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Turning Hindrances Into Challenges: Transformational Leadership Enhances Employees' Competitive Productivity in an Artificial Intelligence-Driven Hospitality Industry

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ABSTRACT

Extant understanding on the role of leadership in shaping employee perceptions of embedding artificial intelligence- (AI-) enabled technologies in workplace environments as either challenges (opportunities) or hindrances (threats) is notably limited. To address this issue, a two-wave, time-lagged survey was conducted and usable data from 224 hospitality employees were analyzed using partial least squares structural equation modeling (PLS-SEM), which, in turn, highlighted the importance of transformational leadership in fulfilling the three fundamental psychological needs of autonomy, competence, and relatedness in a workplace environment enabled by AI technologies. Significantly, meeting the needs for autonomy and relatedness fosters a perception of AI-enabled technologies as challenges to overcome and facilitates the positive appraisal of hindrances. Autonomy, in particular, emerged as a key determinant of this positive perspective. Noteworthily, employees who view AI-enabled technologies as challenges demonstrated a favorable correlation with their competitive productivity. These insights, in turn, contribute to the theoretical generalizability and extension of self-determination theory by integrating the challenge-hindrance appraisal framework and transformational leadership into the evolving discourse of the future of work shaped by AI-enabled technologies.

1 | Introduction

The growing integration of technologies enabled by artificial intelligence (AI) into organizational workflows has sparked considerable interest across industries, including hospitality. While adoption of AI-enabled technologies in this industry is still evolving, they are increasingly embedded in various operational and guest-facing functions, gradually redefining service delivery models and operational strategies (Salgarkar 2025). For instance, advancements in automation and robotics, often incorporating AI components, are transforming tasks like self-service check-in/out, room service delivery, and concierge support (Pan and Froese 2023). Beyond frontline functions, there is also a shift toward the deployment of AI-enabled technologies in back-of-house operations. As Tan et al. (2025) observe, AI-enabled technologies are now being leveraged to handle complex data analytics, optimize workflows, and enhance internal service coordination. For instance, AI-enabled technologies can aggregate and analyze guest feedback from various digital platforms to inform service improvements, monitor quality metrics, and support real-time, data-driven decision-making (Nam et al. 2020). In addition, predictive analytics are playing a crucial role in enhancing revenue management by improving demand forecasting, refining

pricing strategies, and optimizing inventory control (Zhang and Jin 2023). Intelligent recommendation systems contribute to guest personalization by generating tailored suggestions for dining, entertainment, and local experiences based on previous behaviors or preferences (Cai et al. 2024). Likewise, natural language processing technologies, which are commonly integrated into chatbots and virtual assistants and chatbots, enable responsive, real-time guest communication without the need for human mediation (Khaliq et al. 2022). Taken together, these developments imply that digital transformation is proliferating within the hospitality industry, where the integration of AI-enabled technologies is no longer confined to front-of-house operations but is becoming deeply embedded across the entire service ecosystem.

Yet, while these advances undoubtedly boost efficiency, they also introduce psychological uncertainties for employees, affecting their emotional connection to the workplace (Pan and Froese 2023), sense of belonging (Tan, Gim, et al. 2023), turnover intentions (Kong et al. 2021), and potentially leading to job burnout (Matsunaga 2021). To navigate this complex human–AI environment, leadership is key (Turja et al. 2021). More specifically, leadership is instrumental in positively framing AI-enabled technologies' impact as this helps employees understand their potential to reinvigorate their work's purpose and significance (Matsunaga 2021). Among the different forms of leadership, transformational leadership, in particular, has been highlighted for its unique capacity to influence follower perception and inspire personal growth amidst potential challenges (Azam 2023; Li 2023; Matsunaga 2021). This leadership approach focuses on creating a positive and empowering environment where individuals feel valued and motivated to go beyond their self-interests for the greater good of the team or organization (Azam 2023). Empirical evidence substantiate this view, illustrating how transformational leadership style enables followers to overcome personal fears, transform their perception of work, and in turn, achieve higher motivation and job performance (Azam 2023; Lei et al. 2021; Li 2023; Matsunaga 2021).

Considering that the introduction of AI-enabled technologies will inevitably bring about changes in job roles, tasks, and introduce uncertainty among employees, transformational leadership holds the potential to guide employees through this transition. First, transformational leadership fosters adaptability, as this leadership style empowers individuals to embrace change and take ownership of their evolving roles (Alqatawenah 2018). Through articulating a clear and compelling vision for the future, transformational leaders inspire a shared purpose that motivates employees to engage with AI-enabled technologies as a tool for personal and organizational growth. Second, transformational leaders cultivate trust and strong relationships, enhancing employee engagement and job satisfaction during challenging times (Khan et al. 2022). Transformational leaders prioritize the development of their followers, for instance, by promoting a culture of continuous learning that equips employees with the skills necessary to thrive together with the advancements of AI-enabled technologies. Hence, by addressing fears and reframing AI-enabled technologies integration as an opportunity for enhancement rather than a threat, they help reshape perceptions and reduce resistance. Finally, transformational leaders show personal care, concern, and tailor work objectives to individual strengths and weaknesses (Xu and Jin 2022). This personalized strategy involves understanding each employee's unique strengths and weaknesses, wherein this undertstanding, in turn, sallow leaders to provide targeted support and resources. Putting these together, it is evident that the unique attributes of transformational leadership make it worthy of further attention, both academically and managerially.

As highlighted by Leong et al. (2025), AI-enabled technologies are no longer confined to high-tech domains. Its diffusion into service industries brings with it both opportunities and psychological challenges. However, researchers such as Calisto and Sarkar (2024) have started to inquire into how employees make sense of AI-enabled technologies and how leaders can shape these interpretations. Still, Bulchand-Gidumal et al. (2024) argue that such findings remain limited. Given the increasing integration of AI-enabled technologies across the hospitality industry, it is imperative to investigate how human-centered factors, such as leadership and psychological motivation, mediate the experience of technological disruption. As such, this study responds to this void by addressing five key areas that are crucial to understanding the role of transformational leadership in supporting employees in AI-driven work environments.

