

Enhancing Employee Well-Being through Ai-Enabled Stress Management: A Pilot Study in the Manufacturing Sector

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Abstract

Employee mental health is increasingly critical in digital manufacturing environments, where traditional stress management approaches often overlook the dynamic interplay between individual psychological factors and work-related factors. This study integrates the transactional model of stress and coping (tmssc) with self-determination theory (sdt) to propose a dual-path framework that leverages ai-enabled ease of use to enhance employee well-being. A pilot survey involving 50 employees from two electronics factories in shandong, china, employed validated instruments such as the recovery experience questionnaire. Exploratory factor analysis confirmed strong construct validity ($kmo > 0.78$), and correlation analysis identified significant predictors of stress management. Behavioral coping strategies exhibited the strongest correlation with stress outcomes ($r=0.670$), followed by perceived organizational support ($r=0.638$), ai-enabled ease of use ($r=0.634$), technology self-efficacy ($r=0.601$), and job autonomy ($r=0.591$). These findings suggest that when ai tools are perceived as easy to use, they support psychological needs for autonomy and competence, thereby enhancing employees' capacity to cope with stress. The study highlights the importance of designing modular, user-friendly ai systems that align with cultural values, such as mianzi norms and the operational constraints of resource-limited manufacturing settings.

Keywords: Stress Management, Employee Well-being, Artificial Intelligence, HRM Innovation, Manufacturing

Introduction

Mental health and well-being have become critical challenges in the modern manufacturing environment, where high productivity demands, intense competition, and technological disruption amplify psychological stress (WHO, 2022). In China's electronics manufacturing sector, a global production hub, chronic fatigue, anxiety, and mental health

risks are especially prevalent, particularly among rural migrant workers with limited digital skills (Aon TELUS Health, 2024). Traditional stress management strategies such as job rotation or rest breaks have proven insufficient, largely because they overlook the dynamic interaction between individual psychological characteristics and work-related conditions.

To address this gap, the study integrates the Transactional Model of Stress and Coping (TMSC) (Lazarus & Folkman, 1984) with Self-Determination Theory (SDT) (Deci & Ryan, 2000) to develop a dual-path framework for employee stress management. This model examines how individual-level predictors, such as cognitive appraisal, emotional regulation, behavioral coping strategies, and technology self-efficacy, interact with job autonomy, workload perception, and organizational support. A central focus is AI-enabled ease of use, which refers to employees' perception of the usability and simplicity of AI tools like adaptive task scheduling and emotion recognition systems.

Focusing on medium-sized enterprises in Shandong Province, the study argues that AI perceived as easy to use can fulfill core psychological needs of autonomy and competence (Faraj et al., 2018), thereby improving employees' stress management outcomes. This research contributes to the growing intersection of AI-human interaction and organizational psychology, offering culturally adapted insights for stress management in resource-constrained industrial settings.

Literature Review

This section synthesizes theoretical and empirical literature that frames the relationship between individual and work-related predictors, AI-enabled ease of use, and stress management.

Theoretical Framework: TMSC and SDT Foundations

TMSC defines stress as a dynamic interaction between individuals and their environment, shaped by primary appraisal (evaluating threat or challenge) and secondary appraisal (assessing coping resources). In manufacturing contexts, TMSC helps explain how employees interpret workload and whether available tools, including AI, aid adaptation. Key individual predictors include cognitive stress appraisal, emotional regulation, and behavioral coping strategies, ranging from active problem-solving to avoidance (Gross, 2008).

SDT (Deci & Ryan, 1985) complements TMSC by positing that motivation and well-being depend on satisfying needs for autonomy, competence, and relatedness. In this study, job autonomy, technology self-efficacy, and perceived organizational support are mapped onto these needs, influencing both stress management and perceived AI usability.

AI-enabled ease of use serves as a bridging construct, enhancing cognitive coping (TMSC) and fulfilling motivational needs (SDT). This reflects the "technology-psychological fit," where alignment between system functionality and user capacity fosters adoption and resilience (Bergdahl et al., 2023).

Stress management is conceptualized as a proactive capacity for emotional regulation and psychological recovery, aligning with both theoretical models as a dynamic, multidimensional process.

AI in HRM: Psychological Adaptation and Technology Fit

AI in HRM has evolved from administrative automation to include real-time stress detection, personalized feedback, and adaptive task support (Oladele, 2023). Employee adaptation to such systems depends largely on perceived ease of use, drawn from the Technology Acceptance Model and extended to AI contexts.

AI-enabled ease of use reflects how intuitively employees can interact with AI tools, influencing secondary appraisal (TMSC) and fulfilling autonomy and competence needs (SDT). Tools like emotion-sensing systems provide immediate feedback, supporting emotional regulation and stress recovery (Doe, 2021). High ease of use also enhances technology self-efficacy, a key enabler of resilience in tech-intensive environments.

Platforms with adaptive task allocation and self-paced feedback embody the “technology–psychological fit,” aligning system functionality with employees’ cognitive and emotional coping styles (Kandoth & Shekhar, 2022), thereby promoting sustained engagement and stress mitigation.

Prior Research Limitations and Cultural Contextualization

Most AI–stress management studies emerge from Western contexts, often neglecting cultural dimensions essential to understanding coping behaviors in collectivist societies like China (Hu et al., 2024). In Chinese workplaces, *mianzi* (face) and hierarchical norms inhibit emotional expression and support-seeking, undermining the accuracy and effectiveness of AI-based emotion recognition systems. Hierarchical structures also restrict autonomy and bottom-up communication, weakening coping capacity.

