25). By Eq. (12), the IWB slope is 0.344 at one standard deviation above the POS mean and 0.056 at one standard deviation below, the pattern plotted in Figure 14: innovative effort converts into balance where support is high and purchases almost nothing where it is low. The behavioural capability is real but not self-executing; its value is jointly produced by the academic who exercises it and the institution that converts it.

Table 25. Moderating effect of perceived organisational support on the IWB–WLB relationship

Path	β	Boot. M	Boot. SD	t	p
IWB → WLB	0.200	0.200	0.047	4.278	<.001
POS → WLB	0.401	0.402	0.040	10.091	<.001
IWB × POS → WLB	0.144	0.143	0.038	3.792	<.001

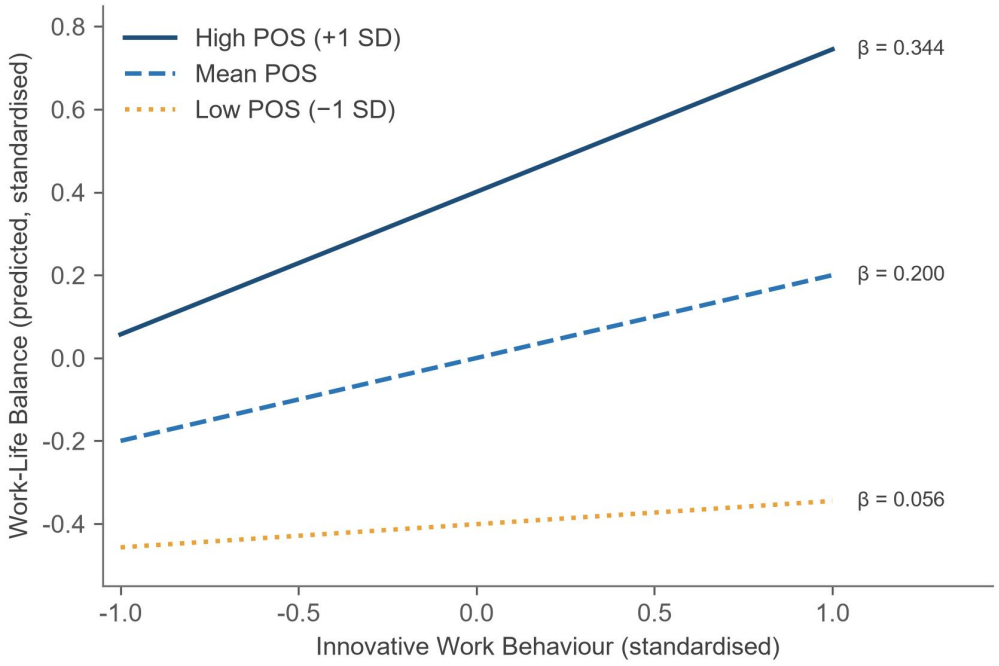


Figure 14. Simple slopes for the IWB–WLB relationship at three levels of perceived organisational support

4.9. Exploratory Gender-Based Subgroup Analysis

Meaningful multi-group comparison requires measurement invariance (ordinarily MICOM) followed by a formal between-group test (Cheah et al., 2023; Henseler et al., 2016). Neither was established, so Table 26 reports within-group estimates as exploratory signals: the first five columns give the female subsample (F, n = 238) and the last five the male subsample (M, n = 164), each with the original estimate, bootstrap mean, standard deviation, t, and p.

Table 26. Exploratory gender-based subgroup path estimates

Path	β (F)	M (F)	SD (F)	t (F)	p (F)	β (M)	M (M)	SD (M)	t (M)	p (M)
FWC → IWB	−0.471	−0.475	0.074	6.390	<.001	−0.483	−0.486	0.073	6.630	<.001
WFC → IWB	−0.427	−0.425	0.074	5.740	<.001	−0.117	−0.123	0.080	1.462	.144
FWC → WLB	−0.156	−0.157	0.102	1.522	.128	−0.132	−0.134	0.091	1.449	.147
WFC → WLB	−0.307	−0.312	0.090	3.410	.001	0.022	0.020	0.080	0.273	.785
IWB → WLB	0.115	0.111	0.101	1.134	.257	0.214	0.212	0.100	2.135	.033
POS → WLB	0.412	0.415	0.088	4.687	<.001	0.525	0.530	0.075	7.025	<.001

