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Algorithmic Performance Appraisal in Freight Logistics: Effects on Driver Trust, Organizational Fairness, and Work-related Stress

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Abstract. Algorithm-based management of freight logistics has fundamentally transformed traditional regulatory paradigms, shifting toward direct efficiency assessments driven by granular data points. Although these algorithmic performance appraisal systems are designed to enhance route efficiency and increase labor productivity, their profound impact on the psychological well-being of logistics workers remains critically underexplored. This research investigates the complex structural relationships among algorithmic performance appraisal characteristics, perceived organizational fairness, driver trust, and work-related stress within the contemporary freight logistics industry. Drawing upon Organizational Justice Theory and the Job Demands-Resources (JD-R) model, this study examines how the opacity and perceived rigidity of algorithmic evaluations precipitate a severe trust deficit between frontline drivers and executive management. Methodologically, a quantitative approach was adopted, utilizing Structural Equation Modeling (SEM) to analyze empirical data collected from commercial freight drivers operating under continuous algorithmic tracking systems. The findings indicate that when drivers perceive algorithmic evaluations as opaque or procedurally biased, their institutional trust significantly deteriorates, while psychological stress and occupational burnout concurrently escalate. The primary theoretical contribution of this paper lies in unboxing the "black-box" problem of algorithmic management from an employee-centric perspective, proposing a validated metric for measuring algorithmic fairness. Furthermore, the empirical results offer actionable strategies for logistics enterprises to construct transparent, human-centric evaluation systems aimed at mitigating employee cognitive burdens, improving retention rates, and ensuring long-term operational resilience amidst ongoing technological disruptions.

Keywords: Algorithmic Management; Performance Appraisal; Freight Logistics; Driver Trust; Organizational Fairness; Work-related Stress

1. Introduction

With the fast development of global digitalization in recent years, there has been a substantial impact on how companies engaged in freight logistics manage human capital. At the heart of these changes are algorithm-based management systems; by constantly gathering granular data, accurately tracking real-time locations, and employing predictive analytics, workforce behaviors can be regulated systematically (Nunes, 2025). Under the increasing pressure to achieve profitability in the highly competitive current era of logistics, algorithms have been used not just as navigational aids but as autonomous managerial tools for evaluating employees' productivity and responsiveness under a continuously monitored environment (Christopher et al., 2025). Unlike traditional human-centric supervision, the monitoring of operational compliance can now be carried out via telematics, biometric recognition, and cab-mounted sensors that record factors impacting driving performance, such as micro-deviations in route selection and hard braking frequencies. These systems also track extended idle durations at long-distance stopover stations. The prerequisite for implementing these systems is their capacity to systematically track driving data and eliminate human bias to create an objective, purely quantitative assessment system for performance evaluation and salary distribution. Therefore, many large-scale logistics enterprises have rapidly introduced such technologies to radically reduce operational costs and organize complex, multi-node logistics networks more efficiently through proprietary algorithms. The application of algorithmic evaluation systems fundamentally disrupts the traditional employer-employee relationship. Interpersonal supervision and empathy-based negotiation have been immediately substituted with unfeeling automation, transforming the driver into a biological extension of the telematics hardware (Le, 2025).

Although algorithmic systems may improve operational efficiency and the spatial optimization of logistics networks through data-driven resource allocation; however, drivers have been significantly disconcerted by the negative psychological impacts of automated performance evaluations. At present, the international freight logistics sector faces systemic vulnerabilities, particularly prolonged driver absences and increased turnover rates. The deterioration of the psychosocial work environment due to this problem has become more pronounced (Trujillo & Calle, 2026). The primary catalyst for workforce alienation is the opaque structure and rigidity of algorithmic assessment systems. The system frequently operates as an impenetrable "black box" and does not provide transparent rationales for the automated decision-making process; it lacks detailed disclosures such as the weighting of driver evaluation metrics, penalty deduction thresholds, and dynamic route assignments. Confusing rule organization and the absence of systematic information disclosure directly undermine the drivers' perception of organizational fairness. There is a pervasive consensus among the workforce that uncontrollable exogenous factors, such as adverse weather anomalies, unexpected traffic congestion, and other emergencies, are not contextualized by the assessment algorithms, leading to machine-generated penalizations.