First, we address a theoretical gap concerning the capacity of transformational leadership to alleviate employee apprehension in response to integrating AI-enabled technologies. While digital transformation and leadership have been extensively studied in information systems and organizational behavior research (see Hashim et al. 2023; Tan, Loganathan, et al. 2024; Zhao and Wu 2023), there is scant empirical work that focuses specifically on the role of transformational leadership in guiding employees through the uncertainties posed by AI-enabled technologies. This is an important oversight, as transformational leadership, by its very nature of its focus on vision, individualized support, and motivational influence, is uniquely positioned to reframe AI-enabled technologies as a source of professional growth rather than anxiety (Matsunaga 2021). The salience of this gap is magnified by the fact that AI-enabled technologies are no longer a concern limited to IT professionals or digital firms—they now affect frontline staff, service workers, and operational teams across a broad range of industries, including hospitality (Tan, Hofman, et al. 2024). As such, there is a need to understand how transformational leadership can shape employee perception in such settings where the findings are not only theoretically valuable but also practically urgent.

Second, our study seeks to address a conceptual misunderstanding in how AI-enabled technologies are being positioned in the current literature. As highlighted by Cai et al. (2024), Ding (2022), and Tan, Gim et al. (2023), the dominant narrative within current research tends to focus on AI-enabled technologies having the consequential outcome of displacing and obsoleting human labor. While valid in some contexts, especially in high-risk work environments, this perspective often overlooks AI-enabled technologies' intended function as a performance enabler—an instrument for augmenting human capabilities, streamlining tasks, and enhancing decision-making (Tan, Gim, et al. 2023). Such one-dimensional framing risks reinforcing fear-based responses and resistance among employees. In this regard, our study seeks to shift this

discourse by empirically exploring AI-enabled technologies as a potentially empowering force that, when appropriately framed and supported by leadership, can improve employee adaptability and competitive productivity. This reframing is critical in light of recent calls from scholars to examine the positive psychological and behavioral outcomes associated with technological adaptation (Lim 2023).

Third, in the same line of argument, many existing studies frequently adopt a deterministic view of AI-enabled technologies' impact, assuming uniform responses such as increased burnout, job insecurity, or withdrawal (see Kong et al. 2021). However, such approaches neglect the inherent variability in how individuals cognitively appraise workplace stressors. As with any form of workplace changes, employees could have two forms of responses: either seeing it as a challenge, offering opportunities for growth, learning, and increased efficiency, or as a threat, potentially leading to stress, resistance, or diminished wellbeing (LePine 2022). This dichotomy aligns with the challenge-hindrance appraisal framework, which emphasizes the role of cognitive appraisal in determining individual reactions to stressors(Travis et al. 2020). In this context, the challenge-hindrance appraisal framework posits that employees can view the same technological change in fundamentally different ways: as a challenge that presents learning and growth opportunities, or as a hindrance that obstructs goals and induces strain (LePine 2022). This distinction is crucial for understanding how organizations can foster more adaptive, opportunity-focused mindsets toward AI-enabled technologies. Our study, therefore, contributes to a more refined understanding of employees' perception—a key area that remains undertheorized in the literature where AI-enabled technologies and organizational behavior intersect.

Fourth, we address a critical psychological mechanisms gap by examining the motivational antecedents that influence how employees appraise AI-enabled technologies in the workplace. While prior research on the challenge–hindrance appraisal framework has illuminated the outcomes of these appraisals—showing, for example, that challenge appraisals are linked to engagement and learning, whereas hindrance appraisals often lead to stress and withdrawal—less is known about what drives employees to perceive a given change in one way or the other (Tan, Hofman et al. 2024; Tan et al. 2025; Wolf and Stock-Homburg 2025). This is especially important where the same technological shift can be interpreted as either an opportunity for growth or a threat to one's role, autonomy, or relevance. To explore this interpretive process, we draw on self-determination theory (SDT), a motivational lens that explains how the fulfillment of three basic psychological needs—autonomy, competence, and relatedness—shapes individuals' motivation and engagement (Gagne et al. 2022). According to Deci and Ryan (2008), when these needs are satisfied, individuals are more likely to internalize change and approach it with curiosity, confidence, and purpose. Conversely, when these needs are violated, employees may respond with skepticism, anxiety, or resistance (Ryan and Deci 2000). As such, SDT offers a powerful lens to understand why some employees view the introduction of AI-enabled technologies as a challenge while others experience it as a hindrance. Hence by integrating SDT with the challenge–hindrance appraisal framework, we investigate how transformational leadership—known to support need satisfaction through vision, empowerment, and individualized consideration—can foster more constructive appraisals of AI-enabled technologies. This integration not only deepens our understanding of the psychological processes that shape employee responses to technological change but also offers actionable insights for leaders seeking to create environments in which AI-enabled technologies are embraced as an opportunity rather than resisted as a threat.

Fifth and finally, we engage with a predictive validity gap that limits the practical utility of much existing research. While explanatory models have dominated studies on AI-enabled technologies and work, they often fall short of offering predictive power—a critical capability for informing future-oriented managerial decisions. As noted by Shmueli et al. (2019), it is not enough to explain variance in theoretical constructs; robust models must also be able to predict outcomes across different samples, contexts, and timeframes. Building on the growing body of work integrating predictive analytics into structural modeling, including approaches such as the partial least squares structural equation modeling (PLS-SEM) with artificial neural networks (ANNs), our study adopts PLS predict with a focus on out-of-sample predictive performance. By incorporating PLS prediction alongside traditional explanatory metrics, we endeavor to enhance the model's practical utility for leadership and HR strategies in an AI-driven world. In doing so, we respond to calls from scholars such as Sharma et al. (2022) and Hair et al. (2024) to bridge the gap between theory and application while positioning our study within the ongoing evolution of predictive validation techniques in hospitality and management research.

In summary, our study addresses the aforementioned knowledge gaps by examining transformational leadership's role through the lens of SDT. We also extend SDT by incorporating the challenge-hindrance appraisal framework, scrutinizing whether the fulfillment of fundamental psychological needs influences the appraisal of AI-enabled technologies implementation as a challenge (opportunity) or hindrance (threat) along with its subsequent effect on competitive productivity, using the hospitality industry as a case. Through this process, we seek to shed light on the mechanisms and boundary conditions that would enrich AI-related research at the intersection of hospitality and management.

