

Predicting Employee Creativity Trajectories Through Longitudinal Deep Learning Models of Motivation and Job Design

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Article Info

Article type:

Original Research

How to cite this article:

Méndez Alvarez, C., & Narayanan, A. (2026). Predicting Employee Creativity Trajectories Through Longitudinal Deep Learning Models of Motivation and Job Design. *International Journal of Innovation Management and Organizational Behavior*, 6(1), 1-10. <https://doi.org/10.61838/kman.ijimob.5277>



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ABSTRACT

Objective: The objective of this study was to predict long-term employee creativity trajectories by developing a longitudinal deep learning model integrating evolving motivational states and job design characteristics.

Methods and Materials: This longitudinal study followed 611 full-time employees from knowledge-intensive organizations in Spain across four measurement waves over 18 months. Repeated measures of intrinsic and extrinsic motivation, psychological empowerment, and job design characteristics (including autonomy, task significance, skill variety, and feedback quality) were collected using validated instruments. Employee creativity was assessed using a multi-source composite index incorporating self-ratings, supervisor evaluations, and peer nominations. Long Short-Term Memory (LSTM) neural networks were employed to model non-linear temporal relationships and predict individual creativity trajectories. Model performance was evaluated using root mean square error, mean absolute error, explained variance, and trajectory similarity indices. Feature importance was examined using attention mechanisms and SHAP values, and unsupervised clustering was applied to identify distinct creativity development profiles.

Findings: The deep learning model explained 76.1% of variance in unseen creativity trajectories. Intrinsic motivation ($\beta_{importance} = 0.31, p < .001$) and job autonomy ($\beta_{importance} = 0.24, p < .001$) emerged as the strongest predictors of sustained creative growth. Four statistically distinct creativity trajectories were identified: accelerated growth (34.5%), stable growth (41.2%), stagnant (16.7%), and declining (7.6%). Employees in the accelerated growth cluster demonstrated significantly higher increases in intrinsic motivation and job autonomy over time ($p < .001$), whereas the stagnant and declining clusters exhibited significant decreases in psychological empowerment and increases in role overload ($p < .01$).

Conclusion: Employee creativity is a dynamic developmental capability shaped by continuous interactions between motivation and job design, and longitudinal

deep learning provides a powerful framework for predicting creative growth and identifying intervention targets.

Keywords: *Employee creativity; longitudinal modeling; deep learning; motivation; job design; organizational innovation*

1 Introduction

Employee creativity has become one of the most strategically valuable resources in contemporary organizations, particularly within knowledge-intensive and innovation-driven economies. As organizations increasingly rely on human capital for sustained competitive advantage, understanding how creativity emerges, develops, and evolves across time has become a central concern for organizational scholars and practitioners alike. Creativity is no longer conceptualized as a static individual trait but rather as a dynamic, developmental process shaped by continuous interactions between employee motivation, job design, and organizational context (Chen & Choi, 2025; Crider et al., 2024; Jnaneswar & Ranjit, 2022). This shift toward a developmental perspective aligns with recent evidence demonstrating that creative performance fluctuates in response to changing motivational states, work conditions, and psychosocial environments (Au-Yeung & Chao, 2024; Fateh et al., 2023; Isac et al., 2024). Consequently, a comprehensive understanding of creativity requires models capable of capturing complex temporal patterns rather than relying solely on static cross-sectional associations.

Motivation represents one of the most powerful psychological drivers of employee creativity. Both intrinsic and extrinsic forms of motivation have been consistently linked to creative behavior, though their mechanisms and durability differ substantially. Intrinsic motivation, rooted in interest, enjoyment, and personal mastery, has repeatedly been identified as a core antecedent of sustained creative engagement (Jnaneswar & Ranjit, 2022; Ma et al., 2023; Sharma & Gautam, 2023). In contrast, extrinsic motivation, including compensation, incentives, and external recognition, exerts more conditional and context-dependent effects on creativity and performance (Adanlawo et al., 2023; David et al., 2025; Lu et al., 2025). Recent research suggests that creativity flourishes when extrinsic incentives are structured to support rather than undermine intrinsic motivation, highlighting the importance of motivational alignment within organizational systems (Pham et al., 2025; Putri, 2025; Syaputra et al., 2025). However, much of the existing literature treats motivation as a static predictor, failing to examine how motivational states evolve over time and how these changes shape long-term creative trajectories.

