Human-Centered Design Perspectives on Emerging Technologies for Workplace Well-Being

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ABSTRACT

Workplace mental health issues cost the global economy approximately US$1 trillion annually in lost productivity due to depression and anxiety alone (WHO, 2024). Researchers increasingly frame workplace well-being as a design challenge that integrates human experience with long-term social sustainability, moving beyond traditional management approaches. This study conducts a design-oriented narrative review to explore how emerging technologies—extended reality (XR), gamification, and AI-driven personalization—can support well-being from human-centered and socially sustainable perspectives. Through qualitative content analysis of approximately thirty representative studies, we identify key design affordances and factors influencing sustainable adoption.

Results show that XR creates immersive environments that enhance physical activity and emotional regulation; gamification drives healthy behaviors via motivational feedback loops; and AI personalization enables adaptive "smart nudging" that respects user autonomy. However, sustainable adoption faces four major challenges: user acceptance, technical maturity, ethical responsibility, and social equity. We argue that these technologies should be treated as socio-technical systems and designed with participatory, transparent, and human-centered principles to align with employee values and the United Nations Sustainable Development Goals. This review contributes an integrative conceptual framework that bridges technological innovation with responsible design for workplace well-being.

Keywords: Workplace well-being, Human-centered design, Social sustainability, AI personalization,

INTRODUCTION

The World Health Organization (WHO) estimates that depression and anxiety cost the global economy US$1 trillion annually in lost productivity, equivalent to 12 billion working days lost each year (World Health Organization, 2024). Despite significant growth in traditional healthcare systems, mental health challenges such as anxiety and workplace loneliness continue to escalate (Valtonen et al., 2025). Consequently, researchers are shifting from traditional managerial approaches toward viewing workplace well-being as a design challenge that integrates human experience with social sustainability. From this human-centered perspective, well-being is not merely a static state but an emergent property of the thoughtful integration of technology into daily work practices.

Emerging technologies—including extended reality (XR), gamification, and AI-driven personalization—continue to influence workplace innovation and social impact (Rotolo et al., 2015). These technologies serve as "design materials" that shape interactions, yet their adoption does not automatically translate into improved well-being (García-Madurga et al., 2024). The effectiveness of these tools depends heavily on design decisions regarding usability, autonomy, and ethical responsibility rather than inherent neutrality (Kourtesis, 2024). Furthermore, the impact of AI is often indirect, mediated through factors such as task optimization and physical safety (Valtonen et al., 2025).

From a design perspective, XR technologies enable immersive experiences that reconfigure how employees exercise, relax, and learn. Virtual fitness environments and meditation spaces have been shown to enhance user

engagement (Cao et al., 2023), while nature-based VR can facilitate emotional recovery and reduce physiological stress during work breaks (Riches et al., 2024). XR also supports effective clinical interventions for anxiety, phobias, and depression (Pons et al., 2022). Recent scoping reviews further underscore XR's potential as an accessible tool for improving well-being among high-stress workforces, such as healthcare practitioners, particularly when synergized with AI to provide individualized support (Tabassum et al., 2025; Schwirtlich et al., 2026).

Gamification serves as another effective strategy by incorporating elements such as points, badges, and leaderboards to motivate behavioral change. Studies emphasize that key design elements—including character design, simplified interfaces, personalization, and social interaction—shape emotional responses and encourage long-term participation in wellness applications (Auf et al., 2021). While these mechanisms boost short-term motivation, their long-term sustainability depends on alignment with intrinsic needs and the mitigation of "surveillance pressure" that can arise from over-monitoring (García-Madurga et al., 2024)

AI-driven personalization expands this design space by enabling adaptive interventions. AI systems analyze user data to deliver tailored health recommendations, with "smart nudging" demonstrating how cognitive technologies facilitate value co-creation while preserving user empowerment (Mele et al., 2021). Similar advantages are observed in enhancing healthcare accessibility (Sawers et al., 2021). However, the implementation of supervised learning for mental health monitoring requires a balance between predictive accuracy and user trust (Venugopal et al., 2026). Integrating Explainable AI (XAI) is therefore essential to ensure algorithmic outputs are interpretable for employees handling sensitive psychological data (Venugopal et al., 2026). When responsibly designed, AI-powered wellness programs offer real-time, individualized support that enhances health outcomes without compromising user autonomy (Cape Fox FCG, 2025; Schwirtlich et al., 2026).