2 | Literature Review

2.1 | Theoretical Framework

This study grounds its insights in the SDT as a primary explanatory lens for the observed phenomenon. SDT, as put forth by Deci and Ryan (2008), is a motivational construct that hinges on the inherent human proclivity toward growth and recognizes three foundational needs that foster this growth: autonomy, competence, and relatedness. *Autonomy*, as defined by Martela and Riekki (2018), implies volitional control over actions and choices in consonance with one's values and interests. *Competence* encompasses the innate desire to be adept and master personally significant skills (Van den Broeck et al. 2016) while *relatedness* is about fostering connections

with others and establishing meaningful relationships (Allan et al. 2016).

To expand upon the theoretical foundation of our study, we also draw upon cognitive appraisal theory, which Folkman et al. (1986) originally conceived as a transactional lens to understand the dynamics of stress and coping, emphasizing that stress is not solely a by-product of external events but also depends on individual appraisals and coping mechanisms. The theory evolved and was popularized as the challenge-hindrance appraisal framework, whereby LePine (2022) notes that the framework seeks to classify stressors as either facilitators or inhibitors of personal growth and goal realization. Noteworthily, the framework's wide application has demonstrated its efficacy in spotlighting employee perceptions and coping strategies regarding workplace stressors (Lepine et al. 2005). Specifically, the framework emphasizes that the way individuals interpret a situation directs their emotional and behavioral reactions to the stressor (LePine 2022). Consequently, individuals who perceive the situation as a challenge are motivated to surmount it, which results in improved performance and positive outcomes (Van den Broeck et al. 2010). Conversely, those who perceive it as a hindrance encounter negative thoughts that obstruct their performance (Van den Broeck et al. 2010).

Our study synthesizes the SDT and the challenge-hindrance appraisal framework, leading to the proposition illustrated in Figure 1. Our research framework argues that through transformational leadership, individuals are likely to perceive themselves as autonomous, competent, and interconnected. This perception would be conducive to positive outcomes, such as heightened intrinsic motivation, engagement, and satisfaction, leading to individuals being more inclined to view difficult work situations as challenges (opportunities). Conversely, those who feel controlled, incompetent, and isolated are more prone to negative outcomes, perceiving difficult situations as hindrances (threats). These appraisals, in turn, significantly impact their competitive productivity in the workplace.

2.2 | Transformational Leadership and Fundamental Psychological Needs

The need for autonomy refers to individuals' desire to experience volition and psychological freedom in their actions (Deci and Ryan 2000). Within transformational leadership, autonomy is particularly nurtured through articulating a compelling vision that gives employees a sense of purpose beyond routine tasks. When this vision is communicated in a way that encourages employee ownership, it enhances the perception of self-directed engagement. Meanwhile, when a transformational leader invites employees to think creatively, it supports autonomous thinking through the exploration of novel approaches to solve work-related problems. This freedom to innovate and voice one's perspectives is critical for fostering autonomy. As highlighted by Li et al. (2024), employees working in the hospitality industry often face unpredictable situations and, at times, must make discretionary decisions. Evidently, such autonomy is vital. Thus, transformational leaders, by virtue of their approach, can significantly contribute to the satisfaction of employees' need for autonomy. Based on this, we hypothesize:

H1a. *Transformational leadership (T1) positively relates to hospitality employees' need for autonomy (T1).*

Hospitality environments are characterized by high performance expectations through customer interaction (Cuomo et al. 2021). Often, employees have to think on the feet to provide advice to customers. Expectedly, the perception of competence is critical not only for motivation but also for service quality and job satisfaction (Rabiul, Karim, et al. 2023). In this regard, competence reflects the psychological need to feel effective and capable of achieving desired outcomes (Deci and Ryan 2000). Transformational leaders fulfil this need by providing clear expectations, meaningful feedback, and opportunities for skill development (Li 2023). As highlighted by Fan and Beh (2024), leaders who offer individual consideration tailor their support to each employee's abilities and developmental needs, thereby facilitating growth and reinforcing a

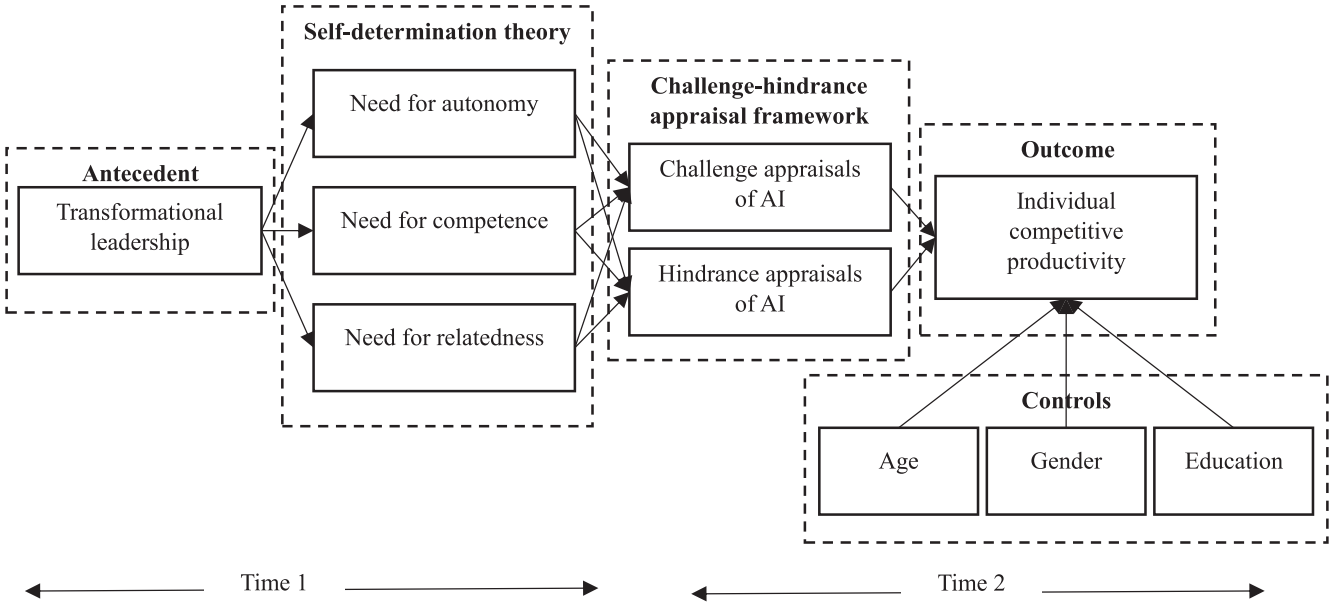

FIGURE 1 | The AI appraisals-competitive productivity framework. AI = artificial intelligence.