Alongside motivation, job design constitutes a second critical pillar influencing employee creativity. The structural features of work—including autonomy, task variety, task significance, feedback quality, and role clarity—create the psychological conditions under which creative behavior becomes possible or constrained (Kurniawan et al., 2023; Mariska et al., 2024; Wang & Wang, 2022). Empirical evidence consistently demonstrates that enriched job characteristics promote creative engagement by enhancing intrinsic motivation and fostering psychological empowerment (Kılıç & Gök, 2022; Ma et al., 2023). Conversely, poorly designed roles characterized by ambiguity, overload, and low autonomy suppress creativity through heightened stress and diminished psychological resources (Au-Yeung & Chao, 2024; Baroun, 2025). Importantly, job design is not static; organizations continually restructure tasks in response to technological change, market demands, and evolving work practices. Thus, employee creativity unfolds within shifting job architectures that interact dynamically with motivational processes.

Recent advances in organizational psychology further emphasize that creativity is embedded within broader systems of job satisfaction, emotional experience, and social context. Job satisfaction, which reflects employees' cognitive and affective evaluations of their work, functions as both an outcome of motivation and a predictor of creative performance (David et al., 2025; Pham et al., 2025; Temory, 2023). Emotional states such as happiness, anxiety, boredom, and psychological strain modulate the cognitive resources available for creative problem solving (Almazrouei et al., 2024; Au-Yeung & Chao, 2024; Chen & Choi, 2025). Moreover, social and family-based motivations introduce additional layers of complexity, sometimes enhancing commitment while simultaneously constraining creativity through role conflict and obligation pressure (Ann et al., 2023; Isac et al., 2024). These findings collectively indicate that creativity emerges from an evolving psychological ecosystem rather than from isolated individual attributes.

Despite these advances, existing empirical approaches remain limited in their ability to model creativity as a dynamic developmental phenomenon. The vast majority of prior studies rely on cross-sectional survey designs and

linear statistical models that impose restrictive assumptions of temporal stability and linearity (Jaffar et al., 2024; Nantwi et al., 2023; Sudha, 2023). Such approaches cannot capture non-linear growth patterns, delayed effects, threshold dynamics, or cumulative interactions that characterize real-world creative development. As a result, the field lacks robust predictive frameworks capable of forecasting how employees' creativity evolves across extended periods of organizational life.

The emergence of deep learning provides an unprecedented opportunity to overcome these limitations. Deep learning models, particularly recurrent neural networks and Long Short-Term Memory architectures, are uniquely suited for longitudinal prediction because they can learn complex temporal dependencies, non-linear relationships, and interaction effects without requiring rigid theoretical assumptions about functional form. In organizational research, early applications of machine learning have demonstrated superior predictive performance for outcomes such as job performance, satisfaction, and turnover; however, the application of longitudinal deep learning to creativity development remains largely unexplored. This methodological gap is especially striking given the inherently dynamic nature of motivation, job design, and creative behavior.

Furthermore, contemporary workplaces are undergoing profound transformation driven by digitalization, remote work, and human–AI collaboration. These structural shifts have fundamentally altered motivational processes and job characteristics, creating new demands for adaptive creativity (Hamouche et al., 2025; Sonnenschein et al., 2022). Human–AI collaboration introduces novel forms of job design that require continuous learning, role renegotiation, and cognitive flexibility, intensifying the importance of understanding how creativity trajectories unfold under changing conditions (Hamouche et al., 2025). Simultaneously, hybrid work arrangements and evolving organizational cultures reshape motivational dynamics, requiring more sophisticated models to anticipate creative outcomes (Liu & Gao, 2025; Sonnenschein et al., 2022).