The pervasive monitoring of AI systems has reduced the sense of autonomy and dignity for professional drivers. Therefore, most drivers no longer have confidence in corporate management and foster negative attitudes at work. Repeatedly striving for machine-dictated targets results in persistent anxiety regarding the loss of human agency. Consequently, striving for high-speed computation while neglecting socio-technical integration leads to severe work-related stress and deteriorated mental health. In fact, the very technologies intended to improve labor productivity also promote an increase in occupational stress among workers and the systemic estrangement of the human resources absolutely required for supply chain operations.

To address these critical industry challenges, this study establishes an analytical framework for the commercial freight logistics industry by focusing on regional and long-distance driver groups under active algorithm-driven performance evaluation models. This paper aims to empirically deconstruct the psychological mechanisms by which algorithmic management affects the quality of work life and organizational commitment among drivers. In particular, it measures directly and indirectly how algorithmic opacity and the perception of rigidity influence drivers' internal calculus of organizational justice. Based on this theoretical foundation, this paper explores the structural associations among diminished fairness perceptions, declining institutional trust, and escalating work-related stress. To ensure a rigorous investigation, a multifaceted measurement system capable of detecting minute variations in worker-perceived algorithmic influence was constructed and validated. By analyzing the key mediating factors of trust and fairness, this study constructs a systematic Structural Equation Model to reveal the behavioral response mechanisms of humans under various circumstances after exposure to digitized logistics supervision. Overall, this research aims to identify specific technical and management intervention areas that can maintain an equilibrium between human-centric adjustments and algorithmic systems within operation-oriented environments. It is a significant deficiency of existing research that academic discussions concerning Industry 4.0 in logistics primarily focus on algorithmic efficiency and cost reduction; they seldom pay attention to human-computer interaction (HCI) dynamics and their psychological externalities. Through a repositioning of the human driver at the core of the technological system, this evidence-based study on the psychological costs of unrestricted algorithms extends Organizational Justice Theory to apply to non-human managerial agents (Park et al., 2025). In practice, it offers a reference for HR personnel to establish "human-in-the-loop" systems, ensuring that the application of technology is reasonable to maintain an equitable work environment and logistics stability(Meidutė-Kavaliauskienė et al., 2025).

2. Research Literature

2.1 The Evolution of Algorithmic Management in Freight Logistics

The management algorithms governing modern freight logistics have diverged radically from historical paradigms, precipitating a profound structural shift in how commercial transportation networks operate. Traditionally, the logistics sector relied entirely on human-centric supervision, where driver performance appraisals and route assignments were mediated by human dispatchers. This traditional model inherently facilitated substantial degrees of context-based interpretation, tacit knowledge transmission, and interpersonal emotional interaction, thereby granting commercial drivers a recognized level of professional autonomy. However, with the rapid maturation of Industry 4.0 and the ubiquitous dissemination of advanced telematics, there has been a massive, industry-wide deployment of continuous, data-driven monitoring systems across the global supply chain (Krzywdzinski, Schneiß, & Sperling, 2024). Contemporary algorithmic systems no longer function merely as passive navigational aids; instead, they operate as autonomous data-harvesting engines that continuously collect voluminous geospatial and behavioral information over extended periods. These granular metrics include hard-braking occurrence rates, acceleration profiles, idling durations, steering volatility, and minute deviations during digital route execution.

This pervasive, uninterrupted gathering of granular data constructs a modern "digital panopticon"—an environment that continuously monitors, quantifies, and evaluates driver behavior through intricate, highly opaque computerized systems. Consequently, the fundamental utility of the algorithm has evolved; it is now empowered to make independent decisions and operate autonomously without the need for human intervention. Currently, such integrated systems can instantaneously conduct performance assessments, supervise real-time operational progress, and even automatically execute disciplinary wage deductions or reallocate routes based on pre-programmed thresholds. This trajectory represents a fundamental disruption in the power dynamics within corporate logistics departments. The occupational craftsmanship previously enjoyed by commercial drivers has been entirely supplanted by rigid mathematical optimization, continuous digitized surveillance, and an overarching environment of algorithmic subjugation (Sun et al., 2025).