Two paths behaved consistently across groups: FWC → IWB (β = −0.471 and −0.483) and POS → WLB (β = 0.412 and 0.525) were significant for both. Three diverged in within-group significance: WFC → IWB and WFC → WLB reached significance only among women, while IWB → WLB reached significance only among men. The FWC → WLB direct path was non-significant in both subgroups, which is unsurprising given reduced within-group power and the

larger indirect share of the FWC effect. Tentatively, work-originating conflict may be more consequential for female academics on the paths tied to balance, while the balance payoff of innovation may be more readily realised among men. Career stage plausibly interacts with any such pattern, since early-career academics face probationary evaluation alongside publication demands and mid-career academics stack research productivity, supervision, and administrative service on the years when children are young and parents are ageing, so gender differences observed in a cross-section may partly proxy for position in these overlapping timelines. A coefficient significant in one group and not the other does not demonstrate that the coefficients differ; these are signals for confirmatory testing, and the evidential weight of the study rests on the full-sample results.

4.10. Summary of Hypothesis Outcomes

All eight hypotheses were supported (Table 27): both conflict directions reduced balance (H1, H2) and innovative behaviour (H3, H4); innovative behaviour improved balance (H5); the indirect effects identified partial mediation (H6, H7); and POS strengthened the IWB–WLB relationship (H8). The gender comparison lies outside the hypothesis-testing framework and carries no verdict.

Table 27. Summary of hypothesis-testing outcomes

Hypothesis	Path / relationship	β	p	Result
H1	WFC → WLB	−0.141	.001	Supported
H2	FWC → WLB	−0.127	.004	Supported
H3	WFC → IWB	−0.285	<.001	Supported
H4	FWC → IWB	−0.427	<.001	Supported
H5	IWB → WLB	0.200	<.001	Supported
H6	WFC → IWB → WLB	−0.057	.001	Supported (partial mediation)
H7	FWC → IWB → WLB	−0.085	<.001	Supported (partial mediation)
H8	IWB × POS → WLB	0.144	<.001	Supported
Exploratory	Female vs male within-group estimates			Not formally tested

5. Discussion

The supported hypotheses assemble into one conditional resource process rather than a list of separate findings: conflict depletes, innovative behaviour partially restores, and organisational support governs the conversion. The direct effects register the loss side of the process, the mediation identifies how conflict weakens balance by shrinking capability, and the moderation shows the capability's payoff rising with organisational enablement. Balance in public universities emerges from the interaction of conflict pressure, retained adaptive capability, and enacted institutional support rather than from individual coping alone (Bakker & Demerouti, 2007; Hobfoll, 1989, 2001;

Johnston et al., 2022; Siem et al., 2025). The subsections that follow set each component of this pattern against the prior literature.

5.1. Conflict and Balance

The net direct effects of WFC and FWC on balance are smaller than the meta-analytic bivariate band of −0.30 to −0.45 (Amstad et al., 2011) because they are estimated with IWB, POS, and the other conflict direction held constant; the bivariate associations here (−.464 and −.474) sit inside that band (Allen et al., 2000; Byron, 2005). The direct strain channel is real but not the dominant route from conflict to imbalance. The significant FWC effect pushes against the older assumption that family-to-work interference is the weaker direction in professional samples (Byron, 2005): intensive parenting norms, filial obligations, and gendered household labour generate family demands that penetrate work functioning in the Chinese setting (Allen et al., 2000). The pattern matches academic evidence that conflict predicts reduced balance most strongly where support is weak and roles unbounded (Johnston et al., 2022; Siem et al., 2025): Johnston et al. (2022) found the negative relationship between work extension and balance persisting even under comparatively high support, which matches the retention of a significant direct WFC effect here despite POS entering the model as both predictor and moderator. The findings validate the bidirectional framework of Greenhaus and Beutell (1985) in the Chinese public-university context: recurrent low-level intrusions operate as structural attrition rather than discrete episodes, and mutually reinforcing depletion across both directions damages sustained role functioning (Allen et al., 2000). For intervention, the implication is symmetrical: workload reduction alone addresses only one direction of the problem.