sense of mastery. Furthermore, when transformational leaders serve as role models by exemplifying high standards and ethical conduct, they inspire employees to emulate these behaviors, further reinforcing their belief in their own capabilities (Rabiul et al. 2024). Research by Kovjanic et al. (2012) supports this connection, finding that transformational leadership contributes significantly to competence need satisfaction. Hence, our next hypothesis is:

H1b. *Transformational leadership (T1) positively relates to hospitality employees' need for competence (T1).*

In hospitality settings, where teamwork and interpersonal relationships are central to daily operations, the need for relatedness plays a vital role in employee experiences (Cuomo et al. 2021). Employees who feel a strong sense of connection with their colleagues and leaders are more likely to experience greater satisfaction, engagement, and emotional resilience (Rabiul, Mansur Ahmed, et al. 2023). According to SDT, relatedness reflects the intrinsic need to feel cared for and to care for others, forming meaningful bonds (Deci and Ryan 2008). Transformational leaders contribute to the fulfillment of this need by fostering an environment of mutual respect, trust, and emotional support (Alqatawenah 2018). As emphasized by Messmann et al. (2021), leaders who show genuine interest in employees' wellbeing and offer individualized encouragement strengthen social connections within the workplace. Moreover, transformational leaders, through their emphasis on shared goals and collective success, promote a team-oriented culture that deepens feelings of belonging (Rabiul et al. 2024). Given these arguments, we postulate.

H1c. *Transformational leadership (T1) positively relates to hospitality employees' need for relatedness (T1).*

2.3 | Fundamental Psychological Needs and Challenge-Hindrance Appraisal of AI-Enabled Technologies

Uncertainty resulting from the introduction of AI-enabled technologies, if unaddressed, may become a pervasive and defining element of organizational life, thereby leading to negative consequences at all levels (Lim 2023). Thus, cultivating a more constructive outlook toward uncertainty is beneficial for both employees and managers. In an evolving workspace, individuals displaying adaptability—modifying their beliefs, work styles, and proactively adopting strategies—are more likely to thrive (Griffin and Grote 2020). As Gagne et al. (2022) suggest, such adaptive behavior and attitudes often stem from self-determined motivation, with Parker and Grote (2020) maintaining that internally motivated individuals are more likely to embrace a novel mindset toward new practices.

Fulfilling employees' psychological need of autonomy plays a role in how they cognitively appraise such technological changes. When this need is satisfied, employees are more likely to perceive AI-enabled technologies adoption as a challenge, as they see themselves having a volition toward learning, growth, and eventually enhanced job performance (Cheng et al. 2023). In other words, a strong sense of autonomy reduces the likelihood that employees will appraise AI-enabled technologies as a hindrance or a threat to their established routines and professional identity (LePine 2022). As noted by Yang and Li (2021), employees who feel empowered and self-directed are better equipped to see organizational changes positively and to minimize feelings of disruption or loss of control. In line with these perspectives, it is proposed that satisfying employees' need for autonomy will be associated with challenge appraisals, rather than hindrance appraisals, of AI-enabled technologies. Thus, the following hypotheses are presented:

H2a. *Fulfilling the need for autonomy in hospitality employees (T1) positively relates to their challenge appraisal of AI-enabled technologies (T2).*

H2b. *Fulfilling the need for autonomy in hospitality employees (T1) negatively relates to their hindrance appraisal of AI-enabled technologies (T2).*

Along with the same line of arguments, whether employees perceive AI-enabled technologies as a chance to grow or as a barrier to their success depends heavily on the fulfillment of their psychological need for competence. As highlighted earlier, competence refers to individuals' need to feel capable, effective, and skilled in managing their environment (Deci and Ryan 2000). When employees' need for competence is fulfilled, they are more likely to appraise AI-enabled technologies innovations as challenges that provide an opportunity to expand their abilities (Cheng et al. 2023). Conversely, employees who feel competent are less likely to perceive AI-enabled technologies as a hindrance that threatens their roles or undermines their skills (Tan, Gim, et al. 2023). As demonstrated by Ventura et al. (2015), work environments that foster a sense of mastery and professional efficacy help employees adapt to technological change with optimism rather than fear. Therefore, fulfilling the need for competence is expected to promote positive challenge appraisals while reducing negative hindrance appraisals of AI-enabled technologies implementation. Based on this rationale, the following hypotheses are proposed:

H3a. *Fulfilling the need for competence in hospitality employees (T1) positively relates to their challenge appraisal of AI-enabled technologies (T2).*

H3b. *Fulfilling the need for competence in hospitality employees (T1) negatively relates to their hindrance appraisal of AI-enabled technologies (T2).*

The way employees respond to technological changes is also heavily influenced by the extent of feeling connected, valued, and cared for by others (Slemp et al. 2024). As shared earlier, the cognitive appraisal theory explains that individuals evaluate changes based on the availability of coping resources (Folkman et al. 1986). Thus, strong feelings of relatedness enhance perceived resources, leading to more positive challenge appraisals of any workplace changes (Van den Broeck et al. 2010). As an extension to this argument, hospitality employees who experience strong social bonds within the workplace are more likely to appraise the introduction of AI-enabled technologies as a challenge, viewing it as an opportunity for collective growth and enhanced collaboration. In other words, they are less likely to perceive AI-enabled technologies as a hindrance, as emotional

support and relational security reduce feelings of uncertainty, exclusion, or threat. This postulation is supported by past research, such as Koo et al. (2021), suggesting that social connectedness promotes resilience during organizational transformations, encouraging employees to focus on potential gains rather than losses. Based on this theoretical and empirical foundation, the following hypotheses are proposed:

H4a. *Fulfilling the need for relatedness in hospitality employees (T1) positively relates to their challenge appraisal of AI-enabled technologies (T2).*

H4b. *Fulfilling the need for relatedness in hospitality employees (T1) negatively relates to their hindrance appraisal of AI-enabled technologies (T2).*

2.4 | Challenge-Hindrance Appraisal of AI-Enabled Technologies and Individual Competitive Productivity

Narrow profit margins, increasing customer expectations, and the escalating use of AI-enabled technologies mean that competition in the hospitality industry is intense (Khaliq et al. 2022). Hence, scholars propose a detailed approach to analyzing an organization's competitiveness across multiple levels (Winzar et al. 2022). This environment prompted the introduction of competitive productivity, which combines competitiveness and productivity and encompasses attitudes and actions seeking to enhance individual performance and outperform competition.