2.2 Organizational Fairness and the Trust Deficit

The complex interactions between algorithmic management and the overarching psychological well-being of employees are most effectively examined through the theoretical lens of Organizational Justice Theory. Under the excessively stringent and inflexible criteria demanded by automated performance evaluations, fundamental components of traditional workplace justice are severely undermined. Procedural justice, which concerns whether the procedures determining performance outcomes are equitable, is profoundly compromised by algorithmic opacity—a phenomenon frequently characterized in contemporary critical management literature as the "black-box problem" (Anonymous, 2019). Due to the extreme corporate secrecy protecting proprietary appraisal algorithms, drivers are entirely precluded from comprehending the underlying factors, dynamic parameters, or computational formulas that dictate their safety evaluation scores and subsequent financial penalties. When forced to navigate this structurally opaque system, drivers inevitably experience a severe degree of information asymmetry, leading to the entrenched belief that these computational determinations are inherently unreasonable, arbitrary, and procedurally unjust.

In addition to procedural violations, severe systemic deficiencies exist regarding the distributive fairness of algorithms when confronted with dynamic, real-time environmental volatility. The computational logic of telematics systems generally classifies unexpected delivery delays caused by exogenous factors—such as sudden traffic collisions, severe meteorological disasters, or unforeseen infrastructure failures—strictly as individual performance failures. This systemic lack of contextual awareness and the algorithm's inherent inability to perceive environmental nuances lead to an inadequately sensitive, zero-tolerance, and highly punitive evaluative ecosystem. Without the structural opportunity to raise an appropriate objection with a human supervisor or to provide detailed contextual explanations for specific on-road incidents, the concept of interactional justice is entirely eradicated. Consequently, the displacement of empathetic human managers by automated machines fractures the essential psychological bond formed through shared vulnerability and interpersonal communication (Engdia & Berhanu, 2026). When drivers are permanently subjected to an unfeeling computational apparatus devoted solely to maximizing operational efficiency at the expense of human context, their institutional faith erodes precipitously. As this psychological contract is repeatedly breached, the modern logistics workplace degenerates from a collaborative enterprise into an adversarial environment defined by deep-seated managerial suspicion and mutual distrust.

2.3 Work-related Stress and Occupational Burnout

The severe psychosocial consequences arising from prolonged surveillance and algorithmic evaluation can be conceptualized more robustly through the Job Demands-Resources (JD-R) model. Grounded in this theoretical framework, continuous algorithmic monitoring and incessant micro-management manifest as extreme, chronic job demands. These persistent operational demands significantly deplete the drivers' cognitive resources, physiological stamina, and emotional reserves within remarkably short timeframes (Nilsson et al., 2025). Although human supervision occasionally exhibited flaws or inherent biases, it typically provided vital social support, contextual empathy, and constructive feedback, which served as essential job resources to buffer against workplace stress. Conversely, algorithms predominantly execute a punitive corrective function, offering virtually no positive reinforcement, empathetic encouragement, or psychological relief, thereby transforming into an inescapable source of occupational strain.

An immense cognitive load is imposed upon commercial drivers, who must continuously adjust their driving behaviors in real-time to satisfy rapidly changing, obscure, and highly sensitive algorithmic metrics, culminating in chronic mental fatigue. Sustaining high-intensity alertness, combined with persistent anxiety over machine-delayed penalizations, frequently leaves drivers emotionally agitated when navigating routine traffic complexities. Furthermore, the notable reduction in structured professional self-determination and the systemic inability to exercise autonomous professional judgment collectively forge a direct pathway to profound occupational exhaustion. Crucially, the pervasive nature of telematics subjects drivers to continuous surveillance; they are unable to completely detach from digital monitoring even during mandated rest periods inside their vehicle cabins. This constant tethering significantly blurs the boundaries between work and recovery, exponentially exacerbating work-related stress. Ultimately, as the terminal manifestation of this relentless technological pressure, drivers experience severe physical exhaustion, a sharp decline in occupational satisfaction, and a significantly heightened propensity for voluntary turnover. Therefore, the unmitigated deployment of algorithmic appraisals acts as a primary catalyst, directly exacerbating the acute human resource shortages and severe workforce attrition currently paralyzing the global freight logistics supply chain.