Based on these considerations, this review adopts a human-centered design perspective to examine how emerging technologies are applied to support workplace well-being, while identifying key design-related factors that influence their socially sustainable adoption.

LITERATURE REVIEW

Contemporary workplaces face rapid technological change and intensified workloads. Prolonged sedentary behavior and blurred boundaries between work and personal life now contribute significantly to employee health crises. According to the World Health Organization (2024), 31% of adults worldwide—approximately 1.8 billion people—fail to meet recommended physical activity levels. This reflects a five-percentage-point increase since 2010. If current trends persist, inactivity could reach 35% by 2030, heightening the risk of cardiovascular disease, diabetes, and cancer (WHO, 2024; Park et al., 2024).

From a human-centered design perspective, these challenges are experiential problems shaped by work environments and tools. Mental health concerns, including anxiety and burnout, are increasingly prevalent (Venugopal et al., 2026). Many employees now rely on digital health applications to manage their well-being (Yee et al., 2016; Wells et al., 2023). Furthermore, workplace mental health issues remain strongly linked to absenteeism and employee turnover (Venugopal et al., 2026). These findings suggest that the way technologies are embedded into everyday practices directly determines the employee experience.

Technological advances frequently disrupt the balance between work and life. Remote and hybrid models offer flexibility but can also intensify chronic stress and harm sleep quality (Mariappanadar & Hochwarter, 2022; Pélissier et al., 2025). Recent evidence suggests a "flexibility paradox" where flexible arrangements may actually increase availability demands, potentially reversing the benefits of working from home (Trevino Garcia & Christensen, 2025).

Autonomy is another critical factor in workplace well-being. Employees with limited control over work processes often experience frustration and low motivation (Sætra, 2019). From a design standpoint, autonomy depends on interaction choices that define how much agency a user has over their tools. This is especially relevant as AI adoption impacts well-being indirectly through task optimization and perceived safety (Valtonen et al., 2025).

Researchers are now exploring emerging technologies as specific design interventions. While these tools involve high uncertainty, they offer significant potential as "design materials" for addressing complex organizational challenges (Rotolo et al., 2015). Extended reality (XR), for instance, creates immersive environments for physical activity and relaxation. Embodied experiences in virtual spaces can increase engagement and reduce stress (Cao et al., 2023). Specifically, nature-based VR environments have been shown to facilitate emotional recovery and reduce physiological stress during work breaks (Riches et al., 2024). Ultimately, experience design and usability determine the efficacy of XR in supporting interventions for anxiety (Kourtesis, 2024; Pons et al., 2022).

Gamification further promotes well-being by integrating points and badges into work tasks. This strategy encourages positive behavior change by aligning design goals with user motivations (Auf et al., 2021). Gamified systems support sustained engagement through carefully designed feedback. However, designers must mitigate "surveillance pressure," as excessive monitoring in these systems can undermine trust and increase psychological strain (García-Madurga et al., 2024). When responsibly implemented, these technologies can enhance both health outcomes and long-term social sustainability in the workplace.

AI-driven personalization facilitates adaptive interventions by analyzing physiological data and work routines. These systems provide tailored recommendations for exercise and stress management. Mele et al. (2021) introduced "smart nudging" to describe how cognitive technologies shape choice architectures while preserving user agency. While such data-driven solutions aim to improve health outcomes and social impact (Sawers et al., 2021), empirical evidence suggests AI's impact is often indirect. Rather than directly increasing happiness, AI improves well-being by optimizing specific tasks and enhancing workplace safety.

Integrating emerging technologies into professional settings requires a framework of social sustainability. Innovation must align with social and environmental responsibility (Singh et al., 2024). From a design perspective, this alignment demands a focus on technology implementation, maintenance, and long-term usability. Designers must specifically address three factors: energy efficiency, e-waste management, and sustained accessibility. These priorities directly support the United Nations Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 8 (Decent Work and Economic Growth). Design interventions contribute to these goals by fostering inclusive work practices and promoting active lifestyles through immersive tools.