5.2. Conflict and Bapability

The asymmetry is the substantive result: FWC constrains IWB ($\beta = -0.427$) half as much again as WFC does ($\beta = -0.285$), an ordering stable across the composite, latent, and structural estimates. Innovation requires cognitive flexibility, persistence, and tolerance for uncertainty (de Jong & den Hartog, 2010; Scott & Bruce, 1994); under depletion individuals protect remaining resources (Hobfoll, 1989), and family-originating interference fragments the attentional continuity on which idea development depends. The result extends Bao et al. (2025) in two ways: it places both conflict directions in one model so their relative weights can be compared, and it connects reduced innovation onward to balance rather than stopping at the innovation outcome. It also converges with evidence that conflict erodes engagement among Chinese faculty through stress and resilience mechanisms (Bao et al., 2025; Shang, 2022). Conflict changes not only how academics feel but what they remain able to do under pressure; institutional calls for innovation become self-undermining when the conflict pressures eroding adaptive capacity go structurally unaddressed.

5.3. Capability, Mediation, and Conversion

The positive IWB effect reframes innovation from a performance imperative into a sustainability resource, consistent with evidence that innovation supports flourishing chiefly when directed at work processes (Lukes & Stephan, 2017) and adding a second face to a literature that treats IWB as an antecedent of performance (Anderson et al., 2014). The mediation gives the “conflict to capability” argument its evidential base: the capability pathway carries 28.8% of the total WFC

effect and 40.1% of the total FWC effect, with partial rather than full mediation the theoretically correct outcome under a multi-channel resource account (Hobfoll, 1989, 2001). Where prior mediation work relied on affective mediators that share a logic of progressive incapacitation (Amstad et al., 2011; Maslach et al., 2001), a behavioural mediator shifts the explanation toward interrupted capability. The decomposition also carries a dual message for intervention: the direct shares respond only to action at the source (workload governance, scheduling, boundary norms), while the indirect shares respond to protecting the conditions of innovative behaviour. The moderation completes the process: support operates as a conversion condition that shapes the payoff structure of behavioural agency (Eisenberger et al., 1986; Rhoades & Eisenberger, 2002), correcting individualised readings of coping and making the COR and JD-R integration concrete, with support the passageway that prevents investment under scarcity from ending in net loss (Bakker & Demerouti, 2007; Hobfoll, 2012). The conditional pattern also disciplines the interpretation of H5: the average positive effect of innovative behaviour conceals substantial variation, since for academics one standard deviation below the POS mean the estimated slope approaches zero and innovative effort purchases little balance at all. The behavioural capability is real but not self-executing; its value is jointly produced by the academic who exercises it and the institution that does or does not convert it.

5.4. Gender Signals

The subgroup estimates suggest possible gendered patterning: the WFC-related paths reached significance only among women, while the IWB payoff reached significance only among men. Work spilling into family may carry a double penalty for female academics, combining boundary violation with the gendered expectation that family obligations will nonetheless be met (Eagly, 1987; Misra et al., 2011), while the conversion of innovative effort into balance may be less reliable where women's contributions are undervalued (Sarsons et al., 2021). The consistency of FWC → IWB and POS → WLB across groups is equally informative: family interference constrains innovation for everyone, and support helps everyone. These remain signals, not findings; confirmatory testing requires invariance assessment and formal coefficient comparison (Byron, 2005; Henseler et al., 2016; Michel et al., 2011).

5.5. Theoretical Contributions

Five contributions follow. First, capability impairment joins the documented affective outcomes of conflict (Allen et al., 2000; Amstad et al., 2011) as a distinct form of loss: the shrinkage of adaptive behavioural room for manoeuvre. Second, COR theory is refined by separating resource loss (conflict), resource investment (IWB), and resource conversion (enabled by POS): investment is not inherently resource-generating but becomes so when the context allows returns (Hobfoll, 1989, 2001, 2012). Third, POS is specified as a conversion condition rather than a diffuse positive climate (Eisenberger et al., 1986; Rhoades & Eisenberger, 2002). Fourth, COR and JD-R are sequenced rather than cited in parallel, with the interaction term the point where process explanation meets work-design classification (Bakker & Demerouti, 2007; Demerouti et al., 2001). Fifth, a provincial Chinese university system is treated as a theoretically meaningful context: the configuration of significant FWC effects, a strong POS main effect, and conversion-dependent innovation reflects an academic labour regime of persistent evaluation, diffuse boundaries, and

sponsored initiative (Gao & Wang, 2024; Johnston et al., 2022). Balance itself is recast by these results: not a static equal division of time but a sustainability outcome produced by role pressures, retained capability, and organisational enablement in interaction, which connects the balance literature's summary-appraisal definition to an explicit generating process.