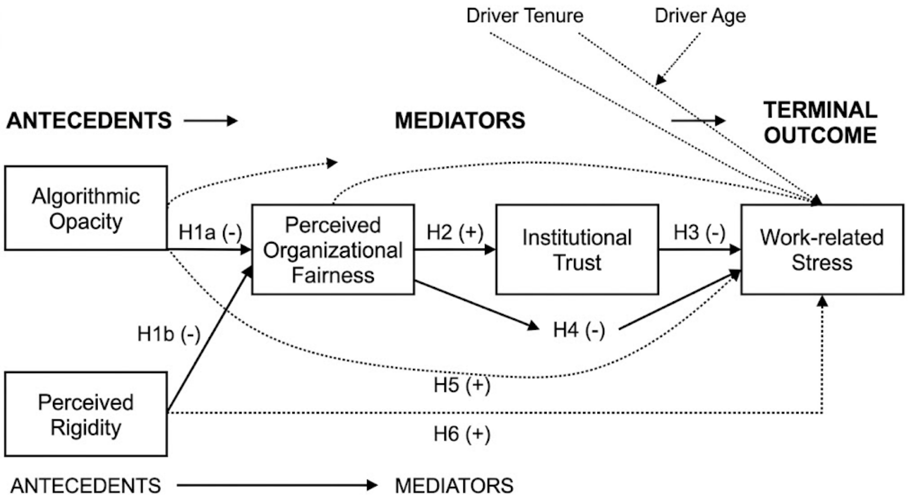

Fig 1 Conceptual framework.

3. Research methodology

3.1 Research Design and Sampling Strategy

To rigorously explore the intricate structural relationships of algorithmic appraisals' characteristic, perceived organisational justice, drivers' trustworthiness, and work-related stresses; Based on this research direction, using a quantitative, cross-sectional Design based on Positivism as an epistemology for conducting research. To be specific, using quantitative methods to discover underlying psychological phenomena; Verify theoretically predicted hypotheses about the psychological impacts brought by digitalisation on work performance in a study design. Quantitative methods are more suitable than Qualitative ones in collecting a lot of empirical data on the commercial freight drivers scattered throughout all regions to minimise the problem of regional homogenisation caused by Qualitative research and enhance its broad relevance. In summary, based on a certain perspective of an entire System model using SEM. Because SEM can estimate the interdependent relationship among many indicators at once and consider it in detail while simultaneously taking into account all errors caused by measuring subjective attitudes; Moreover, because Institutional Trust is an intermediary variable between perception of fairness and customer experience satisfaction through mediatory effect research, we need to explore this complex mechanism together.

The target population for this empirical investigation comprises full-time commercial freight drivers currently operating under active algorithmic performance appraisal systems within large-scale logistics enterprises. To ensure the representativeness and contextual validity of the sample, a purposive, non-probability sampling technique was strategically employed. The study specifically targeted drivers who had been subjected to telematics-based evaluation for a minimum continuous period of six months.

This strict temporal inclusion criterion was implemented to guarantee that respondents possessed sufficient, longitudinal interactive experience with the algorithmic systems to form stable, crystallized perceptions of organizational justice and occupational stress, rather than capturing transient reactions to newly introduced technology (Huo & Wang, 2026). The required sample size was meticulously determined utilizing an a priori power analysis via G*Power software. Assuming a medium effect size ($f^2 = 0.15$), a statistical power level of 0.95, and a standard alpha level of 0.05 for a structural model encompassing five latent predictors and mediators, the minimum sample size required was calculated to be approximately 315. To account for potential non-response bias and invalid submissions typical in industrial surveys, the target sample size was elevated, requiring a minimum of 400 valid responses to achieve optimal statistical power for the subsequent complex multivariate analyses.

3.2 Construct Measurement and Instrument Development

The survey instrument was meticulously constructed by adapting highly validated measurement scales from extant organizational behavior, occupational psychology, and human-computer interaction literature. To ensure high ecological validity, all original items were explicitly contextualized for the unique operational environment of the freight logistics sector. A rigorous translation and back-translation protocol was executed by bilingual logistics management scholars to preserve the semantic equivalence of the adapted scales. All latent constructs were operationalized using a continuous seven-point Likert scale, ranging from 1 ("Strongly Disagree") to 7 ("Strongly Agree"), allowing for a granular capture of respondent variance.