Medium-sized enterprises in regions like Shandong face unique stress management challenges: limited AI adoption (25–35%) and constrained digital infrastructure (Shandong White Paper, 2023). These firms require modular, low-cost AI solutions, such as stress-tracking plug-ins or semi-automated chatbots, that align with cultural norms and technological readiness.

By highlighting these gaps, this study positions AI-enabled ease of use within a culturally contextualized TMSC–SDT framework, offering a scalable and psychologically adapted approach to stress management in China’s digital manufacturing sector.

Methodology

This pilot study adopted a quantitative, cross-sectional survey design to examine how individual psychological traits and work-related factors influence employees’ stress management in AI-mediated manufacturing environments, focused on evaluating the construct validity, reliability, and predictive relationships of core variables. A structured questionnaire was administered to 50 full-time employees from two medium-sized electronics manufacturers in Jinan, Shandong Province, using purposive sampling to ensure heterogeneity in roles and hierarchy. Participants had a minimum of one year of experience in digitally integrated workplaces and provided informed consent under institutional ethical guidelines.

The survey measured constructs such as cognitive stress appraisal, emotional regulation, behavioral coping strategies, technology self-efficacy, workload perception, job autonomy, organizational support, and AI-enabled ease of use, with stress management as the dependent variable. All items were adapted from validated scales and rated on a five-point Likert scale. Data were analyzed using SPSS 29, applying Exploratory Factor Analysis (EFA) to assess construct validity, and Cronbach's alpha to evaluate internal consistency. Pearson correlation analysis tested predictive validity between independent variables and dependent variable, with significance thresholds set at $p < 0.01$.

Results

This pilot study evaluated the construct validity, internal consistency reliability, and predictive validity of the proposed measurement model using data from 50 manufacturing employees.

Construct Validity

Exploratory Factor Analysis (EFA) confirmed the factorability of all scales. KMO values ranged from 0.661 (Technology Self-Efficacy) to 0.846 (Perceived Organizational Support), with six constructs exceeding the 0.78 threshold, indicating strong sampling adequacy (Kaiser, 1974). Bartlett's Test of Sphericity was significant ($p < 0.001$) for all variables, supporting the structural integrity of the latent constructs. Constructs such as Job Autonomy (KMO = 0.839) and Stress Management (KMO = 0.834) demonstrated particularly strong factor structures, laying a robust foundation for future confirmatory modeling.

Reliability

All constructs achieved Cronbach's alpha (α) values above 0.74, meeting accepted reliability standards (DeVellis & Thorpe, 2021). Job Autonomy ($\alpha = 0.919$), Behavioral Coping Strategies ($\alpha = 0.911$), and AI-enabled Ease of Use ($\alpha = 0.898$) exhibited the highest reliability. Even the lowest-scoring construct, Technology Self-Efficacy ($\alpha = 0.745$), remained within the acceptable range, indicating strong internal consistency across scales.

Predictive Validity

Pearson correlation analysis demonstrated significant positive relationships between all independent variables and Stress Management ($p < 0.01$). Behavioral Coping Strategies showed the strongest correlation ($r = 0.670$), followed by Perceived Organizational Support ($r = 0.638$) and AI-enabled Ease of Use ($r = 0.634$). Other significant predictors included Technology Self-Efficacy ($r = 0.601$), Job Autonomy ($r = 0.591$), and Workload Perception ($r = 0.565$). The combined independent variables yielded an overall correlation of $r = 0.685$, reinforcing the explanatory power of the dual-path model grounded in TMSC and SDT.

These findings empirically support the structural soundness and theoretical assumptions of the proposed framework, highlighting the joint contribution of psychological resources and technology usability to workplace stress management.

Discussion

This pilot study investigated the predictive mechanisms of employee stress management in AI-mediated manufacturing by integrating TMSC and SDT into a dual-path framework. Data from 50 employees in Shandong's electronics sector provided empirical support for the model, confirming the role of both individual psychological traits and work-related factors, including AI-enabled ease of use, in shaping stress management.

Construct validity and internal consistency reliability were established through EFA (KMO > 0.78) and Cronbach's alpha ($\alpha > 0.74$), indicating robust psychometric properties. Correlation analysis revealed that behavioral coping strategies, perceived organizational support, and AI-enabled ease of use were the strongest predictors of stress management, validating the importance of both human agency and technological support in AI-driven environments.

Theoretical Contribution and Practical Implications

The study offers a novel contribution by proposing and testing an integrated TMSC–SDT framework, positioning AI-enabled ease of use as a mediating construct linking psychological needs with stress outcomes. This expands theoretical understanding of technology–psychological fit in industrial HRM contexts, an area often underexplored.

For HRM practitioners, the findings underscore the importance of designing modular, user-friendly AI tools that fulfill employees' needs for autonomy and competence. Digital transformation strategies should emphasize employee-centric AI integration and be supported by an organizational culture that promotes perceived support and adaptive workload management.

Limitations and Future Research

The study is limited by its small sample size and regional focus, affecting generalizability. Future research should expand across sectors and cultures, using longitudinal and SEM approaches to test causal mechanisms. Incorporating objective performance indicators and exploring culturally nuanced stressors, e.g., mianzi in China or tatemaie, honne in Japan, will deepen contextual relevance. Emphasis on scalable, low-cost AI interventions in SMEs across emerging economies offers promising directions for both theory and practice.

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