Baumann et al. (2019) explained that individual competitive productivity plays a crucial role in creating organizational and, by extension, national competitive productivity. In other words, the effectiveness at one level affects the next (Winzar et al. 2022). From this perspective, it is natural for us to examine how challenge-hindrance appraisals of AI-enabled technologies deployment influence individual competitive productivity, given that this variant of competitive productivity is the cornerstone that would eventually cumulate to the macro-level competitive productivity.

As highlighted earlier, the challenge-hindrance appraisal framework suggests that work situations can be perceived as both a challenge and a hindrance (Webster et al. 2011). Further research demonstrates significant insights, outlining that individuals who perceive situations as a challenge enhance their confidence, leading to a productive work environment (Yang and Li 2021). In contrast, Travis et al. (2020) demonstrated that the presence of hindrance stressors tends to have negative effects, including lower enthusiasm at work and lower engagement. Based on existing literature, we argue that the appraisal of AI-enabled technologies deployment, as a challenge or hindrance, impacts one's competitive productivity, leading to the following hypotheses:

H5a. *The deployment of AI-enabled technologies, appraised as a challenge (T2), enhances individual competitive productivity (T2).*

H5b. *The deployment of AI-enabled technologies, appraised as a hindrance (T2), reduces individual competitive productivity (T2).*

3 | Methodology

3.1 | Instrumentation

A survey by means of questionnaire administration was conducted. The questionnaire consists of items measuring the constructs or variables in the study. We examined transformational leadership using a seven-item measure (Carless et al. 2000). Example items include "My immediate leader communicates a clear and positive vision of the future" and "My immediate leader gives encouragement and recognition to staff." We drew on Deci and Ryan's (2000) 21-item instrument for assessing basic psychological needs, compartmentalizing into autonomy (7 items), competence (6 items), and relatedness (8 items). Sample items included "I feel like I can make a lot of inputs to deciding how my job gets done," "People at work tell me I am good at what I do," and "I really like the people I work with."

We operationalized the challenge and hindrance appraisals of AI-enabled technologies by utilizing four-item measures from Ding (2021). Challenge appraisals were gauged by statements such as "The job uncertainty generated from AI-enabled technologies will show me I can do something new." In contrast, hindrance appraisals were measured by items like "The job uncertainty generated from AI-enabled technologies will limit how well I can do." Finally, we assessed individual competitive productivity using a nine-item measure borrowed from Baumann et al. (2019). Items include "I benchmark my work performance against my work team leaders in order to aspire to the same or higher job market position".

3.2 | Data Collection

We collected data from employees working in hotels. With support from one of China's major state-owned enterprises in Zhuhai, which has an AAA credit rating, HR managers were approached via a letter to secure data collection permission (Gree 2022). The survey included a filtering question to ensure only employees with AI-enabled technologies experience participated, a method akin to Monzani et al. (2021) and Tan, Hofman et al. (2024).

We employed back-translation for the survey (English to Chinese and back to English) to preserve the original meaning of the questions. We pre-tested the survey and sought inputs from two academic and industry experts to further refine question clarity, thereby strengthening content validity. In this study, we employed a two-wave, time-lagged data collection design, gathering responses from the same sample population at two different points in time. This approach was deliberately chosen to enhance the internal validity of the study and to reduce the potential for common method bias (Podsakoff et al. 2003). Hence, by separating the measurement of predictor and outcome variables, we sought to minimize respondents' consistency motives and shared method effects, thereby improving the credibility of the observed relationships. Moreover, the time-lagged design strengthens causal inference by providing temporal precedence, offering a stronger basis for directional claims compared to a purely cross-sectional design. Similar studies, such as Chênevert

et al. (2013) and Tan, Hofman et al. (2024), have adopted a similar approach.

The first wave (T1) garnered 259 responses from 300 questionnaires focusing on transformational leadership and basic psychological needs. The second wave (T2) received 224 matching responses from 259 surveys concentrating on challenge and hindrance appraisals of AI-enabled technologies, and individual competitive productivity, thereby resulting in an 86.5% response rate verified through identification codes. We achieved this response rate by implementing response-enhancing strategies, including assurance of information being kept confidential and assessed only by researchers.

We adopted two benchmarks in ascertaining the adequacy of sample size. First, we adopted Kock and Hadaya's (2018) inverse square root method, where the recommended minimum sample size for PLS-SEM is 160. Second, the minimum sample size based on G*power analysis of 80% power at 0.15 effect sizes is 85. On this note, the effect size of 0.15 was selected based on Cohen's (1988) guidelines and has been commonly used as a benchmark in studies (see Fam et al. 2019, 2020; Tan, Ho, et al. 2023). Using both benchmarks, the final sample size of 224 exceeds the required threshold, indicating that analysis can proceed. Table 1 shows the breakdown of the respondents.

3.3 | Data Analysis

Data were analyzed using PLS-SEM. PLS-SEM is a distribution-free technique, meaning it does not assume multivariate normality of the data. This makes it particularly appropriate for handling real-world data, which often violates normality assumptions—a common occurrence in behavioral and organizational research (Adler et al. 2023). Importantly, PLS-SEM also supports predictive modeling, which aligns with the objectives of this study (Sarstedt et al. 2022). The extensive use of PLS-SEM across various studies in behavioral psychology (Le et al. 2021), hospitality (Lim et al. 2022), human resource management (Ringle et al. 2020), leadership (Rabiul, Karatepe, et al. 2023), and technology acceptance (Tan, Leong, et al. 2024) adds further credibility to its selection for this study. The analysis procedure starts with the measurement model, followed by assessing the exploratory and predictive results.