Another emerging dimension is the role of proactive behavior and job crafting in shaping creativity over time. Employees increasingly act as active architects of their own jobs, modifying tasks, relationships, and cognitive boundaries to enhance meaningfulness and creative potential (Fateh et al., 2023; Kılıç & Gök, 2022). These self-initiated changes introduce feedback loops between motivation, job design, and creativity that unfold across time and cannot be

adequately captured by static methods. Similarly, the growing importance of leisure crafting, gamification, and non-work experiences further complicates the developmental pathways of creativity (Chen & Choi, 2025; Liu & Gao, 2025).

The international scope of creativity research also highlights the necessity of longitudinal modeling across diverse cultural and economic contexts. Studies conducted in Asia, Africa, Europe, and the Middle East reveal that motivational structures, job satisfaction mechanisms, and creativity drivers vary substantially across societies (Almazrouei et al., 2024; Ann et al., 2023; Nantwi et al., 2023; Ni Kadek Sari Jayanti & Surya, 2023). These differences reinforce the need for flexible modeling frameworks capable of learning from complex, heterogeneous data rather than relying on universal linear assumptions.

Collectively, the literature converges on a central conclusion: employee creativity is a dynamic, evolving capability shaped by continuous interactions among motivation, job design, emotional experience, and contextual change. Yet the field lacks predictive models that integrate these components over time with sufficient precision and explanatory power. Longitudinal deep learning offers a powerful solution to this challenge by enabling the discovery of hidden behavioral patterns, non-linear developmental trajectories, and individualized creative pathways from rich temporal data.

The aim of this study is to predict employee creativity trajectories over time by developing and validating a longitudinal deep learning model that integrates evolving motivational states and job design characteristics.

2 Methods and Materials

This study adopted a longitudinal, predictive research design aimed at modeling employee creativity trajectories over time using deep learning architectures trained on repeated measures of motivational states and job design characteristics. The target population comprised full-time employees working in medium and large knowledge-intensive organizations across Spain, including sectors such as information technology, engineering services, financial services, advanced manufacturing, and professional consulting. A stratified multi-stage sampling strategy was employed to ensure proportional representation of organizational size, sector, and geographic region, covering major economic hubs including Madrid, Barcelona,

Valencia, Bilbao, and Seville. Initial recruitment yielded 724 employees, of whom 682 provided complete baseline data and consented to participate in all subsequent waves of the study. Attrition across the four data collection waves over an 18-month period resulted in a final longitudinal sample of 611 participants, corresponding to an overall retention rate of 89.6%, which is considered acceptable for advanced longitudinal modeling. Participants' average age at baseline was 36.4 years ($SD = 7.9$), with organizational tenure ranging from 1 to 22 years ($M = 6.8$ years). The sample included professionals, middle managers, technical specialists, and creative staff, with approximately 47% female and 53% male participants. All procedures adhered to ethical guidelines of the Spanish Psychological Association and were approved by the institutional review committee of the host university. Informed consent was obtained at baseline, and participants were assigned anonymous identifiers to ensure confidentiality across measurement waves.

The longitudinal design consisted of four measurement occasions separated by six months, allowing the capture of both short-term fluctuations and long-term developmental patterns in creativity, motivation, and job design perceptions. This temporal structure was selected to balance model sensitivity to dynamic change with practical constraints of organizational access and participant burden. The research design explicitly focused on within-person change modeling and inter-individual differences in growth trajectories, enabling the estimation of latent creativity pathways as functions of evolving motivational and structural job characteristics.

Employee creativity was assessed at each wave using a multi-source measurement strategy. Self-reported creative behavior was measured with a validated creativity performance scale capturing idea generation, idea promotion, and idea implementation. Supervisors independently evaluated employee creativity using a parallel version of the instrument, and peer nominations were collected within each work unit to mitigate single-source bias. These three indicators were combined into a composite creativity index using latent variable modeling prior to input into the deep learning framework.