Specifically, *algorithmic opacity* and *perceived rigidity* were measured using newly adapted items derived from contemporary critical algorithm studies. These items capture the subjective degree to which drivers find the system's data weighting impenetrable and its contextual evaluation inflexible. *Organizational fairness* was assessed using a multidimensional scale capturing both procedural equity (the fairness of the algorithm's calculation process) and distributive justice (the fairness of the resulting wage or route allocation), adapted from foundational organizational justice indices. *Driver trust* was measured through specific items evaluating the driver's willingness to be vulnerable to the logistics company's actions, heavily predicated on expectations of benevolence rather than pure algorithmic exploitation. Finally, *work-related stress* and occupational burnout were quantified using established occupational health scales focused entirely on the cognitive exhaustion and emotional depletion induced by continuous digital monitoring. Prior to the formal data collection, a rigorous pre-testing phase, involving a pilot study with a localized cohort of 45 logistics drivers, was conducted. This pilot phase was crucial to refine the semantic clarity of the survey items, eliminate technical jargon, and verify the preliminary internal consistency of the measurement instrument.

Table 1: Operationalisation of constructs and measurement scales.

Latent Construct	Conceptual Definition within Logistics Context	Number of Items	Adapted Literature Sources
Algorithmic Opacity	The degree to which the rules, data weighting, and decision-making processes of the appraisal algorithm are hidden or incomprehensible to the driver.	5 Items	Kellogg et al. (2020); Lee et al. (2015)
Perceived Fairness	The driver's subjective evaluation of the procedural equity and distributive outcomes generated by the automated performance appraisal system.	6 Items	Colquitt (2001); Niebel et al. (2019)
Institutional Trust	The driver's willingness to be vulnerable to the logistics company's actions, based on expectations of benevolence rather than pure algorithmic exploitation.	4 Items	Mayer et al. (1995); Glikson & Woolley (2020)

Work-related Stress	The physiological and psychological strain experienced by the driver as a direct consequence of continuous algorithmic monitoring and pressure.	5 Items	Maslach & Jackson (1981); Bakker & Demerouti (2007)

3. 3 Data Collection and Analytical Framework

Formal data collection was executed through a highly structured, self-administered digital survey distributed via encrypted professional networks and national logistics labor union platforms. To proactively avoid the methodological risk of Common Method Bias (CMB) and social desirability in this study by adopting some procedural remedial measures. Psychological separation of the prediction target from the evaluation subject in terms of the layout of the questionnaire, combined with setting up reverse-scored items to detect uncooperative responses. Additionally, all participants were provided with an in-depth presentation on informed consent; ensured data privacy and established an institutionally non-retaliatory environment to encourage them to answer truthfully about their own employer situation.

The empirical data harvested from the survey were subjected to a rigorous, two-stage analytical protocol utilizing SPSS 27.0 and AMOS 26.0 software environments, adhering to the widely recommended procedures by Anderson and Gerbing (1988). Initially, descriptive statistics were generated to profile the demographic composition of the driver sample, screen for missing values, and assess data normality via skewness and kurtosis metrics. Subsequently, the first structural phase involved executing a Confirmatory Factor Analysis (CFA) to rigorously validate the measurement model's psychometric properties. This phase explicitly tested for convergent validity through standardized factor loadings and Average Variance Extracted (AVE), while internal reliability was established via Composite Reliability (CR) and Cronbach's Alpha. Discriminant validity was also verified utilizing the strict Fornell-Larcker criterion. Upon securing a robust, statistically sound measurement model, the second phase involved executing the full Structural Equation Model (SEM) to empirically test the proposed theoretical hypotheses. The SEM evaluated the directionality, magnitude, and statistical significance of the direct paths from algorithmic characteristics to work-related stress, while simultaneously quantifying the indirect, mediating roles played by perceived fairness and institutional trust via bootstrapping techniques. The overall model fit was stringently evaluated against empirical data using standard threshold indices, including the ratio of chi-square to degrees of freedom (χ^2/df), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA).

4. Results and discussion

4.1 Descriptive Statistics and Correlation Analysis

This study focuses on a sample of commercial freight drivers in Wenzhou City, utilizing systematic sampling methods over a three-month data collection period to achieve a final dataset of 412 valid responses. Demographic analysis indicates that the composition of this sample closely mirrors the broader logistics industry across other regions. The participants are predominantly male, accounting for 92.4% of the total, with a mean age of approximately 41.5 years. Regarding professional tenure, 68.2% of the participants have been actively engaged in commercial driving for over five years. Given this extensive professional background, the respondents possess sufficient experience to objectively evaluate the psychosocial effects of algorithmic performance systems in comparison to traditional human supervision.