TABLE 1 | Respondents' profile.

Characteristic	*n* (224)	% (100)
Generational cohort		
Silent generation	1	0.4
Baby boomers	2	0.9
Generation X	42	18.8
Millennials	75	33.5
Generation Z	104	46.4
Gender		
Female	81	36.2
Male	143	63.8
Education		
Up to secondary	22	9.8
Up to college: Certificate or diploma	59	26.3
Up to university: Bachelor degree	81	36.2
Up to university: Master degree	59	26.3
Up to university: Doctoral degree	3	1.3

4 | Results

4.1 | Measurement Model

To evaluate the measurement model, we scrutinized its convergent and discriminant validity. According to the model displayed in Table 2, and following the standards set by Hair et al. (2017), the model effectively demonstrated convergent and discriminant validity as it exhibited Cronbach's alpha and composite reliability indices exceeding 0.70, coupled with an average variance extracted (AVE) surpassing 0.50. The measurement model's discriminant validity was further confirmed via the heterotrait–monotrait ratio (HTMT) test, with Table 3 revealing all values falling below the maximum threshold of 0.85. Finally, the variance inflation factor (VIF) for the model resides below the maximum threshold of three, highlighting that multicollinearity is not a key area of concern (see Table 4).

4.2 | Structural Model

The structural model results are presented in Table 4. The table further validates that transformational leadership significantly and positively correlates with the three primary psychological needs of autonomy, competence, and relatedness at $\beta = 0.453$, $\beta = 0.377$, and $\beta = 0.567$, respectively. Consequently, H1a, H1b, and H1c are supported at $p < 0.001$.

Upon examining the effects of challenge appraisal on AI-enabled technologies, only the fulfillment of autonomy (H2a: $\beta = 0.280$, $p < 0.001$) and relatedness (H4a: $\beta = 0.216$, $p < 0.01$) significantly correlates with a positive challenge appraisal. Conversely, satisfying the need for competence fails to establish a substantial relationship with challenge appraisal (H3a: $\beta = 0.147$, $p = 0.071 > 0.05$). Hence, H2a and H4a are supported, but not H3a.

As for AI-enabled technologies' hindrance appraisal, autonomy emerges as the sole determinant exhibiting a positive significant impact (H2b: $\beta = 0.259$, $p < 0.01$). Contrarily, fulfilling the needs for competence (H3b: $\beta = -0.066$, $p = 0.238 > 0.05$) and relatedness (H4b: $\beta = 0.092$, $p = 0.154 > 0.05$) did not exert any substantial influence. Therefore, H2b is supported, but not H3b and H4b.

The results also reveal that among the two appraisal forms, only the challenge appraisal forges a significant positive relationship

TABLE 2 | Measurement model.

Construct	Item	Loading	Average variance extracted (AVE)	Cronbach's α	Composite reliability	Source
Transformational leadership	TL1	0.776	0.682	0.922	0.931	Carless et al. (2000)
	TL2	0.806				
	TL3	0.888				
	TL4	0.866				
	TL5	0.832				
	TL6	0.796				
	TL7	0.810				
Need for autonomy	AUT1	0.680	0.588	0.765	0.764	Deci and Ryan (2000)
	AUT2	**del**				
	AUT3	**del**				
	AUT4	0.815				
	AUT5	0.769				
	AUT6	0.797				
	AUT7	**del**				
Need for competence	COM1	**del**	0.689	0.769	0.794	Deci and Ryan (2000)
	COM2	0.707				
	COM3	0.864				
	COM4	0.906				
	COM5	**del**				
	COM6	**del**				
Need for relatedness	REL1	0.842	0.648	0.865	0.883	Deci and Ryan (2000)
	REL2	0.773				
	REL3	**del**				
	REL4	0.755				
	REL5	0.834				
	REL6	**del**				
	REL7	**del**				
	REL8	0.818				
Challenge appraisals of AI-enabled technologies	CA1	0.857	0.743	0.885	0.885	Ding (2021)
	CA2	0.887				
	CA3	0.873				
	CA4	0.830				
Hindrance appraisals of AI-enabled technologies	HA1	0.823	0.775	0.903	0.923	Ding (2021)
	HA2	0.914				
	HA3	0.902				
	HA4	0.879				

(Continues)

TABLE 2 | (Continued)

Construct	Item	Loading	Average variance extracted (AVE)	Cronbach's α	Composite reliability	Source
Individual competitive productivity	ICP1	0.566	0.513	0.879	0.889	Baumann et al. (2019)
	ICP2	0.742				
	ICP3	0.668				
	ICP4	0.660				
	ICP5	0.760				
	ICP6	0.729				
	ICP7	0.795				
	ICP8	0.837				
	ICP9	0.646				

TABLE 3 | Heterotrait–monotrait (HTMT) ratio of correlations.

Construct	TL	AUT	COM	REL	CA	HA	ICP
Transformational leadership (TL)							
Need for autonomy (AUT)	0.533						
Need for competence (COM)	0.432	0.797					
Need for relatedness (REL)	0.607	0.663	0.646				
Challenge appraisals of AI-enabled technologies (CA)	0.310	0.588	0.528	0.506			
Hindrance appraisals of AI-enabled technologies (HA)	0.260	0.313	0.174	0.209	0.253		
Individual competitive productivity (ICP)	0.287	0.397	0.449	0.370	0.357	0.151	

with individual competitive productivity (H5a: $\beta = 0.317$, $p < 0.001$), whereas the hindrance appraisal fails to have a noteworthy impact on individual competitive productivity (H5b: $\beta = 0.017$, $p = 0.440 > 0.05$). Thus, H5a is supported, but not H5b.

To further decipher the model's explanatory power, we scrutinized the effect size and R^2 values. Relying on Cohen (1988) as a benchmark, the challenge appraisal (0.297) and need for autonomy (0.205) were found to have considerable R^2 values. Regarding the effect sizes (f^2), autonomy, competence, and relatedness have small effect sizes toward the R^2 values for both challenge and hindrance appraisal of AI-enabled technologies. Similar trends were noticed for the appraisals' effects on individual competitive productivity. However, transformational leadership demonstrated a medium to large effect on the R^2 for the three fundamental psychological needs, thereby highlighting the importance of transformational leadership in this regard.

