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Assessing the Impact of Perceived Supervisory Support on Service Recovery Performance: The Role of Work Engagement and Emotional Stability Among Libyan Air Traffic Controllers

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Abstract: Air traffic controller employees in Libya face difficult working environments due to a lack of supervisory support in a high-pressure environment. This support is necessary for the capacity to make crucial decisions, especially in emergencies requiring quick action and decision making. This study's purpose was to leverage the social exchange theory to investigate the mediating role of work engagement and the moderating role of emotional stability in the relationship between perceived supervisory support and the service recovery performance of air traffic controllers in three units: the Area Control Center, Approach Control, and Control Tower. A stratified sampling technique was employed to collect data from 168 air traffic controller employees. Of the total responses, 6 were considered invalid, resulting in 162 valid usable responses. The collected data were analyzed using partial least squares structural equation modeling (PLS-SEM) software (version 4.1.0.8). This study discovered that perceived supervisory support had a positive and significant impact on service recovery performance and work engagement. It was revealed that work engagement partially mediates the relationship between perceived supervisory support and service recovery performance. Furthermore, the moderating relationship between emotional stability and perceived supervisory support had a positive and significant influence on service recovery performance. Supervisors should adopt measures that enhance employee engagement, such as acknowledging individual and collective achievements, promoting involvement in decision making, and providing avenues for professional development. These will contribute to improvements in supervisory support and impact service recovery performance.

Keywords: air traffic controllers; emotional stability; perceived supervisory support; service recovery performance; work engagement

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1. Introduction

The safety and efficiency of air transportation depend on the presence of air traffic controllers (ATCs) [1]. ATCs uphold a secure distance between aircraft in flight, ensuring they are not in close contact. They furnish exact directives for landings and take-offs, orchestrate emergency actions, and convey essential information about weather and airspace conditions [2]. ATCs must provide information with accuracy and lucidity due to the significant hazards linked to their profession. A considerable degree of training and continuous education is necessary to meet this obligation and stay abreast of the constantly evolving demands of air traffic management [3].

ATCs must demonstrate exceptional service recovery performance (SRP), as errors or miscommunications can have significant consequences [4]. ATCs must promptly rectify service faults, such as miscommunications about flight paths, by rerouting planes and providing clear instructions to pilots [5]. Their ability to handle unforeseen problems is a testament to their professionalism and helps maintain confidence in the air traffic control system [6]. Furthermore, perceived supervisory support (PSS) is critical for ATCs. A strong supervisory support system fosters a healthy workplace culture, instilling in workers a sense of appreciation and empowerment and promoting collaboration and cooperation [7]. When ATCs receive support from their superiors, they are more likely to respond proactively during service disruptions, improving communication with pilots and enabling swift responses [8]. In a high-pressure environment, understanding supervisors can alleviate stress and enhance performance. Ultimately, PSS plays a crucial role in enhancing the safety of air traffic management operations and the effectiveness of individuals [9].

ATCs in Libya confront unique challenges due to insufficient PSS, particularly in a high-pressure environment [10]. Controllers are often overwhelmed with a heavy caseload during peak operational hours and lack administrative support. This absence of support hampers their ability to make critical decisions, especially in emergencies that demand swift action. Supervisors' lack of constructive criticism impedes skill development, leaving ATCs ill-equipped to handle unforeseen situations. This situation poses a significant threat to the safety and effectiveness of the national ATC system [11].

While studies have explored the impact of PSS on SRP [12,13], there is a notable dearth of research focusing on ATCs in Libya. The literature has yet to delve into the mediating role of work engagement (WE) in this relationship, and the moderating role of emotional stability (ES) remains unexplored. These knowledge gaps underscore the urgent need for new research to enhance our theoretical understanding and inform practical applications in service recovery within air traffic management.

This study aimed to fill existing gaps in the literature by addressing specific research questions. The findings provide practical and empirical contributions, offering valuable insights that enhance understanding and advance knowledge in the field: How does PSS impact the SRP of the ATCs in Libya? How does WE mediate the relationship between PSS and SRP? What is the moderating role of ES in the relationship between PSS and SRP? Finally, what is the moderating role of ES in the relationship between WE and SRP?

This paper contributes to the literature by exploring the impact of PSS on the SRP of ATCs in Libya. This research examines a significant knowledge gap in the impact of PSS on high-stakes performance, specifically for ATCs facing distinct obstacles. Addressing this gap would significantly enhance air traffic management's operational efficiency and safety, leading to enhanced decision making and service recovery in this vital sector. Moreover, this study contributes to the literature by analyzing the mediation role of WE in the relationship between PSS and SRP. This research will aid in formulating strategies that promote commitment and improve air traffic control's operational efficiency and service quality. Furthermore, this research contributes to the literature by exploring the moderating role of ES in the relationship between PSS and SRP. Employees with more excellent ES have superior stress management skills and can sustain composure and focus in high-pressure environments. Understanding this contribution is crucial for formulating air traffic management methods that enhance performance. Organizations can enhance the efficacy of ATCs by implementing tailored support systems that acknowledge the significance of individual traits, such as ES. The potential for improved decision making and service recovery offers a hopeful outlook for the aviation industry.

This study addresses a research gap by focusing on the essential requirement for effective SRP among Libyan ATCs. Understanding the significance of PSS is crucial for

improving SRP and maintaining operational efficiency and safety in air traffic control. As key players in the industry, supervisors will leverage the research findings to create supportive work environments by recognizing essential factors like ES and WE that can enhance ATC performance. This recognition of their role will make them feel valued and integral to the industry's success. Ultimately, the results will improve ATC operations and offer significant recommendations to legislators and aviation authorities, helping the aviation industry.

2. Literature Review

2.1. Theoretical Prospective

The relationship between PSS, SRP, WE, and ES can be explored using the social exchange theory (SET) and the job demands–resources (JD-R) theory. Despite varying focus on resource accessibility and interpersonal dynamics, both theories elucidate the influence of PSS on SRP.

The JD-R theory balances job demands and accessible resources that influence employee performance and well-being [14]. According to the theory, job resources include the social, psychological, or physical elements that assist individuals in achieving their goals, alleviating demands, or promoting personal growth [15]. Job demands are the attributes of a position that require sustained effort and may lead to stress.

PSS is an essential employment resource that helps personnel navigate the challenging workload ATCs face. PSS enhances WE and ES by offering emotional support, guidance, and a sense of safety [16]. Thus, these resources enhance SRP. Access to adequate task resources, such as PSS, allows ATCs to handle pressure better, thereby improving their performance in service recovery and WE [17].