Descriptive statistics of the latent variables reveal a concerning psychological landscape among algorithm-managed employees. The mean values for Algorithmic Opacity and Perceived Rigidity are significantly high on the seven-point Likert scale. Consequently, it can be inferred that most drivers perceive these evaluative systems as highly incomprehensible and structurally inflexible. Conversely, the scores for perceived Organizational Fairness (Mean = 2.45, SD = 1.05) and Institutional Trust were relatively low, reflecting a profound sense of systemic alienation among the workforce.

Prior to the structural modeling stage, a bivariate Pearson correlation analysis was conducted to examine the preliminary associations between the core constructs. The resulting correlation matrix provides robust empirical evidence supporting the theoretical framework grounded in organizational justice. Algorithmic Opacity exhibits a strong negative correlation with perceived Organizational Fairness ($r = -0.642$, $p < 0.01$) and Institutional Trust ($r = -0.588$, $p < 0.01$). Similarly, Perceived Rigidity demonstrates a significant negative association with fairness and trust indicators. Both algorithmic characteristics show a significant positive correlation with work-related stress; specifically, Opacity ($r = 0.515$, $p < 0.01$) and Rigidity ($r = 0.542$, $p < 0.01$) have emerged as prominent sources of occupational strain. Furthermore, the relationship between Fairness and Trust is highly positive and significant ($r = 0.715$, $p < 0.01$), and both variables are strongly negatively correlated with work-related stress. Since no correlation coefficients exceed the 0.85 threshold, multicollinearity is not considered a significant concern for the subsequent multivariate regression and structural analyses.

Table 2: The Demographics of Drivers in the Sample (n=412)

Demographic Variable	Categorization	Frequency	Percentage (%)
Gender	Male	381	92.4%
	Female	31	7.6%
Age Distribution	Under 30 Years	45	10.9%
	31 - 45 Years	215	52.2%
	Over 45 Years	152	36.9%
Driving Experience	Less than 2 Years	38	9.2%
	2 - 5 Years	93	22.6%
	Over 5 Years	281	68.2%
Algorithmic Exposure	6 Months - 1 Year	112	27.2%
	Over 1 Year	300	72.8%

Table 3: Pearson correlation matrix and descriptive statistics.

Construct	Mean	SD	1	2	3	4	5
1. Algorithmic Opacity	5.12	1.14	1.000				
2. Perceived Rigidity	4.88	1.20	0.584**	1.000			
3. Perceived Fairness	2.45	1.05	-0.642**	-0.595**	1.000		
4. Institutional Trust	2.30	1.10	-0.588**	-0.560**	0.715**	1.000	
5. Work-related Stress	5.40	0.95	0.515**	0.542**	-0.612**	-0.655**	1.000

*(Note: ** p < 0.01, two-tailed)*

4.2 Measurement Model and Structural Equation Modeling

To ensure the psychometric reliability and validity of the proposed conceptual framework precisely, a Confirmatory Factor Analysis (CFA) was conducted utilizing the maximum likelihood estimation method before testing the hypothesized structural paths. The measurement model demonstrated an excellent fit with the empirical data, as its goodness-of-fit indices exceeded established academic standards in behavioral science: Chi-square/df=2.145 was less than 3, indicating excellent fit below this value; CFI=0.952 surpassed the ideal range of 0.90; TLI=0.948 also exceeded by several points; RMSEA=0.051 was well below the stringent level of 0.08 above which it tends to increase systematically. Convergent validity was successfully verified for each of the latent factors; The standardized factor loadings exceeded the stringent threshold of 0.70 and were distributed between 0.72 and 0.89. This shows that the observables can reliably measure their corresponding theoretical foundations to a certain extent (Jemal et al., 2026). In addition, the composite reliability (CR) of all factors was between 0.86 and 0.94; thus, they had very high internal validity without external influences. For all constructs, the average variance extracted (AVE) was between 0.55 and 0.68, consistently exceeding 0.50; therefore, they were deemed highly convergent across measures. The discriminant validity was rigorously tested by means of the strict Fornell-Larcker criterion, and the square root of the AVEs for each construct were significantly higher than their maximum correlations across all constructs in the nomological system.