Ethical considerations are fundamental to the design of these technologies. AI-driven personalization and data-intensive systems raise critical concerns regarding privacy, transparency, and fairness. The debate over "nudging" highlights the ongoing tension between behavioral influence and user autonomy (Schmidt & Engelen, 2020; Sætra, 2019). Furthermore, excessive monitoring can trigger "surveillance pressure," which may create a climate of mistrust and increase employee stress. Addressing these risks requires reflective design practices that prioritize trust and inclusivity (Ranchordás, 2020). Integrating Explainable AI (XAI) is essential to ensure that algorithmic decisions remain interpretable and trustworthy for employees handling sensitive psychological data.

METHODOLOGY

This study adopts a design-oriented narrative review. It examines how extended reality (XR), gamification, and AI-driven personalization support workplace well-being. The analysis is grounded in human-centered design (HCD) and social sustainability frameworks. Unlike meta-analyses, which require homogeneous quantitative data, a narrative approach facilitates the synthesis of interdisciplinary literature, including conceptual and qualitative works. This method is appropriate for identifying thematic patterns and design affordances in rapidly developing fields.

Literature Search and Identification

Literature was identified through structured searches conducted between January and March 2025. We utilized four primary databases: Google Scholar, Scopus, Web of Science, and IEEE Xplore. Search strings combined keywords such as "workplace well-being" OR "employee well-being" with technology-specific terms including

"extended reality," "gamification," and "smart nudging". To ensure a comprehensive scope, the search included reports from the World Health Organization (WHO) and relevant grey literature.

Inclusion and Exclusion Criteria

Inclusion criteria required: (1) peer-reviewed journal articles or conference proceedings published after 2015; (2) an explicit focus on workplace or employee well-being; and (3) a discussion of the target technologies from a design or socio-technical perspective. We excluded purely technical papers lacking well-being implications and studies set exclusively in clinical or educational contexts. To mitigate selection bias, results were cross-validated across multiple databases. Searching continued until thematic saturation was reached.

Data Analysis and Synthesis

After removing duplicates, approximately 30 representative studies were selected for qualitative content analysis. Coding focused on four main themes: (1) design affordances, (2) impacts on employee experience, (3) factors influencing sustainable adoption, and (4) ethical considerations. This thematic approach enabled the construction of an integrative conceptual framework. The framework links specific technological features—such as "smart nudging" (Mele et al., 2021) and immersive environments (Cao et al., 2023)—with socially sustainable workplace outcomes.

RESULTS AND DISCUSSION

This synthesis identifies key themes in how technology supports workplace well-being. We focus on experiential impact, adoption challenges, and human-centered design rather than conventional empirical results.

Design affordances of emerging technologies for workplace well-being

Emerging technologies provide distinct design affordances for workplace well-being. Extended reality (XR) creates immersive and embodied experiences that enhance employee engagement. VR meditation and virtual workspaces, for example, reduce stress and improve emotional regulation (Pons et al., 2022). These benefits stem from the specific design of immersion, interaction, and sensory feedback.

Gamification motivates engagement and healthy behaviors through challenges, rewards, and feedback loops. These systems transform routine tasks into meaningful experiences. Well-designed gamification promotes physical activity and a sense of achievement (Auf et al., 2021). Success depends on aligning game elements with user motivations and workplace contexts, rather than the elements themselves.

AI-driven personalization enables adaptive interventions by analyzing behavioral and health data. These systems offer targeted support for stress management and lifestyle changes (Zhang et al., 2022). Personalization serves as both a technical feature and a design challenge involving trust, transparency, and user control.

Design challenges in the socially sustainable adoption of emerging technologies

The literature identifies several design challenges that hinder the sustainable adoption of emerging technologies. User acceptance remains a critical factor. Resistance arises when employees perceive technologies as intrusive, complex, or misaligned with their needs (Walser & Remus, 2021). Therefore, participatory design must involve users to ensure that technological interventions meet actual workplace requirements.

Technological maturity also determines adoption outcomes. Unreliable or costly systems undermine long-term engagement and organizational commitment (Rotolo et al., 2015). From a design perspective, maturity encompasses technical reliability, usability, and seamless integration into existing work practices.