Motivational states were operationalized through repeated measurement of intrinsic motivation, extrinsic motivation, autonomous regulation, controlled regulation, and psychological empowerment. Standardized instruments with demonstrated cross-cultural validity in Spanish organizational contexts were employed, all using seven-

point Likert response formats. Job design characteristics were measured using an expanded job characteristics framework, including task autonomy, task significance, skill variety, feedback quality, task identity, role clarity, role complexity, workload balance, and opportunities for job crafting. In addition, contextual job resources such as leader support, coworker support, and innovation climate were assessed to capture environmental influences on creative development.

At each wave, data were collected through secure online questionnaires distributed during working hours with organizational coordination. Supervisors completed parallel evaluations through a separate secure portal. To enhance measurement reliability, temporal consistency checks and attention filters were embedded in the survey instruments. All psychometric instruments demonstrated strong internal consistency across waves, with Cronbach's alpha coefficients ranging from .81 to .93, and measurement invariance across time was confirmed prior to model estimation to ensure that observed change reflected true developmental change rather than measurement artifacts.

Data analysis proceeded in three integrated phases: longitudinal data preprocessing, deep learning model development, and creativity trajectory interpretation. Prior to modeling, missing data patterns were examined and found to be missing at random; therefore, multiple imputation using chained equations was applied to preserve statistical power and temporal structure. All variables were standardized within-wave, and longitudinal sequences were constructed for each participant, yielding time-series vectors of motivational states and job design features aligned with corresponding creativity outcomes.

A deep learning framework based on Long Short-Term Memory (LSTM) neural networks was developed to capture non-linear temporal dependencies between predictors and creativity trajectories. The model architecture consisted of stacked LSTM layers followed by fully connected dense layers for creativity prediction at each time point. Dropout regularization and early stopping procedures were employed to prevent overfitting. The dataset was partitioned into training (70%), validation (15%), and test (15%) subsets using participant-level splitting to avoid temporal leakage. Model performance was evaluated using root mean square error, mean absolute error, and dynamic time warping distance to assess both point prediction accuracy and trajectory shape similarity.

To enhance interpretability, attention mechanisms were integrated into the LSTM architecture, allowing

identification of the most influential motivational and job design features at each time step. Feature attribution was further examined using SHAP (Shapley Additive Explanations) values computed on the trained model, providing individualized explanations of creativity predictions and enabling the identification of critical predictors driving upward, stable, or declining creativity trajectories.

Finally, unsupervised clustering of predicted creativity trajectories was conducted using dynamic time-series clustering to identify distinct developmental profiles of creative growth. These trajectory classes were then compared across demographic and organizational variables using multilevel modeling, enabling examination of

structural conditions under which particular creativity pathways emerge. All analyses were conducted using Python-based deep learning libraries and advanced statistical modeling software, with full reproducibility ensured through fixed random seeds and cross-validation protocols.

3 Findings and Results

Table 1 provides the foundational descriptive statistics for all core study variables across the four waves and serves as the empirical baseline for subsequent inferential and predictive analyses.

Table 1

Descriptive Statistics of Study Variables Across Four Waves

Variable	Wave 1 Mean	SD	Wave 2 Mean	SD	Wave 3 Mean	SD	Wave 4 Mean	SD
Employee Creativity Index	3.91	0.64	4.05	0.61	4.19	0.58	4.33	0.55
Intrinsic Motivation	4.12	0.72	4.25	0.69	4.38	0.66	4.52	0.63
Extrinsic Motivation	3.67	0.75	3.71	0.73	3.74	0.71	3.77	0.70
Psychological Empowerment	3.84	0.68	3.96	0.66	4.08	0.63	4.21	0.61
Job Autonomy	3.59	0.70	3.71	0.67	3.85	0.65	3.98	0.62
Task Significance	3.74	0.66	3.88	0.64	4.01	0.61	4.15	0.59
Skill Variety	3.62	0.69	3.76	0.66	3.89	0.63	4.03	0.60
Feedback Quality	3.48	0.71	3.61	0.68	3.75	0.65	3.88	0.62

The descriptive trends reveal a consistent and gradual increase in employee creativity across the 18-month period, accompanied by parallel growth in intrinsic motivation, psychological empowerment, and core job design

characteristics. In contrast, extrinsic motivation demonstrated only modest increases, suggesting that internal motivational mechanisms and enriched job structures were the primary developmental drivers of creative growth.