The JD-R model tends to oversimplify the influence of job resources and expectations, neglecting the intricacies and quality of interpersonal relationships, particularly between managers and employees [18]. The SET theory considers these reciprocal relationships more clearly and explains the study of PSS and its influence on SRP. JD-R often regards resources such as PSS as simple elements that mitigate demands. This premise insufficiently addresses the impact of support on engagement and ES in complex environments.

SET offers a more comprehensive framework for understanding the relational and reciprocal relationships crucial to this study, notwithstanding the excellent insights provided by JD-R theory. The notion of reciprocal linkages, entailing the exchange of resources, support, or advantages, constitutes the foundation of SET [19]. These exchanges often result in employees positively reacting to their supervisors' supportive behaviors, enhancing their productivity and dedication. PSS is essential for fostering a safe and trusting environment. This empowers controllers to execute their responsibilities with enhanced assurance and diminished apprehension [20]. Employees who receive support from their supervisors are more inclined to feel respected and secure in their roles, leading to enhanced WE and superior SRP [21].

Furthermore, SET demonstrates how ES, as a personality trait, can influence this relationship. Enhanced ES in ATCs may improve their receptiveness to supervisory support, augmenting their performance under pressure [22]. By emphasizing the importance of the supervisor–employee relationship, SET provides a comprehensive framework for understanding the dynamics that drive individual and organizational achievement in air traffic control.

2.2. Hypothesis Development

2.2.1. Influence of PSS on SRP

PSS, the measure of how much employees feel their supervisors value their contributions and care about their welfare [23], is a key factor in creating a psychologically safe workplace. Supervisors provide employees with vital resources, such as training, and offer emotional support through empathy, encouragement, and understanding, strengthening the connection between employees and their organizations [24]. These supportive actions significantly influence employee well-being and work attitudes [25]. When employees perceive their superiors as supportive, it boosts their confidence and motivation to address client issues and enhances their SRP [26]. Supportive supervisors empower workers to proactively address service errors without fear of accountability, fostering psychological safety [27]. As a result, supervisory support should be viewed as a positive factor when evaluating an organization's internal service quality, supported by prior research [28,29].

SET, which posits that performing a favor for another party will yield future reciprocation [30], is significant in motivating employees to engage with the organization. When employees recognize that their leaders are supportive, they should be more motivated to reciprocate this support. Empirical studies show that PSS impacts employee work outcomes, including job satisfaction, organizational commitment, and turnover intention [31]. Previous research has also proven the association between service performance and supervisory support. Herawati et al. [32] found that supervisory support can improve service performance and decrease fatigue tendencies. Employee engagement in SRP depends on their impression of managerial support for mistake management [33]. Oentoro et al. [12] identified that PSS significantly and positively influences SRP. From the above discussion, the following hypothesis was developed:

H1: *PSS significantly and positively influences SRP.*

2.2.2. Influence of PSS on WE

PSS enhances employee engagement in the workplace. When employees believe their supervisors are not offering adequate support, they cannot commit to resource acquisition. Conversely, individuals who obtain feedback on their job performance will endeavor to gain new abilities and formulate action plans [34].

Research consistently shows that PSS has a positive impact on employee well-being, effectively mitigating stress and enhancing WE [35,36]. Supervisors play a crucial role in communicating the organization's goals and identity as intermediaries between the company and its employees. As a result, employees often view their supervisors as the embodiment of the organization's values and mission [37]. Employees who receive supportive supervisory assistance often feel obligated to reciprocate to the organization by increasing their involvement at work from a social exchange perspective [38]. A study by Odai et al. [39] further supports this, showing that substantial supervisory support fosters a high-quality relationship between supervisors and employees, enhancing employee engagement. These positive outcomes of PSS offer a promising perspective on the potential impact on employee engagement and well-being.

The concepts of PSS broaden when they show genuine concern for their employees' achievements and provide support [40]. This underscores the reciprocal nature of the PSS–employee relationship, where the workers must return the favor by increasing their workload. Employees who perceive their supervisors as responsive to their concerns experience psychological safety and feel motivated to integrate various aspects of their lives, including work experiences, into their professional roles [41]. Similarly, employees who believe their supervisors genuinely care about their performance are more likely to

form perceptions of their psychological accessibility. Ling Suan and Mohd Nasurdin [42] examined the correlation between PSS and job engagement among hotel employees. The results demonstrated that PSS considerably affected WE. The findings of their study indicate that employees exhibit increased engagement, characterized by heightened energy, commitment, and absorption in their professional tasks, when they receive encouragement from their superiors [43]. Thus, the following hypothesis was developed:

H2: *PSS significantly and positively influences WE.*

2.2.3. Influence of WE on SRP

WE constitutes intrinsic motivation defined by the pleasure and excitement derived from an activity [35]. Engaged individuals devote extra time and effort to their work because of the direct relationship between job happiness and task completion. Furthermore, research suggests that engagement is associated with favorable psychological outcomes, including improved health [44]. These findings suggest that employees who are healthier and less prone to stress will surpass their less engaged counterparts in job performance. Similarly, satisfied employees exhibit greater effectiveness owing to their heightened self-confidence [9].

Moreover, researchers have examined various factors related to WE, including job performance [45,46]. Nonetheless, the exact correlation between WE and SRP has largely eluded academic examination. Previous research has concentrated on employee effectiveness in specific responsibilities [47]. The ability of an employee to recover from service failures does not correlate with their capability to perform their regular jobs well, as service recovery constitutes a distinct situation from routine responsibilities. WE is a critical factor in assessing an employee's performance in service recovery. Due to their customer- and service-oriented mentality, engaged employees are more likely to excel during recovery by addressing client concerns swiftly [48].

Moreover, studies demonstrate that driven employees encounter positive emotions more often than their disengaged counterparts [35,49]. When supervisors offer support, it incentivizes employees to invest greater effort and energy into their tasks, thereby increasing their engagement levels at work. According to SET, engaged personnel are more inclined to enhance their focus and dedication towards enhancing SRP and therefore more effectively alleviating disruptions through mutual support. Zahoor's [50] empirical study demonstrates that frontline staff with proactive personalities notably enhance their WE levels. Thus, this enhanced engagement positively influences the effectiveness of service recovery. From the discussion above, the following hypothesis was developed:

H3: *WE significantly and positively influences SRP.*

2.2.4. Mediating Role of WE in the Relationship Between PSS and SRP

WE, a psychological condition associated with one's employment, is characterized by vigor, dedication, and absorption [51]. This condition is gratifying and beneficial [35]. Eseye and Debebe [52] characterize vigor and absorption as elevated energy and mental resilience during work; dedication signifies profound engagement in one's tasks, accompanied by a sense of importance and challenge; absorption denotes complete concentration and immersion in one's work. According to Eldor and Vigoda-Gadot [53], reciprocal exchange is essential to engagement because employees actively use their unique skills to fulfill role-related duties. Engaged personnel will demonstrate their commitment physically, psychologically, and emotionally while executing their obligations, motivated by the resources provided by the organization [54].