5.6. Practical Implications

The model dictates a three-front agenda. First, reduce avoidable interference at its sources: transparent workload models, consolidated administrative reporting, scheduling rules that keep meetings and deadlines out of non-work time, family-sensitive timetabling and load allocation for the FWC direction, and explicit digital communication norms (response-time expectations, protected periods, separated emergency channels) against the ambient pressure of permanent availability (Choi et al., 2022; Mazmanian et al., 2013; Schieman & Young, 2013). Second, budget for innovation rather than merely demanding it: protected time for process improvement, recognition of workflow innovation in evaluation, and non-punitive space for experimentation, because overload displaces innovative behaviour with short-term compliance. Third, make support real at the point of conversion: POS is enacted daily by deans, department heads, and coordinators in workload negotiation, timetable sensitivity, leave flexibility, and non-punitive responses to strain, so investment in line-management capability is investment in the conversion mechanism itself. The distinction between formal and enacted support is decisive, because a policy that exists on paper but is not experienced at the point of workload negotiation will not register as POS and will not condition the payoff of innovation. Support should also be differentiated across career stages: early-career academics face probationary evaluation and role ambiguity, mid-career academics stack promotion demands on peak caregiving years, and senior academics carry heavy supervisory and administrative loads. Implementation is a cycle rather than a memo: diagnosis of where interference concentrates, demand redesign, capability protection, support enactment, and evaluation against process, perception, capability, and sustainability indicators, with responsibility distributed across central governance, faculty leadership, and peer practice. At policy level, performance intensification without matching resources deepens the very conflict that erodes adaptive capacity.

5.7. Limitations and Future Research

Six limitations bound the claims. The cross-sectional design yields associations, not temporal causation, and cannot exclude reverse influence (Maxwell & Cole, 2007). Single-source self-reports leave residual common-method risk despite clean diagnostics (Kock, 2015; Podsakoff et al., 2003). The quota sample supports theory testing, not population inference. IWB was modelled as a unified construct, compressing innovation types that may relate differently to balance. POS was the sole moderator tested; leadership style, schedule control, and family-supportive practices remain untested passageways. The gender evidence is exploratory. Future research should pursue longitudinal, diary, and experience-sampling designs to trace whether repeated interference gradually suppresses innovative behaviour, whether balance recovers in low-pressure periods, and whether support interrupts loss spirals; multi-source measurement using supervisor or peer ratings of innovation, workload records, and timetable data, together with disaggregated innovation types; comparative and intersectional designs with invariance testing and formal between-group comparison (Cheah et al., 2023; Henseler et al., 2016); intervention studies of workload reform,

communication norms, and supervisor-support training; and technology-mediated boundary permeability as a distinct mechanism (Choi et al., 2022; Mazmanian et al., 2013).

6. Conclusion

Work–life balance among public university academics is the outcome of a conditional resource process. Both directions of work–family conflict reduce balance directly and by disabling innovative work behaviour; that behaviour partially restores balance; and perceived organisational support determines whether the restoration pays off. All eight hypotheses were supported in a screened sample of 402 academics: the model explained 36.3% of the variance in innovative behaviour and 49.7% in balance, and the family-originating direction of conflict, often treated as secondary in professional samples, proved the stronger constraint on the capability pathway. The conflict–balance relationship is therefore a matter of reduced capability and contextual enablement as much as of direct strain. Universities protect academic sustainability not by reducing ambition alone, nor by expecting resilience alone, but by ensuring that institutional conditions do not progressively convert commitment into depletion.

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Conceptualization, X.W and W.G.; methodology, X.W and T.M.; resources, W.G and M.X.; writing—original draft preparation, X.W, W.G, T.M and M.X.; writing—review and editing, X.W, W.G, T.M and M.X. All authors have read and agreed to the published version of the manuscript.

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Informed consent was obtained from all participants involved in the study.

Data Availability Statement:

The raw data supporting the conclusions of this article will be made available by the authors on request.

Conflict of Interest:

The authors declare no conflict of interest.

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