Table 2

Longitudinal Deep Learning Model Prediction Performance

Metric	Training Set	Validation Set	Test Set
Root Mean Square Error (RMSE)	0.283	0.297	0.309
Mean Absolute Error (MAE)	0.214	0.227	0.238
R ² (Explained Variance)	0.791	0.773	0.761
Trajectory Similarity Index	0.902	0.887	0.872

The LSTM-based longitudinal model achieved high predictive accuracy, explaining over 76% of the variance in unseen creativity trajectories. The trajectory similarity index

indicates strong preservation of individual growth patterns, confirming that the model captured both the magnitude and shape of creativity development over time.

Table 3

Feature Importance Rankings from Attention Mechanism and SHAP Analysis

Predictor	Relative Importance Weight
Intrinsic Motivation	0.31
Job Autonomy	0.24
Psychological Empowerment	0.19
Skill Variety	0.14
Task Significance	0.09
Feedback Quality	0.07
Extrinsic Motivation	0.05

The integrated attention–SHAP analysis revealed intrinsic motivation as the dominant predictor of creative growth, followed closely by job autonomy and psychological empowerment. Extrinsic motivation

contributed minimally to long-term creativity trajectories once internal and structural variables were accounted for, underscoring the primacy of self-driven and design-based mechanisms in sustained creativity development.

Table 4

Creativity Trajectory Cluster Characteristics

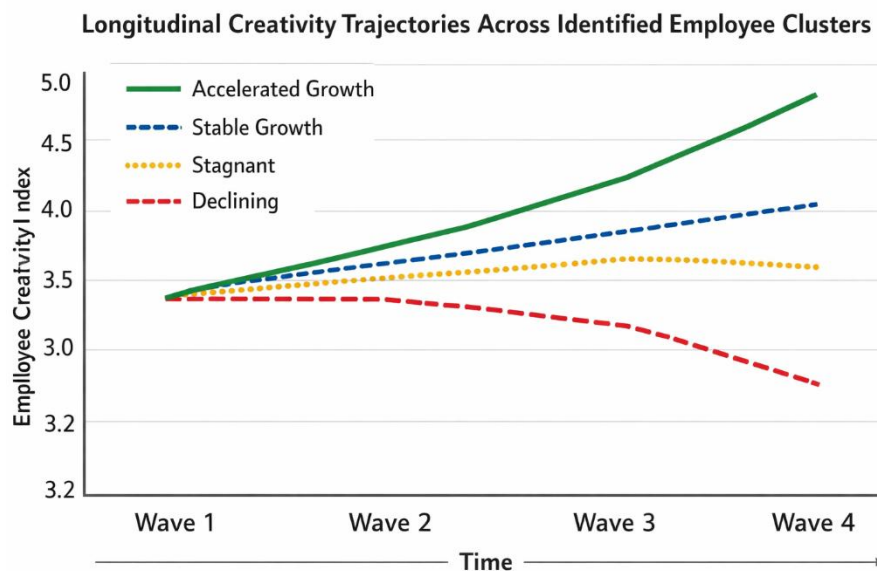
Trajectory Cluster	Percentage of Sample	Initial Creativity Mean	Final Creativity Mean	Dominant Predictors
Accelerated Growth	34.5%	3.88	4.71	High intrinsic motivation, increasing autonomy
Stable Growth	41.2%	3.94	4.29	Moderate motivation, stable job design
Stagnant	16.7%	3.90	3.96	Low empowerment, limited job enrichment
Declining	7.6%	4.02	3.61	Decreasing motivation, role overload

Four distinct creativity development pathways emerged. Over one-third of employees exhibited accelerated creative growth driven by rising intrinsic motivation and expanding job autonomy, whereas approximately one-quarter of the

sample experienced stagnation or decline associated with deteriorating motivational resources and constrained job structures.