Studies have shown a positive association between employee engagement and supportive environments [55,56]. WE is positively associated with several important outcomes, including employee performance, organizational commitment, work satisfaction [35], and organizational citizenship behavior [57], in terms of consequences. Wang et al. [15] argued that despite the significant growth of WE research over the past decade, the notion of engagement has received inconsistent examination and remains relatively nascent. Researchers have recommended incorporating further studies into the engagement literature [58].

The existence of a mediating variable, which offers a more significant understanding of an individual's attitudes and behaviors, may elucidate the relationship between managerial support and employee behavioral outcomes [44]. As evidenced by specific studies, engagement is both a mediator and an influencer in the relationship between management approaches and employee results [35,49]. To the researchers' knowledge, no study has examined the mediating function of WE in the relationship between PSS and SRP in Libya. Based on the prior explanation, it is logical to infer that employees with higher engagement levels will possess a positive perspective of managerial support, encompassing supervisory aid and high-performance work practices. Furthermore, it is advisable to investigate the method that clarifies the relationship between supervisor support and employee service. From the discussion above, the following hypothesis was developed:

H4: *WE positively and significantly mediates the relationship between PSS and SRP.*

2.2.5. Moderating Role of ES in the Relationship Between PSS, WE, and SRP

This study used ES as a significant moderator affecting the relationship between PSS, SRP, and WE. ES is maintaining composure and resilience under pressure or stress. This essential personality feature is often defined by reduced anxiety, emotional instability, and a melancholy mood within the framework of the Big Five personality traits [59]. Stress overwhelms individuals, but demonstrating ES more frequently enables them to maintain their performance in high-pressure scenarios.

The SET posits that ES empowers employees, improving the reciprocity between their performance and PSS. When supervisors provide support, emotionally stable personnel develop a sense of duty and self-assurance that drives them to deliver exceptional performance and exhibit heightened engagement. As Ikputu et al. [60] asserted, this empowerment is a powerful motivator that can significantly impact workplace dynamics. This study demonstrates that emotionally healthy air traffic controllers, with their resilience, are more inclined to sustain elevated levels of WE and effectively leverage supervisor assistance, even under high-pressure circumstances. Thus, ES amplifies the positive impact of PSS on SRP by enabling employees to maintain their composure, resilience, and focus.

Furthermore, ES regulates the relationship between WE and SRP. ATCs with enhanced ES demonstrate remarkable adaptability, effectively channeling their WE toward effective performance, even when recovery is necessary [61]. This adaptability is a reassuring quality that can help individuals navigate challenging situations, strengthening the relationship between their engagement and actual performance.

According to SET, ES is a vital personal resource that affects how employees engage with and respond to their supervisors' support, impacting their SRP. Kundi et al. [62] highlighted the moderating influence of ES in their analysis of the relationship between WE and performance pressure on employees. Their research indicated that ES moderated this link and affected workers' feelings of pressure to achieve. Individuals with more excellent ES regarded performance pressure as a challenge rather than a danger, leading to heightened engagement at work. This indicates that ES aids employees in reinterpreting

difficult situations to improve their involvement at work. From the discussion above, the following hypothesis was developed:

H5: *ES moderates the relationship between PSS and SRP.*

H6: *ES moderates the relationship between WE and SRP.*

The hypotheses formulated from the literature reviewed were used to build the study framework displayed below (Figure 1):

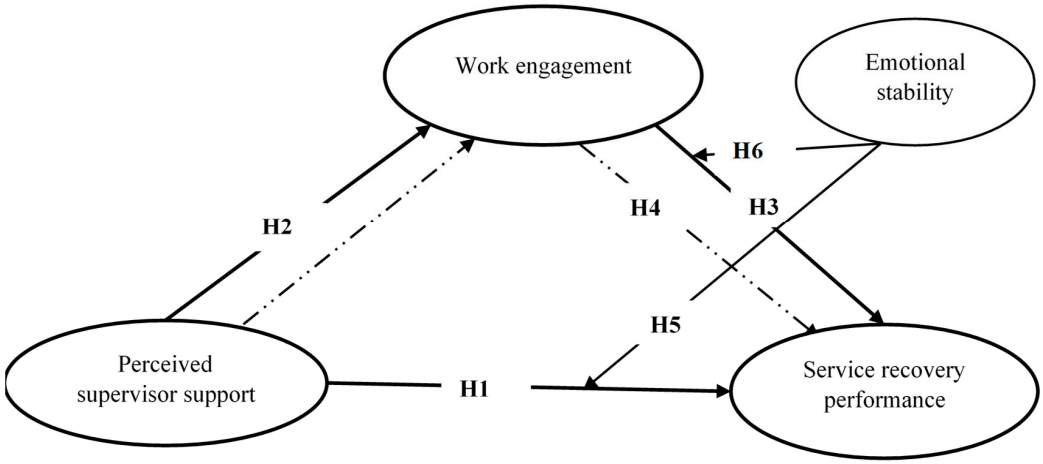


Figure 1. Research Model. Source(s): Authors' own work (2025).

3. Materials and Methods

3.1. Data and Sample

The choice of Libya for this study was predicated on its distinctive geopolitical circumstances and continuous efforts to reconstruct its civil aviation infrastructure [63]. The country encounters considerable difficulties in efficiently managing air traffic due to its intricate airspace and the substantial air traffic from adjacent areas. Analyzing ATCs in Libya provides crucial insights into the optimal execution of service recovery strategies, where operational efficiency and safety are paramount. Libya is suitable for this research due to its ambitions to reintegrate into global air traffic networks, highlighting the imperative for effective air traffic management [64].