4.3 | Robustness Test: Control Variables and Predictive Analytics

To enhance the model's explanatory power and eliminate confounding effects, we controlled for age, highest qualification, and gender, as suggested by Brennan (2008), Niessen et al. (2010), and Tan, Gim et al. (2023). This approach facilitated understanding whether these variables exerted any extraneous influence on the relationships under study. The results in Table 4 revealed that none of these control variables significantly correlated with the endogenous variable.

As highlighted earlier, previous studies like Ding (2021) predominantly suffer from the lack of predictive analysis, a process that utilizes data to foresee future outcomes. Even though studies have employed Q^2 as a predictive relevance indicator, Shmueli (2011) critiqued this method for its potential inaccuracies due to the integration of in-sample and out-of-sample predictions. To circumvent this limitation, we implemented the more reliable PLS prediction technique in our study. Results from Table 5 showed that the model has superior predictive power, as the root mean squared error (RMSE) values for the linear model (LM) are smaller than those for the PLS-SEM model.

5 | Discussion and Conclusion

Through integrating theories of transformational leadership, self-determination, and challenge-hindrance appraisal, this study investigates the influence of transformational leadership on the fundamental psychological needs of employees, the subsequent impact on their appraisal of AI-enabled technologies as either challenges (opportunities) or hindrances (threats), and in turn, their effects on individual competitive productivity. To

TABLE 4 | Structural model.

Hypothesis	Relationship	Path coefficient	Standard error	*t*	5.00%	95.00%	VIF	f^2	R^2
H1a	TL → AUT	0.453	0.061	7.429***	0.342	0.545	1.000	0.259	0.205
H1b	TL → COM	0.377	0.061	6.128***	0.270	0.473	1.000	0.165	0.142
H1c	TL → REL	0.567	0.050	11.304***	0.473	0.642	1.000	0.475	0.322
H2a	AUT → CA	0.280	0.083	3.381***	0.142	0.411	1.788	0.062	0.297
H2b	AUT → HA	0.259	0.088	2.943**	0.087	0.383	1.788	0.041	0.079
H3a	COM → CA	0.147	0.100	1.471(NS)	−0.031	0.301	1.758	0.018	
H3b	COM → HA	−0.066	0.092	0.713(NS)	−0.217	0.088	1.758	0.003	
H4a	REL → CA	0.216	0.088	2.443**	0.062	0.355	1.567	0.042	
H4b	REL → HA	0.092	0.090	1.021(NS)	−0.065	0.235	1.567	0.006	
H5a	CA → ICP	0.317	0.079	4.001***	0.169	0.427	1.054	0.107	0.103
H5b	HA → ICP	0.017	0.110	0.152(NS)	−0.171	0.180	1.054	0.000	
	Control variables								
	Age → Individual competitive productivity	−0.065	0.072	0.896(NS)	−0.203	0.076			
	Gender → Individual competitive productivity	−0.036	0.151	0.236(NS)	−0.329	0.265			
	Education → Individual competitive productivity	0.097	0.083	1.163(NS)	−0.083	0.250			

Note: *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.
Abbreviations: AUT, need for autonomy; CA, challenge appraisals of AI-enabled technologies; COM, need for competence; HA, hindrance appraisals of AI-enabled technologies; ICP, individual competitive productivity; NS, not significant; REL, need for relatedness; TL, transformational leadership.

TABLE 5 | PLS predict results.

		PLS-SEM	LM	PLS-LM
	Q^2 predict	RMSE	RMSE	RMSE
ICP1	0.023	1.448	1.449	−0.001
ICP2	0.030	1.255	1.260	−0.005
ICP3	0.023	1.319	1.334	−0.015
ICP4	0.008	1.277	1.320	−0.043
ICP5	0.013	1.170	1.191	−0.021
ICP6	0.005	1.223	1.251	−0.028
ICP7	0.032	1.130	1.137	−0.007
ICP8	0.029	1.218	1.248	−0.030
ICP9	0.015	1.196	1.231	−0.035

Abbreviations: ICP, individual competitive productivity; LM, linear model; PLS-SEM, partial least squares structural equation modeling; RMSE, root mean squared error.

this end, our study offers several noteworthy observations and takeaways.

Firstly, our study illustrates a strong positive relationship between transformational leadership and the fulfillment of autonomy, competence, and relatedness among employees. This echoes Kovjanic et al.'s (2012) assertion that satisfying followers' needs is instrumental for transformational leaders in fostering positive employee outcomes. Unlike transactional leadership, which hinges on rigid control and incentives to propel employees toward goals, transformational leadership aligns employee self-motivation with organizational objectives, thereby promoting a sense of autonomy (Martela and Riekki 2018). Transformational leaders also cultivate a sense of competence by facilitating personal growth, instilling confidence, and modeling behaviors (Li 2023). Hence, by underscoring collaboration's value and re-aligning follower values, they create more cohesive teams, enhancing a sense of relatedness (Seljemo et al. 2020).

Secondly, we discover that both autonomy and relatedness contribute positively to employees' challenge appraisal of AI-enabled technologies. This aligns with previous research, such as Gagne et al. (2022), suggesting that higher self-determination levels alleviate tension and boost self-motivation at work. Employees, when granted control and decision-making power, perceive work situations as growth opportunities and assume responsibility for upskilling. Moreover, a strong sense of belonging encourages a collective approach toward challenges, fostering a collaborative culture that values continuous learning and innovation in the face of AI-enabled technologies implementation.

Thirdly, our study also establishes a significant positive link between autonomy and hindrance appraisal of AI-enabled technologies. Indeed, several empirical studies suggest a 'threshold effect' where excessive autonomy negatively influences learning

outcomes and employee wellbeing (Wielenga-Meijer et al. 2011). This implies that autonomy can act as a double-edged sword. Beyond a certain level, autonomy might trigger inefficiencies, confusion, and stress, affecting employees' perception of AI-enabled technologies negatively. Employee individual differences and personality traits further complicate their responses to autonomy. While some employees may flourish with more autonomy, others might find it daunting or stressful. Therefore, transformational leaders need to balance autonomy levels, considering individual employee needs and traits.