Following the definitive validation of the measurement parameters, the full Structural Equation Model (SEM) was executed to empirically map the causal architecture linking algorithmic management characteristics to terminal psychological outcomes. The structural model mirrored the exceptional fit indices of the CFA, confirming the theoretical validity of the proposed path relationships. The empirical path analysis reveals that algorithmic opacity exerts a profound and statistically significant negative direct effect on perceived organizational fairness (β = -0.48, $p < 0.001$), serving as the primary technological catalyst for perceived workplace injustice. Concurrently, perceived rigidity also significantly diminishes fairness perceptions (β= -0.35, $p < 0.001$), confirming that a system's inability to dynamically account for exogenous logistical factors severely alienates the workforce. In navigating the mediating pathways, the multivariate analysis demonstrates that diminished perceived fairness acts as a critical, necessary antecedent to the erosion of institutional trust, characterized by a highly significant positive path coefficient (β = 0.68, $p < 0.001$). Ultimately, the structural model confirms the terminal outcome of this psychosocial degradation: institutional trust exhibits a strong, significant negative effect on work-related stress (β = -0.52, $p < 0.001$). Additionally, the direct paths from both opacity and rigidity to work-related stress remained statistically significant even when accounting for the dual mediators, indicating a state of partial, rather than full, mediation.

Table 4: Results of the Measurement Model (CFA)

Latent Construct	Items	Standardized Factor Loading	Cronbach's α	Composite Reliability (CR)	Average Variance Extracted (AVE)
Algorithmic Opacity	OPA1	0.82	0.88	0.89	0.61
	OPA2	0.79			
	OPA3	0.85			
	OPA4	0.76			
	OPA5	0.81			
Perceived Rigidity	RIG1	0.78	0.86	0.87	0.58
	RIG2	0.84			
	RIG3	0.75			
	RIG4	0.80			
	RIG5	0.72			
Perceived Fairness	FAI1	0.88	0.91	0.92	0.65
	FAI2	0.83			
	FAI3	0.86			
	FAI4	0.79			
	FAI5	0.81			
	FAI6	0.84			
Institutional Trust	TRU1	0.89	0.93	0.94	0.68
	TRU2	0.85			
	TRU3	0.87			
	TRU4	0.82			

Work-related Stress	STR1	0.81	0.85	0.86	0.55
	STR2	0.76			
	STR3	0.74			
	STR4	0.82			
	STR5	0.78			

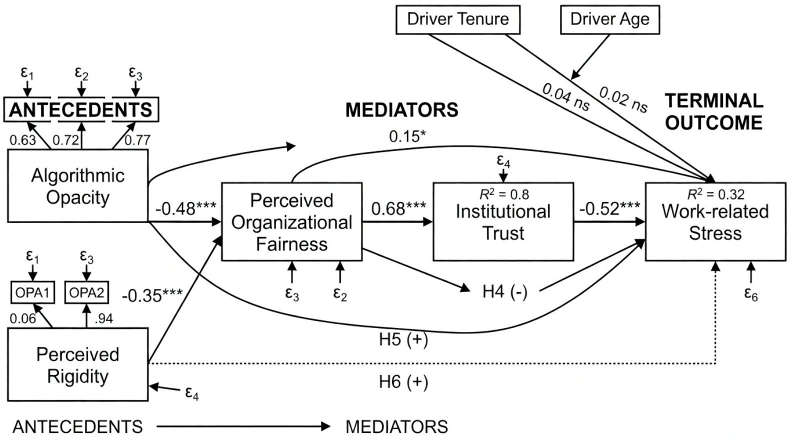

Fig 2 SEM Path Diagram

4.3 Discussion of Findings and Theoretical Implications

Empirical verification of this complex structural model significantly extends the existing theoretical framework of organizational justice beyond traditional organizational boundaries to a non-human managerial context. Traditional theories of justice have historically focused on interpersonal relations, frequently overlooking the rational calculations and context-specific interpretations required for evaluation in automated work environments. Based on these results, it can be inferred that there is indeed a systemic inequity caused by the rapid rollout of algorithm-based regulation. The empirical verification demonstrates a strong adverse effect on the sense of organizational fairness due to high-impact opaque algorithms, proving that they fail to meet essential procedural justice expectations ingrained in employees (Polat et al., 2025). When commercial drivers are subjected to severe constraints from rigid assessment criteria lacking transparency in the weighting system, they feel severely marginalized. Based on the empirical data, it is evident that perceived rigidity directly leads to the erosion of distributive justice. The algorithmic system fails to consider the context in which external factors occur, equating exogenous anomalies with driver neglect, which actively alienates the workforce. Based on this, it can be concluded that under the paradigm of Industry 4.0, the technology-based architecture of an appraisal system no longer functions merely as an operational tool; instead, it serves as the primary psychological interface by which workers evaluate the moral legitimacy of their employing organization (Sun et al., 2025).