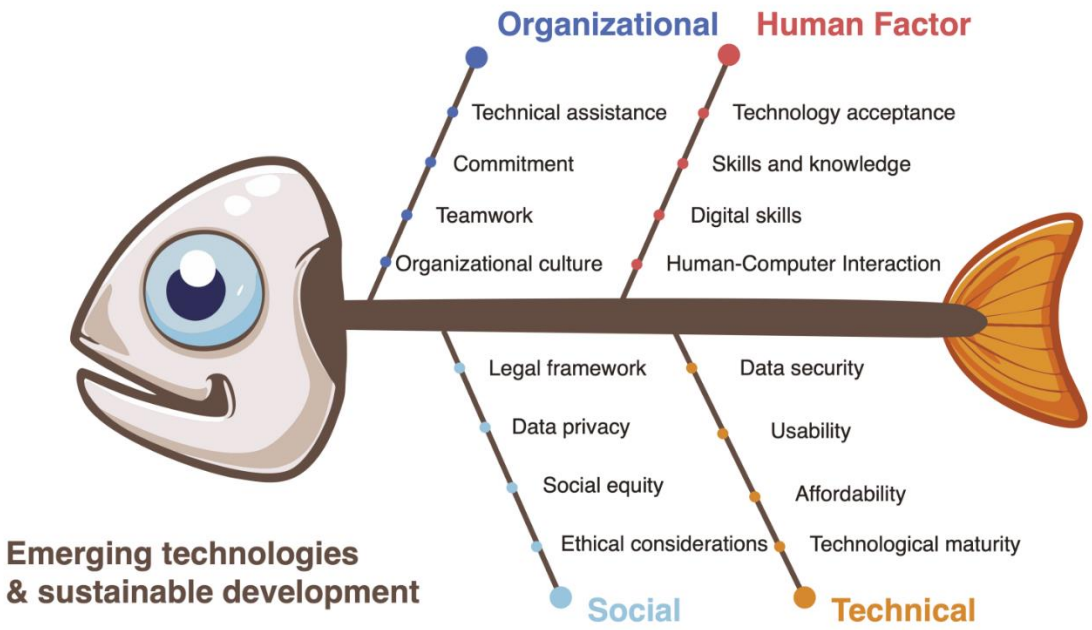

Figure 1. Conceptual framework of emerging technologies for workplace well-being.

Figure 1 illustrates a conceptual framework for the socially sustainable adoption of emerging technologies in supporting workplace well-being. The framework was constructed through iterative thematic synthesis of the reviewed literature. It draws on three foundational perspectives: (1) socio-technical systems theory, which emphasizes the interdependent relationship between social and technical elements in organizational settings (Bostrom & Heinen, 1977; Cherns, 1976); (2) the principles of human-centered design as outlined in ISO 9241-210, which prioritize user involvement, iterative processes, and usability; and (3) the United Nations Sustainable Development Goals, particularly SDG 3 (Good Health and Well-being) and SDG 8 (Decent Work and Economic Growth), to ensure alignment with broader social sustainability objectives.

The framework employs an Ishikawa (fishbone) diagram structure to systematically categorize the root causes, barriers, and enabling factors influencing sustainable technology adoption. These factors are organized into four interconnected dimensions:

- organizational (e.g., leadership support, workplace culture, and policy alignment),
- human (e.g., user acceptance, perceived autonomy, and intrinsic motivation),
- social (e.g., equity of access, data privacy, inclusion, and avoidance of digital divides),
- technical (e.g., system maturity, usability, reliability, and integration with existing workflows).

This four-dimensional structure highlights that successful and sustainable adoption cannot be achieved through technical excellence alone; it requires deliberate alignment and balance across all dimensions. By visualizing these interdependencies, the framework functions as both a theoretical contribution—bridging human-centered design with social sustainability in the context of emerging technologies—and a practical diagnostic tool for managers and policymakers to identify potential failure points and design more balanced implementation strategies.

Ethical issues present a final challenge in the design of well-being technologies. Discussions on behavior-oriented design emphasize three core concerns: data privacy, algorithmic bias, and employee autonomy (Schmidt & Engelen, 2020). Neglecting these issues creates distrust and social controversy. To ensure fairness, designers must adopt strategies that address diverse user backgrounds and prevent the reinforcement of existing inequalities (Ranchordás, 2020).

The reviewed technologies present promising affordances but exhibit contextual variations and limitations. XR excels in immersive, embodied experiences effective for mental health in high-stress office settings (Pons et al., 2022), with scoping reviews highlighting its role in practitioner well-being (Mould et al., 2025). However, barriers persist in remote or manual labor contexts due to hardware costs and maturity.