ATC employees require essential attention since they are crucial to aviation's safe and effective functioning [65]. ATCs are tasked with the oversight of aircraft operations and the execution of crucial decisions in real time. A thorough understanding of their experiences and the influence of PSS on their performance is essential for enhancing safety standards and operational efficiency in Libya's aviation sector. This study, with its focus on three central ATC units—Area Control Center, Approach Control, and Control Tower—and gathering data from the ATC departments, presents a promising opportunity for improvement. The administrators provided the total number of employees in the departments, which was 290, to ensure precise data gathering. The Yamane technique was utilized to ascertain the sample size, ensuring that the chosen sample appropriately reflects the employees' dynamics within these essential divisions based on the known population number. This strategy facilitates the generalization of results and mitigates bias. It is quoted as follows:

$$N = \frac{P}{1 + P(e^2)}$$

where "N" represents the sample size.

"P" represents the total population size of the known employees at ATC departments. "e" represents the margin of error estimated at 5%.

$$\boldsymbol{N} = \frac{290}{1 + 290(5^2)}$$

N = 168

3.2. Sampling Strategy

Using a stratified sampling technique, we categorized the ATC population into strata based on the number of employees at the three selected ATC units. This method is crucial as it enhances the reliability of our results by ensuring representation from all strata. The inclusion criteria for selecting employees from the ATC departments at the three units in Libya were as follows: Possess a minimum of six months of experience in their designated jobs, be a full-time employee of the ATC departments, and be currently employed at one of the units. This study excluded employees on leave, in non-operational roles, or with less than six months of experience during the data collection.

Table 1 reveals that the Area Control Center possessed the second-highest population with 96 employees, providing 56 samples. Approach Control provided 47 samples from 82 employees, while Control Tower, with the largest workforce of 112, provided 65 samples. This stratification ensures the comprehensive inclusion of diverse experiences from multiple ATC departments, enriching this study. One potential bias is the overrepresentation of upper strata. To counter this, the researchers employed proportional allocation, a method that ensures the sample sizes reflect the population at each unit. This approach guarantees representativeness and enables generalization of the findings to the entire Libyan ATC workforce.

Table 1. Population and sample based on strata.

Unit	Population	Proportion	Sample
Area Control Center (ACC)	96	$\frac{96}{290} \times 168$	56
Approach Control (APP)	82	$\frac{82}{290} \times 168$	47
Control Tower (TWR)	112	$\frac{112}{290} \times 168$	65
Total	290		168

3.3. Procedures of Data Collection and Cleaning

The research was designed with a clear focus on relevance. It used printed questionnaires to collect data from the chosen participants according to the specified sample sizes. The decision to use printed questionnaires rather than Google Forms was made to ensure that only affiliated traffic controller staff participated in this study. This approach, which excluded non-affiliated staff, maintained this study's focus on relevant personnel, making the findings more applicable and valuable. Responses were gathered directly from the departments in a more controlled manner, further enhancing this study's relevance.

The sample size was decreased to 162 participants due to the invalidation of 6 returned responses caused by incomplete information during data input. This resulted in a 96.43% response rate, confirming that the ATC department staff at the three units demonstrate high participation. Moreover, the use of printed questionnaires alleviated technological obstacles and offered a concrete method for data collection.

3.4. Measurements and Scale

The research utilized validated questionnaires from credible sources to guarantee the reliability and relevance of the tools adopted to assess essential ATCs in Libya. These ques-

tions were based on previously conducted research generally recognized in organizational studies, offering a robust framework for assessing this study's features of interest.

The PSS questions were adopted from Karasek et al. [66]. They consisted of five questions pertinent to the ATCs in Libya, as supervisory support is crucial for improving performance in high-pressure, rapid environments like air traffic control. The nine WE items chosen from Talebzadeh and Karatepe [67] highlight the acute awareness, resilience, and concentration ATCs must possess to navigate the strict demands of their careers effectively. The five SRP questions from Abdul Rahim et al. [68] were particularly relevant because service recovery is vital to ATC duties. ATCs are expected to quickly manage unforeseen errors to maintain operating safety and restore order. The seven questions on ES obtained from Li and Ahlstrom [69] were used to evaluate the emotional resilience of ATCs responsible for managing stress and pressure.

This study adopted a five-point Likert scale from Nyarko et al. [70], with the options strongly agree (5), agree (4), undecided (3), disagree (2), and strongly disagree (1). This scale, attached to each question, played a significant role in enhancing the data collection process. It enabled all the participants to provide their opinions based on their current situation on each question and their agreement or disagreement with each question.

3.5. Statistical Tools for Data Analysis

The data were analyzed using SMART PLS (Version 4.1.0.8), a statistical software. It is especially advantageous for assessing complex models, including direct, moderating, and mediating relationships [71]. SMART PLS was selected over AMOS because of its enhanced prediction powers and higher robustness in handling complicated, hierarchical models [72]

The moderating and direct relationships were assessed using the SMART PLS technique. This approach streamlines the assessment of path coefficients and interaction terms within structural models [73,74]. A two-tailed test with a 5% bias-corrected significance level was utilized to perform 5000 iterations of the mediation analysis through a bootstrapping technique. This method accurately computes standard errors and confidence intervals for path coefficients, ensuring the validity of the results and providing a robust basis for testing assumptions [75]. Bootstrapping in SMART PLS is an optimal tool for evaluating hypotheses in mediation analysis, as it provides a non-parametric approach for determining the importance of indirect effects.

4. Empirical Findings and Results Presentation

4.1. Demographic Characteristics of Respondents

Table 2 presents the socio-demographics of employees at the ATC department in Libya. The ATC department at the three units in Libya primarily consists of young employees, with 26.54% and 31.48% of the workforce aged between 21 and 40. This indicates the possibility of continuous growth and advancement. The minimal proportion of senior employees (51 years and above), 12.35%, underscores the urgent need for succession planning to address impending retirements.

The gender distribution in the department is a critical area that necessitates immediate attention, as a significant imbalance exists of 95.06% male and 4.94% female. Most employees (53.09%) hold a bachelor's degree, whereas 22.84% hold a master's degree. Although the smaller proportion of PhD holders (3.09%) indicates potential areas for improvement in advanced research and leadership development, it nonetheless signals a well-educated workforce.

The tenure data reveal a solid foundation of experience, with 33.95% of employees possessing 6–10 years of service. However, there being 9.26% of employees with over

20 years of tenure indicates the necessity of prioritizing the retention of highly experienced personnel for sustained operational stability.