Figure 1

Longitudinal Creativity Trajectories Across Identified Employee Clusters



The findings collectively demonstrate that employee creativity is not a static attribute but a dynamic developmental process shaped by evolving motivational

states and job design conditions. The deep learning model not only achieved strong predictive accuracy but also uncovered structurally meaningful creativity trajectories

with clear organizational and psychological signatures, providing a robust empirical foundation for theory development and targeted managerial intervention.

4 Discussion

The present study sought to advance understanding of employee creativity as a dynamic developmental phenomenon by applying longitudinal deep learning models to examine how evolving motivational states and job design characteristics jointly shape creativity trajectories. The findings provide compelling empirical evidence that employee creativity follows distinct non-linear developmental pathways rather than remaining stable over time. The deep learning model achieved high predictive accuracy and revealed four meaningful creativity trajectories—accelerated growth, stable growth, stagnant, and declining—thereby confirming the theoretical proposition that creativity is not a static personal attribute but a malleable capacity continuously shaped by psychological and structural work conditions (Chen & Choi, 2025; Crider et al., 2024; Jnaneswar & Ranjit, 2022). This dynamic perspective is consistent with emerging scholarship emphasizing creativity as an evolving behavioral system influenced by motivation, job characteristics, and contextual change (Au-Yeung & Chao, 2024; Fateh et al., 2023; Isac et al., 2024).

A central contribution of this study lies in demonstrating that intrinsic motivation is the most powerful and enduring predictor of creative growth over time. The feature importance analysis showed that intrinsic motivation exerted substantially stronger influence on creativity trajectories than extrinsic motivation or compensation-related factors. This finding aligns closely with established motivational theory and empirical evidence indicating that intrinsic motivation fosters sustained engagement in complex problem solving, experimentation, and idea generation (Jnaneswar & Ranjit, 2022; Ma et al., 2023; Sharma & Gautam, 2023). Prior studies have consistently reported that intrinsically motivated employees exhibit higher levels of creative performance because they experience greater enjoyment, autonomy, and psychological ownership of their work (Fateh et al., 2023; Kılıç & Gök, 2022). The present longitudinal evidence extends this literature by demonstrating that intrinsic motivation does not merely correlate with creativity at a single time point but actively drives long-term creative development.

By contrast, extrinsic motivation and compensation-related variables displayed comparatively weaker and more conditional effects on creativity trajectories. Although compensation and external rewards were associated with baseline levels of performance and satisfaction, they did not sustain long-term creative growth once intrinsic motivation and job design factors were accounted for. This pattern is consistent with findings showing that financial incentives primarily influence job satisfaction and performance but have limited capacity to sustain creativity without supportive motivational climates (Adanlawo et al., 2023; David et al., 2025; Syaputra et al., 2025). Similarly, research indicates that the motivational influence of compensation is mediated through satisfaction and organizational commitment rather than directly producing creative behavior (Pham et al., 2025; Putri, 2025). The present findings therefore reinforce the conclusion that extrinsic incentives alone are insufficient for fostering durable creative development.

The strong effect of job autonomy and psychological empowerment observed in this study further underscores the structural foundations of creativity. Employees whose roles allowed greater discretion, task variety, and meaningful decision authority were significantly more likely to follow accelerated creativity growth trajectories. This result corroborates extensive evidence demonstrating that enriched job characteristics enhance creative engagement by strengthening intrinsic motivation and perceived competence (Kurniawan et al., 2023; Mariska et al., 2024; Wang & Wang, 2022). Evidence further indicates that work autonomy and task variety promote innovative behavior through increased intrinsic motivation, while job crafting amplifies the positive relationship between proactivity and creativity (Kılıç & Gök, 2022; Ma et al., 2023). The present longitudinal design confirms that these structural effects are not transient but accumulate over time to produce sustained creative growth.

The identification of a stagnant and declining creativity group further illuminates the consequences of constrained job design and deteriorating motivational resources. Employees in these trajectories exhibited decreasing psychological empowerment, rising role overload, and declining intrinsic motivation—conditions that have been repeatedly associated with creative suppression and emotional exhaustion (Au-Yeung & Chao, 2024; Baroun, 2025). Unsafe or rigid organizational environments significantly impair employee performance and psychological well-being (Baroun, 2025), while job anxiety depletes cognitive resources necessary for creativity (Au-

Yeung & Chao, 2024). These mechanisms likely contributed to the observed downward creativity trajectories.