While the reviewed technologies offer promising affordances, a critical comparison reveals important contextual differences and limitations. XR technologies excel in creating immersive, embodied experiences that are particularly effective for mental health interventions in high-stress office environments (Pons et al., 2022). However, they may face adoption barriers in remote or blue-collar settings due to hardware costs and technical maturity.

Gamification demonstrates strong short-term effects on engagement through feedback loops and social elements. Yet, its long-term sustainability is often limited by "gamification fatigue" or reduced intrinsic motivation when rewards overshadow autonomy. In contrast, the impact of AI-driven personalization is typically indirect. Rather than directly improving happiness, AI enhances well-being by optimizing specific work tasks and improving occupational safety. Strategic adoption must therefore align technological capabilities with the specific needs and values of the workforce.

These comparisons underscore that no single technology is universally superior; effectiveness depends heavily on work type, organizational culture, and careful human-centered implementation.

Balancing technological innovation and human-centered design

Researchers must balance technological innovation with human-centered design. Advanced capabilities do not automatically guarantee positive well-being. Overlooking user experience and emotional responses often makes technology difficult to use or even counterproductive (Dimitrokalli et al., 2020).

Human-centered design prioritizes user needs throughout the development process. Employee adoption is driven by four factors: ease of use, enjoyment, privacy, and autonomy (Mirsch et al., 2018). Sustainable technologies must integrate innovation with design practices that foreground human experience and ethical responsibility.

Design implications for practice and policy

Applying emerging technologies to workplace well-being requires a structured, human-centered implementation process. Organizations should initially prioritize preparation and needs assessment. Participatory workshops help identify specific well-being challenges and facilitate the co-design of interventions matching real workplace contexts. At this stage, establishing clear ethical and privacy frameworks is essential to build foundational trust.

Implementation should then proceed through controlled pilot programs. These allow organizations to test XR environments and AI personalization on a limited scale while gathering feedback on usability and acceptance. Training programs and refinements based on user experience are critical during this phase to minimize resistance and technical difficulties.

Finally, successful pilots can be scaled organization-wide. Continuous monitoring ensures long-term effectiveness and alignment with social sustainability objectives. Policymakers can reinforce these efforts by providing regulatory guidance on ethical technology use, offering incentives for responsible adoption, and promoting equitable access. Following this phased approach allows practitioners and policymakers to maximize technological benefits while safeguarding employee autonomy, privacy, and fairness.

CONCLUSION

This study examined how extended reality (XR), gamification, and AI-driven personalization support workplace well-being and social sustainability. The review indicates that these technologies can enhance employee engagement alongside physical and psychological health. However, successful integration depends more on

design and work practices than on technological capability alone. We frame these tools as socio-technical interventions that actively reshape employee behavior and perception.

Well-being outcomes are maximized when three specific design elements align with user needs: immersive XR environments, gamified motivation, and adaptive AI personalization. Notably, AI impacts well-being indirectly by optimizing work tasks and enhancing occupational safety. Conversely, socially sustainable adoption faces four primary hurdles: technical immaturity, low user acceptance, ethical accountability, and social equity. Effective design must balance innovation with human-centered principles. Factors such as usability, autonomy, and transparency determine how employees adopt new tools. To establish trust, integrating Explainable AI (XAI) is essential to ensure algorithmic decisions remain interpretable. Consequently, ethical considerations—including privacy, bias, and agency—must be treated as core design components rather than external constraints.

Limitations and Future Research

This narrative review has several limitations. First, while we utilized structured search strategies, the inclusion of approximately thirty studies may not capture the entire breadth of this fast-evolving field. Second, most reviewed studies originate from Western or high-income contexts, which restricts the generalizability of findings to diverse cultural and organizational environments. Third, as an emerging field, many technologies lack longitudinal empirical evidence. This makes it difficult to draw definitive conclusions about their sustained impact on well-being.

Future research must prioritize longitudinal studies to assess long-term engagement and health outcomes. Comparative cross-cultural research is also necessary to evaluate how contextual factors moderate technology effectiveness. Furthermore, intervention-based studies should examine specific design choices—such as different nudging strategies or gamification mechanics—within real-world workplace settings. Such research will clarify how human-centered design supports responsible technology integration and addresses the unique needs of diverse workforces, including high-stress healthcare practitioners and aging populations.

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