Table 2. Socio-demographics of employees at the ATC department in Libya.

		n	Percentage (%)
Age	20 years and below	14	8.64
	21–30 years	43	26.54
	31–40 year	51	31.48
	41–50 years	34	20.99
	51–60 years	12	7.41
	61 years and above	8	4.94
Gender	Male	154	95.06
	Female	8	4.94
Educational level	High school	23	14.20
	Bachelor's degree	86	53.09
	Master's degree	37	22.84
	Ph.D.	5	3.09
	Others	11	6.79
Tenure	Less than 5	22	13.58
	6–10	55	33.95
	11–15	42	25.93
	16–20	28	17.28
	Above 20 years	15	9.26
Total		162	100

Table 3 presents the descriptive statistics of all the variables used for this study. The average PSS score suggests that employees typically sense a moderate degree of support from their bosses. This aid is advantageous, although it may be enhanced to elevate morale and productivity, as supervisory help is positively associated with improved performance outcomes and employee retention. Although strengthening capabilities in this sector could lead to greater customer satisfaction and improved service quality, the average SRP result indicates that employees are assured in their capacity to resolve service concerns.

Table 3. Descriptive statistics of this study's variables.

Variables	N	Min	Maxi	Mean	Std. Deviation
PSS	162	1.00	5.00	3.6023	1.05203
SRP	162	1.00	5.00	3.6847	0.89768
WE	162	1.00	5.00	4.0855	0.85412
ES	162	1.17	5.00	3.9558	0.70826

Perceived supervisor support (PSS); service recovery performance (SRP); work engagement (WE); emotional stability (ES).

The mean WE score indicates that employees exhibit considerable enthusiasm and commitment. Strong employee engagement leads to enhanced organizational outcomes, such as heightened productivity and less absenteeism. The mean score for ES demonstrates proficient stress management and emotional regulation. Opportunities exist to improve mental health, resulting in increased productivity and resilience in the workplace.

4.2. Measurement Model Fitness Assessment

Table 4 presents the assessment results of the fitness of the measurement model obtained through the confirmatory factor analysis (CFA). The standardized root-mean-square residual (SRMR) and the normed fit index (NFI) were utilized to evaluate the fitness of the measurement models. The SRMR score was 0.05, signifying a good fit below 0.08,

which is generally acceptable [76,77]. The SRMR score signifies that the model accurately represents the relationships among the variables, allowing minimal residual discrepancies, thereby indicating a well-fitting model. Similarly, the NFI value was 0.890, below the standard acceptable fit criterion of 0.90 [78]. Nonetheless, this value demonstrates that the model performs adequately compared to the baseline.

Table 4. Measurement model (fitness assessment).

Indices	Obtained Values	Interpretation
SRMR	0.050	Good fit
NFI	0.890	Good fit

4.3. Reliability and Convergent Validity

Table 5 illustrates the outcomes of the reliability and convergent validity evaluations. The reliability of the constructs was assessed using Cronbach's alpha (α) and composite reliability (CR) values. α and CR values beyond 0.70 signify strong reliability [79]. All constructs yielded values surpassing this threshold, signifying strong internal consistency.

Table 5. Reliability and convergent validity.

Construct	Item	Outer-Loading	AVE	CR	α
Perceived supervisor support	PSS1	0.839	0.752	0.924	0.918
	PSS2	0.862			
	PSS3	0.866			
	PSS4	0.882			
	PSS5	0.885			
Work engagement	WE2	0.791	0.729	0.944	0.938
	WE3	0.873			
	WE4	0.890			
	WE5	0.845			
	WE6	0.839			
	WE7	0.839			
	WE8	0.894			
Emotional stability	ES1	0.831	0.650	0.932	0.894
	ES3	0.835			
	ES5	0.742			
	ES6	0.852			
	ES7	0.756			
	ES8	0.815			
Service recovery performance	SRP1	0.879	0.738	0.887	0.881
	SRP2	0.850			
	SRP3	0.896			
	SRP4	0.808			

The Average Variance Extracted (AVE) and standardized loadings were computed to assess convergent validity. The AVE must surpass 0.50, and the standardized loadings must exceed 0.70 to show convergent validity [80]. The standardized loading for each construct is presented in Table 5. Any standardized loadings lower than 0.70 were deleted from the construct items. For instance, WE1, ES2, ES4, and SRP4 were all deleted because they had standardized loadings less than the recommended threshold. This is because they signify insufficient item dependability, indicating that they fail to reflect constructs appropriately, compromising model validity. Furthermore, the results demonstrated that each item within the instrument dimensions surpassed the suggested threshold. For example, the AVE for SRP exceeding the 0.50 threshold and all standardized loadings for items exceeding

0.70 indicate the presence of convergent validity, and all the results obtained for the other constructs also met this threshold (refer to Table 5).

4.4. Discriminant Validity

Table 6 illustrates the use of the Fornell–Larcker [81] criterion and the HTMT ratio to assess discriminant validity. Franke and Sarstedt [82] state that the HTMT ratio calculates the average correlations among items across multiple constructs as well as within a single construct. An HTMT ratio of less than 0.9 is considered acceptable, as it ensures adequate discriminant validity and differentiation of the constructs. The distinctiveness of each construct was validated by the observation that all HTMT ratio values fell below the 0.9 threshold, as established by this analysis.

Table 6. Discriminant validity: Heterotrait–Monotrait (HTMT) ratio and Fornell–Larcker criterion.

	Heterotrait–Monotrait Ratio (HTMT)						**Fornell–Larcker Criterion**			
	ES	**PSS**	**SRP**	**WE**	**ES × WE**	**ES × PSS**	**ES**	**PSS**	**SRP**	**WE**
ES							**0.806**			
PSS	0.066						−0.054	**0.867**		
SRP	0.160	0.657					−0.152	0.597	**0.859**	
WE	0.051	0.447	0.473				0.016	0.422	0.436	**0.854**
ES × WE	0.089	0.058	0.040	0.030						
ES × PSS	0.037	0.046	0.118	0.060	0.617					

The square root of the Average Variance Extracted (AVE) for each construct was compared to the correlations between that construct and others, following the Fornell–Larcker criterion [81]. To establish discriminant validity, the square root of the AVE must exceed the correlations with other constructs. The diagonal values, representing the square root of the AVE, consistently exceeded the off-diagonal values, which indicated inter-construct correlations. The square root of the AVE for ES was 0.806, exceeding the values for WE (0.016), SRP (−0.152), and PSS (−0.054). The square root AVE of PSS was 0.867, which was also greater than the correlation values of SPR (0.597) and WE (0.422). These results indicate the distinctiveness of the constructs.