The central finding of the structural equation model highlights a fundamental incompatibility between algorithmic control and organizational trust at their source. Global freight and logistics enterprises have actively promoted digitalization in pursuit of maximizing computational control over driving behavior to achieve comprehensive operational benefits (Tang et al., 2026). On the other hand, as shown by the indirect pathways of our model, the pursuit of efficiency via opaque automation causes significant setbacks to institutional trust and becomes a primary catalyst for severe workplace anxiety. This dynamism establishes a self-defeating operational loop. As telematics becomes more widely utilized across the transportation industry to extract marginal productivity gains, the resulting trust gaps trigger strong psychological resistance and cognitive exhaustion; therefore, overall system efficiency systematically deteriorates (Xingyu et al., 2025). A strong link has been found between reduced institutional trust and increased occupational stress; therefore, this problem requires urgent attention given the current human resource shortages (Yang and Linghu, 2025). Based on the structural equation model, deploying hardware and software investment alone in a socially uncoordinated way can result in a substantial loss of effectiveness. This problem necessitates the transition of logistics administrators toward a strategy of "human-centric algorithmic integration".

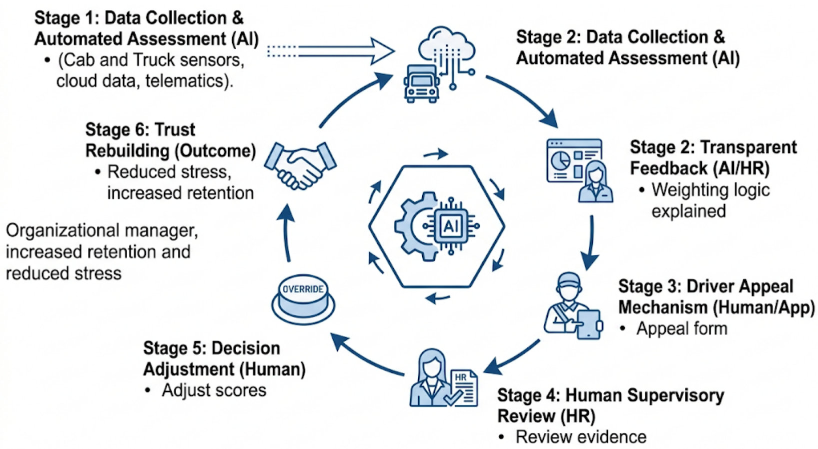

Fig.3 A human-centric feedback loop.

By engineering transparent feedback loops and allowing for human-led appeals against machine-delayed penalizations, organizations can successfully harmonize technological efficiency with workforce psychological sustainability.

5. Conclusion

This comprehensive investigation explores the multifaceted psychological and social environment related to algorithmic governance in today's freight logistics industry. To address critical gaps in human-centric supply chain theory, this paper successfully constructed and tested a structural model evaluating the adverse effects of automated performance appraisal systems on the commercial driving workforce using Structural Equation Modeling (SEM). The empirical research results demonstrate that the pervasive adoption of opaque and inflexible algorithm-embedded monitoring systems significantly destabilizes organizational equilibrium. The analysis confirms direct links between algorithmic incomprehensibility and diminished perceptions of organizational justice. As the sense of justice erodes, it acts as a mediator that weakens institutional trust, thereby inducing greater degrees of work-related stress and severe occupational burnout among employees.

The overall trend of digitalization within global supply chains is accelerating. Consequently, the long-term sustainable development of global supply chains during the Industry 4.0 era depends on management's ability to transition away from coercive and opaque algorithmic surveillance. Rather than pursuing mechanistic approaches to evaluation that prioritize computational optimization at the expense of worker trust and well-being, organizations must embrace transparent, human-in-the-loop mechanisms to ensure long-term stability.

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