Importantly, the results also highlight the nuanced role of emotional and social factors in shaping creativity over time. Evidence shows that happiness and prosocial motivation strengthen innovative work behavior (Almazrouei et al., 2024), whereas family-based motivation can paradoxically hinder creativity by shaping employees' job perceptions and emotional strain (Isac et al., 2024). Motivation in service contexts is deeply intertwined with emotional regulation and organizational climate (Ann et al., 2023). The present findings support these conclusions by demonstrating that emotional and social influences contribute to the dynamic shifts in creativity trajectories observed across the study period.

The application of longitudinal deep learning constitutes a major methodological advancement. Traditional linear models are ill-equipped to capture the non-linear, path-dependent nature of creativity development documented here. By contrast, the deep learning framework successfully modeled delayed effects, threshold dynamics, and cumulative interactions among motivation and job design variables. This methodological contribution is particularly important given the increasing complexity of modern workplaces shaped by digital transformation, hybrid work arrangements, and human–AI collaboration (Hamouche et al., 2025; Sonnenschein et al., 2022). Effective human–AI collaboration requires continuous redesign of jobs and adaptive motivational systems, conditions that demand precisely the type of longitudinal predictive modeling employed in this study (Hamouche et al., 2025).

The identification of distinct creativity trajectory clusters carries important theoretical implications. Rather than assuming uniform creative development across employees, the results demonstrate that individuals follow qualitatively different creative pathways shaped by their motivational and structural work environments. This insight supports emerging perspectives that conceptualize creativity as a developmental capability embedded within broader systems of job satisfaction, organizational culture, and contextual change (Chen & Choi, 2025; Crider et al., 2024). Furthermore, cross-cultural evidence indicates that motivational structures and creativity drivers vary across societies (Almazrouei et al., 2024; Nantwi et al., 2023; Ni Kadek Sari Jayanti & Surya, 2023), highlighting the necessity of flexible, data-driven modeling approaches.

5 Conclusion

Overall, the present study provides strong empirical support for a dynamic, systems-based model of employee creativity and demonstrates the value of longitudinal deep learning for uncovering hidden behavioral trajectories. By integrating evolving motivational states with job design features, the research offers a robust predictive framework capable of informing both theory development and organizational practice.

Despite its contributions, the study has several limitations. First, although the longitudinal design improves causal inference, the observational nature of the data limits definitive conclusions about causality. Second, the sample was restricted to organizations in Spain, which may limit the generalizability of findings to other cultural and economic contexts. Third, although multi-source data were used, some measures relied on self-report instruments that may be influenced by social desirability or response bias. Finally, deep learning models, while powerful, are inherently complex and may pose challenges for full interpretability despite the use of attention mechanisms and feature attribution methods.

Future studies should replicate this model across different cultural contexts and organizational sectors to examine the universality of the identified creativity trajectories. Researchers should also explore the integration of physiological and behavioral data, such as digital work traces and neurocognitive indicators, to further enhance predictive accuracy. Additionally, experimental and intervention-based designs could test whether targeted changes in job design and motivational systems can deliberately shift employees from stagnant or declining trajectories into accelerated growth pathways. Expanding model architectures to incorporate team-level and organizational-level dynamics would also provide a more comprehensive understanding of creativity as a multilevel phenomenon.

Organizations should prioritize the systematic cultivation of intrinsic motivation and psychologically empowering job designs to support sustainable creative growth. Managers should actively redesign roles to enhance autonomy, task variety, and meaningful contribution while minimizing unnecessary constraints and overload. Continuous monitoring of motivational and job design indicators can allow early identification of employees at risk of creativity stagnation or decline, enabling timely intervention. Finally, the adoption of advanced predictive analytics, including

longitudinal machine learning systems, can provide leaders with powerful decision-support tools for nurturing creativity and innovation over time.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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