4.5. Structural Model Fitness Assessment

The structural model's assessment was performed using four essential indices, and meeting the established criteria for each of these indices assures the robustness and unbiasedness of the structural model's findings. The indices include predictive relevance (Q^2), effect size (f^2), R-squared (R^2) values, and variance inflation factor (VIF) [83]. These indices elucidate the model's robustness, explanatory ability, and predictive accuracy.

4.5.1. Coefficient of Determination (R^2)

The R^2 values of the structural model reflect the degree to which the predictors explain the variance in the dependent variables [84]. The R^2 for SRP was 0.437, indicating that the WE and PSS explain 43.7% of the variance in SRP. This indicates a moderate level of influence of the WE and PSS on SRP.

Similarly, WE had an R^2 value of 0.178, indicating that its PSS explains 17.8% of the variance in WE. Although this represents a reduced percentage of variance, it nonetheless indicates that PSS influences WE. These results are presented in Table 7 and graphically in Figure 2, showing the percentage of influence of WE and PSS on SRP.

Table 7. Results of coefficient of determination (R^2) and predictive relevance (Q^2).

Variables	R^2	Q^2
SRP	0.437	0.361
WE	0.178	0.168

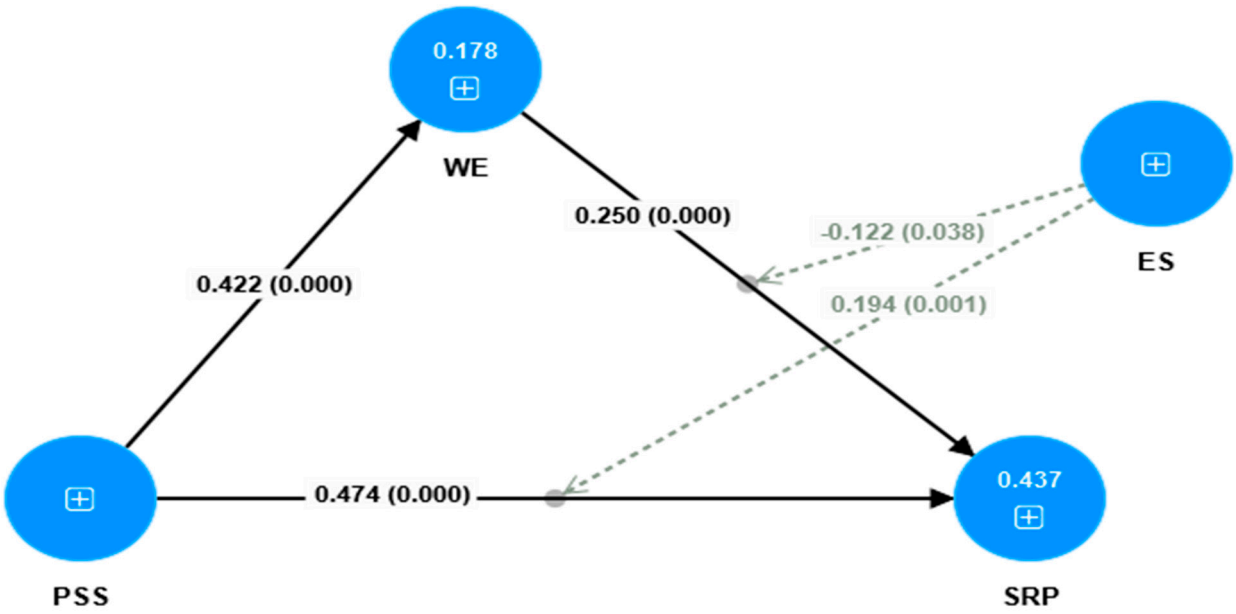


Figure 2. Structural Model.

4.5.2. Predictive Relevance (Q^2)

The structural model's predictive relevance (Q^2) scores (see Table 7) indicate its capacity to forecast the values of the endogenous variables [85]. The Q^2 value of 0.361 for SRP signifies a substantial degree of predictive relevance in the model. Suppose the model's predictors can accurately capture the variance in SRP, as evidenced by a Q^2 value exceeding zero. In that case, one may safely forecast the potential effects of changes in the predictors on SRP.

Again, the Q^2 value for WE of 0.168 indicates that the model possesses considerable predictive relevance for WE but is lower than the Q^2 value for SRP. This indicates that the model's variables can predict variations in WE, although they are less effective than their ability to predict variations in SRP. The model's effectiveness in delivering predictive insights into both SRP and WE are highlighted by the comprehensive Q^2 results, which validate the correlations established in the research.

4.5.3. Effect Size (f^2)

Table 8 shows the effect size (f^2) values for the structural model. These values show how certain predictors affect the endogenous variables [86]. The f^2 value of 0.32 signifies that PSS exerts a medium effect size on SRP, demonstrating a substantial influence of PSS on SRP. Thus, enhancing supervisory support holds the potential to markedly improve SRP.

Table 8. Results of effect size.

Construct	SRP
PSS	0.320
WE	0.09
ES	0.037

The f^2 value of 0.09 for WE on SRP signifies a minor effect size, suggesting that job engagement exerts a delayed influence on SRP compared to PSS. The ES f^2 score of 0.037 for SRP signifies that ES influences SRP, as seen by the low effect size. These values collectively offer a significant comprehension of the various processes via which the model's outcomes are affected by multiple factors.

4.6. Common Method Bias

This study sought to reduce common method bias (CMB) by utilizing the variance inflation factor (VIF) as a diagnostic tool [87–90]. Multicollinearity may amplify the correlations among variables, indicating bias from the data collection methodology. VIF aids in ascertaining whether this is applicable. In this examination, inner VIF (Table 9) values were determined to be below the recommended level of 3.3 [91]. This suggests that neither shared method variance nor multicollinearity caused significant concern for the identified relationships across variables. Obtaining VIF values below the standardized threshold indicates that the research effectively mitigated CMB-related problems, enhancing the data's validity.

Table 9. Results of hypothesis test.

Hypotheses	Path (Relationship)	Coefficient (β)	VIF	Standard Error	t-Value	*p*-Values	Decision
H1	PSS → SRP	0.474	1.246	0.053	8.962	0.000	Supported
H2	PSS → WE	0.422	1.423	0.067	6.306	0.000	Supported
H3	WE → SRP	0.250	1.241	0.059	4.261	0.000	Supported
			Mediating effect				
H4	PSS → WE → SRP	0.106		0.033	3.188	0.001	Partial mediation
			Moderating effect				
H5	ES × PSS → SRP	0.194	1.668	0.064	3.007	0.001	Supported
H6	ES × WE → SRP	−0.122	1.682	0.069	1.773	0.038	Supported

In conclusion, the results for Q^2, f^2, R^2, and VIF indicate the fitness of the structure model used to decide whether to accept or reject the hypothesis. Therefore, the findings from the structure model indicate robustness and unbiased results.