Additionally, Ding and Hung (2021) share similar findings regarding the relationship between employees' perceptions of AI-enabled technologies deployment and their own competitive productivity. Perceiving AI-enabled technologies as a challenge cultivates a growth-oriented mindset among employees, encouraging skill development and knowledge enhancement. This eagerness to learn boosts competitiveness and productivity as employees become adept at handling AI-related tasks and embracing new challenges. The potential job insecurity stirred by AI-enabled technologies did not significantly impact individual competitive productivity, as shown by the insignificance of hindrance appraisal in our study.

5.1 | Theoretical Implications

Our study enriches the current body of knowledge in several ways.

First, we present a synthesized view of the SDT and challenge-hindrance appraisal framework. This offers a more comprehensive understanding of the underlying mechanisms that connect leadership, employees' fundamental psychological needs, and individual competitive productivity in an AI-infused environment. Noteworthily, the study emphasizes the need to consider various psychological components to understand how leaders can effectively guide the challenges and leverage the opportunities introduced by AI-enabled technologies. In doing so, leaders stand a better chance at meeting the fundamental psychological needs of employees, and, in turn, influencing their competitive productivity.

Second, we extend the challenge-hindrance appraisal framework by shedding light on the psychological processes that impact employees' challenge-hindrance appraisal of AI-enabled technologies. In particular, our findings underscore the crucial role of fulfilling the fundamental psychological needs of autonomy, competence, and relatedness in molding employees' perception of AI-enabled technologies. This insight, in turn, contributes to a more granular understanding of the challenge-hindrance appraisal framework within the scope of AI-enabled technologies adoption. This assertion also reinforces LePine's (2022) argument that the challenge-hindrance appraisal framework should not be viewed as a static concept, rather, one that is shaped by the extent to which employees' psychological needs are met and may dynamically evolve over time, contingent upon the employees' underlying psychological states.

Third, our study broadens the existing body of knowledge by underscoring the role of competitive productivity as a consequential variable within the context of AI-enabled technologies. Notably, our study elucidates the positive influence of AI-enabled technologies' adoption on employees' job performance, presenting evidence that alleviates fears of job replacement. Moreover, we offer insights on how satisfying employees' basic psychological needs can be capitalized upon to boost productivity in an AI-driven context. Specifically, our findings illuminate the complex interplay between leadership roles, employees' psychological needs, AI-enabled technologies implementation, and competitive productivity. This highlights the necessity for a more comprehensive approach to AI-enabled technologies deployment that equally weighs both human and technological aspects.

Finally, the robustness of our research model is further bolstered through control variables and predictive analysis. The results from these multi-robustness tests enhance the explanatory viewpoint with a causal and predictive focus, which, as Lim (2021) and Sarstedt and Danks (2021) have pointed out, is especially critical for social science researchers.

5.2 | Managerial Implications

The gleaned insights have significant repercussions for human resource management, emphasizing that the efficacy of adopting AI-enabled technologies is contingent on organizations' capability to address their employees' psychological needs and afford requisite support and resources for maximizing competitive productivity.

First, organizations should assign top priority to the cultivation of transformational leadership skills, which serve as a catalyst for fulfilling employees' psychological needs for autonomy, competence, and relatedness, as demonstrated by our results. Given its importance, the embodiment of transformational leadership should extend beyond top-tier management and should permeate all echelons within an organization, inclusive of frontline managers and executive leadership, through tailored development programs, thereby ensuring comprehensive support for employees grappling with the challenges of AI-enabled technologies adoption.

Second, managers can promote an ownership ethos among employees by actively involving them in the decision-making process related to the implementation of AI-enabled technologies. To circumvent the perception of technological advancements as threats to employee autonomy, organizations should equip their staff with the necessary resources and grant them the latitude to interface with AI-enabled technologies in ways that align with their unique needs and preferences. This directly supports our finding that autonomy needs satisfaction positively predicts challenge appraisals, which, in turn, significantly influence individual competitive productivity. That is to say, engaging employees in meaningful tasks and fostering a sense of purpose in their roles cultivates employee autonomy, thereby invigorating their motivation to adopt AI-enabled technologies.

Third, organizations should prioritize initiatives that foster strong interpersonal connections among employees to fulfill their need for relatedness. Our findings indicate that employees who feel a sense of belonging and connection at work are more likely to appraise AI-enabled technologies as opportunities

rather than threats. Managers can support this by creating mentorship programs, peer support groups, or cross-functional project teams that encourage collaboration around AI adoption. Such initiatives build social bonds and a shared sense of purpose, helping employees feel supported during technological transitions, which, in turn, promotes positive challenge appraisals.

Finally, organizations can implement training programs to augment employee autonomy, thereby bolstering their capability to effectively utilize AI-enabled technologies and affording them avenues for growth and development. Such initiatives can help reframe employees' perception of AI-enabled technologies as a challenge, rather than a hindrance, to their job performance. Through such informed leadership practices and targeted training, organizations can adeptly address the psychological needs of their employees and provide the necessary support and resources to maximize their competitive productivity, thereby harnessing the full potential of AI-enabled technologies adoption.

5.3 | Limitations and Future Research Directions

While the present study provides valuable insights, it does have certain limitations that open the door to future research opportunities.

First, the sample employed in this study was exclusively composed of employees within China's hospitality industry. In this regard, the extrapolation of the findings to other industries or socio-cultural contexts might be restricted. As a result, future research should seek to assess the theoretical generalizability of this study across different industries and cultural settings.

Second, the focus of this study was limited to the adoption of AI-enabled technologies among employees. Hence, future research could explore the validity of the proposed model with regard to other technological innovations or within contrasting organizational environments.

Third, the use of self-reported measures in this study may give rise to response biases, such as social desirability bias. Therefore, future research could endeavor to integrate objective measures or utilize a multisource evaluation approach in order to mitigate such potential biases.

Finally, the study honed in on the influence of transformational leadership, without considering the possible effects of other leadership styles, such as transactional or laissez-faire leadership. Thus, future investigations could contrast the relative impacts of diverse leadership styles on the adoption of AI-enabled technologies. This avenue of research could illuminate more granular insights into leadership's role in technology adoption for work, workers, and workplaces.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data would be made available upon reasonable request from the corresponding author.

Ethics Statement

This project has been allocated the Ethics Approval Number H8925 by James Cook University Ethics Committee.

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