4.7. Hypothesis Testing

Table 9 presents the outcomes of the SEM path analysis, including direct, mediating, and moderating effects. Figure 2 graphically displays the findings of the direct, mediating, and moderating relationship.

4.8. Direct Effect Results

The first hypothesis (H1) examined how PSS significantly affects SRP. The findings demonstrated that PSS significantly and positively influenced SRP (β = 0.474, t = 8.962, $p < 0.01$), leading to the acceptance of the hypothesis (H1).

The second hypothesis (H2) examined the significant influence of PSS on WE. The results demonstrated that PSS positively and significantly affected WE (β = 0.422, t = 6.306, $p < 0.01$), and the hypothesis (H2) was confirmed.

The third hypothesis (H3) assessed if there is a significant relationship between WE and SRP. The findings demonstrated that WE exerted a positive and significant impact on SRP (β = 0.250, t = 4.261, $p < 0.01$); therefore, hypothesis 3 was validated.

4.9. Mediation Analysis

Hypothesis 4 (H4) investigated the mediating role of ES in the relationship between PSS and SRP. This study revealed that ES partially mediates the relationship between

PSS and SRP, confirming this hypothesis (β = 0.106, t = 3.188, $p < 0.01$). As a result, H4 was accepted.

4.10. Moderating Analysis

ES moderates the relationship between PSS and SRP, as well as between WE and SRP, in accordance with Hypotheses 5 and 6 (H5 and H6). The findings demonstrated that the moderating relationship between ES and PSS had a positive and significant influence on SRP (β = 0.194, t = 3.007, $p < 0.01$). As a result, H5 was accepted. The findings further revealed that the interaction between ES and WE had a negative and significant impact on SRP (β= −0.122, t = 1.773, $p < 0.05$). As a result, H6 was affirmed.

5. Discussion

This study contributes to the growing evidence that PSS influences SRP through a mechanism involving WE and ES. The findings revealed that PSS significantly and positively impacts SRP, indicating that employees who perceive their supervisors as polite and helpful are more effective in service recovery efforts. This aligns with SET, which posits that employees engage in reciprocal exchanges within the workplace [92]. Managers who provide resources, support, and direction encourage ATCs to exert greater effort, especially during service disruptions. These findings validate similar conclusions by Luo et al. [93], who identified that transformational leadership significantly enhances SRP.

Employees who perceive their supervisors as committed to their professional development and well-being demonstrate increased motivation, dedication, and resilience [94]. Such support boosts their confidence, enabling them to take the initiative and resolve client issues swiftly and effectively. Assurance of supervisors' availability for guidance leads to improved SRP [95], equipping ATCs to manage service disruptions with composure and focus. Furthermore, supervisors are viewed as friendly and empathetic, and they empower employees to address customer service challenges effectively. Supervisors who engage actively with ATCs, provide guidance, and foster a supportive environment significantly impact the effectiveness of service recovery operations. These findings highlight that effective leadership transcends task management, fostering a supportive and empathetic environment that motivates employees to excel, even in demanding service situations [96].

This study also found that PSS positively affects WE, suggesting that employees who perceive their supervisors as supportive feel more involved, enthusiastic, and focused. These results align with the findings of Khan and Lakshmi [97], who demonstrated a strong positive relationship between PSS and WE. According to SET, trust and support in workplace relationships foster advantageous behaviors [92]. Thus, the findings support the SET theory. Supervisors' guidance, feedback, and emotional support enhance employees' commitment and investment by making them feel valued and acknowledged [98]. This reciprocal relationship fosters a positive work environment, encouraging cooperation, productivity, and organizational success. Employees are more motivated to invest the time and effort needed to meet their responsibilities when they perceive their supervisors as compassionate and respectful.

Supervisors play a pivotal role in promoting a constructive work atmosphere by providing continuous emotional support, feedback, and guidance [99]. When employees are assured of their supervisors' backing, they are more likely to show initiative, embrace openness, and exhibit creativity. Aviation firms can build a supportive culture through effective leadership, leading to a more engaged and productive workforce. Supervisors' trust and concern motivate ATCs to excel, emphasizing the importance of training supervisors in supportive communication skills and relationship building to improve employee engagement and organizational performance.

This study further demonstrated that WE significantly enhances SRP, suggesting that highly engaged employees are better equipped to manage service interruptions and resolve customer issues. This finding aligns with Zahoor [50], who observed a positive relationship between WE and SRP. Engaged employees feel valued and supported and exhibit proactive and effective behaviors in service recovery as a form of reciprocity [100]. This highlights the importance of fostering employee engagement in aviation firms to improve SRP, particularly in critical areas like service recovery. The findings support SET by emphasizing that positive interactions between managers and employees yield reciprocal benefits. Engaged ATCs demonstrate excellent proficiency, focus, and empathy, enabling them to handle customer interactions professionally and compassionately, even in challenging scenarios [101]. Aviation companies can enhance SRP by prioritizing employee engagement, as engaged personnel are better prepared to effectively overcome challenges and address service issues.

Additionally, this study found that WE partially mediates the relationship between PSS and SRP, suggesting that WE amplifies the direct effect of PSS on SRP. This implies that ATCs are more likely to engage in service recovery efforts and exhibit higher levels of engagement when they perceive substantial support from their supervisors [102]. Supervisory support enhances employee engagement, strengthening their ability to manage service recovery responsibilities effectively. However, the partial mediation in this study indicates that factors beyond WE, such as training and organizational culture, influence the relationship between PSS and SRP [103]. Recognizing the mediating role of WE allows aviation firms to implement tailored strategies that enhance employee engagement and supervisory support, ultimately improving SRP.

The findings also highlighted the moderating role of ES in the relationship between PSS and SRP, indicating that emotionally resilient employees perform better under pressure during service recovery. Employees with high ES effectively manage stress and maintain a positive outlook, enabling them to leverage supervisory support more efficiently [104]. Conversely, employees with lower ES may struggle to translate supervisory support into improved performance due to stress or negative emotions. These findings emphasize the importance of considering individual differences in emotional resilience and providing support systems that bolster ES across the workforce.

Finally, the interaction between ES and WE negatively impacted SRP. While ES and WE are generally advantageous, overly engaged employees may face burnout, reducing their capacity for effective service recovery [105]. Emotionally stable ATCs, when highly engaged, may exhibit lower stress responses, leading to complacency and reduced adaptability in handling unpredictable service disruptions. Their stability might limit the sense of urgency required for effective service recovery, making them less responsive to dynamic challenges. This reduced flexibility and proactive effort can hinder their ability to manage critical recovery situations efficiently. This underscores the importance of balancing engagement with adequate support and recognition for service recovery initiatives. Aviation firms must offer tangible incentives and institutional backing to ensure employees understand the significance of their contributions and feel motivated to excel in service recovery efforts.

6. Conclusions

This study focused on Libyan ATCs and examined the interrelations between SRP, ES, WE, and PSS. Data were collected through a stratified sampling method from 168 ATC employees across three units in Libya. After eliminating 6 invalid responses during the data keying process, 162 valid responses remained, ensuring a representative sample that reflected the diverse demographics of the profession. Studies have not explored

the mediating role of WE in this relationship or the moderating role of ES, creating significant knowledge gaps in the literature. The collected data were analyzed using PLS-SEM.

The findings revealed that PSS significantly and positively influences both SRP and WE, underscoring the critical role of supportive leadership in enhancing employee outcomes. Furthermore, WE was shown to significantly and positively impact SRP, indicating that highly engaged employees are more proactive and likely to exceed expectations in resolving challenges, thereby ensuring clients receive timely and satisfactory solutions.

Additionally, this study demonstrated that WE partially mediates the relationship between PSS and SRP, suggesting that employees with higher engagement levels are better equipped to handle service recovery situations effectively. The moderating effect of ES on the relationship between PSS and SRP was positive and significant, highlighting the importance of emotional resilience in leveraging supervisory support to improve performance. However, the moderating effect of ES on the relationship between WE and SRP was negative and significant, suggesting that excessive engagement without adequate support may hinder service recovery efforts.

These findings emphasize the importance of fostering a supportive workplace environment and cultivating emotional resilience among ATCs to enhance SRP. By prioritizing leadership strategies that promote engagement and emotional stability, organizations can improve their overall service recovery capabilities.

7. Theoretical Implications

This study offers significant theoretical contributions by advancing the understanding of the relationships among PSS, WE, ES, and SRP in the context of ATCs. By applying SET to the findings, this study underscores the practical importance of fostering strong working relationships to enhance employee engagement and performance. For instance, the relationship between PSS and SRP underscores the critical role of social interactions. Employees who perceive robust support from supervisors demonstrate outstanding commitment and diligence in fulfilling their responsibilities, providing valuable insights for organizational leaders.

The research further highlights that WE mediates the association between PSS and SRP, illustrating how engaged employees leverage the support they receive to improve their performance in high-pressure situations. This mediating role enriches SET by demonstrating how the lasting effects of supportive leadership extend beyond immediate interactions to shape employee attitudes and behaviors over time.

This study also emphasizes the moderating role of ES in these relationships, shedding light on how individual differences influence employees' responses to supervisory support and their participation in service recovery efforts. This finding underscores the need to consider personality traits when assessing employee engagement and designing leadership strategies, aligning with broader organizational behavior and psychology theories.

Overall, this study contributes to the theoretical discourse in organizational behavior by integrating SET with insights into WE and ES to provide a nuanced understanding of the factors influencing SRP in high-stakes environments like air traffic control. Future research could build upon these findings, further enriching the theoretical foundations of human resource management and organizational studies by exploring these dynamics across diverse organizational settings.

8. Managerial Implications

The findings of this study offer valuable insights for aviation firms, particularly those operating in high-risk environments like air traffic control. The results emphasize the importance of supervisors supporting ATCs to enhance WE and SRP. A supportive

work environment is critical, and managers must prioritize fostering such an atmosphere by expressing appreciation, providing necessary resources, and fostering transparent communication. These efforts help instill a sense of significance and involvement among ATCs, ultimately improving their performance in service recovery situations.

This study highlights the crucial role of supervisors in driving employee engagement. Supervisors should implement strategies to enhance WE, including recognizing individual and team accomplishments, encouraging participation in decision making, and offering opportunities for professional growth. Higher levels of engagement are strongly associated with increased resilience and proactivity, which are essential for improving SRP.

Additionally, the significant influence of ES on employee performance underscores the need for aviation firms to adopt a tailored approach to recruitment and training. This is particularly relevant for roles that demand high performance under pressure. Investing in training programs that focus on emotional intelligence and resilience can equip ATCs with the skills needed to manage stress effectively, resulting in improved outcomes.

Aviation firms can significantly enhance SRP and achieve operational excellence by fostering a supportive work environment that values individual personality traits and promotes WE. These managerial practices boost employee satisfaction and strengthen the organization's reputation for delivering exceptional service in demanding contexts like ATC operations.

9. Limitations and Directions for Future Research

While this study provides valuable insights, it is important to acknowledge several limitations. One notable limitation is the sample size. Although data were collected from 162 employees, this sample may be insufficient for generalizing the findings to the broader population of ATCs in Libya or other high-risk settings. Increasing the sample size in future studies would enhance the reliability of the results and provide a more comprehensive understanding of the relationships analyzed.

Additionally, the study's focus on ATCs may restrict the generalizability of the findings to other professions. Future research could broaden the sample to include other roles within the aviation industry or examine similar dynamics in other high-stress sectors, such as healthcare or emergency services. This expanded scope would offer a more holistic view of this study's applicability across diverse organizational contexts.

Another limitation is the use of a cross-sectional research design, which captures data at a single point in time. This approach may limit the ability to infer causality or understand the evolution of relationships among PSS, WE, ES, and SRP. Future studies employing longitudinal designs could provide a clearer picture of how these variables interact over time and the long-term impact of changes in supervisory support on engagement and performance outcomes. Future studies should adopt qualitative methods to gain deeper insight into this topic. Since this study employed a quantitative approach, qualitative research can more comprehensively explore underlying mechanisms, contextual factors, and individual experiences.

While this study identified ES as a key moderating variable, future research should explore the potential influence of other personality traits or contextual factors on the relationships examined. Investigating elements such as team dynamics, organizational culture, and individual coping strategies could yield deeper insights into employee behavior and performance in service recovery contexts.

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