

Explainable XGBoost Prediction of Employee Turnover Intention Using Organizational Behavior and Human Resource Features

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ABSTRACT

Objective: This study aimed to develop and interpret an XGBoost-based machine-learning model for predicting employee turnover intention among employees in France using organizational behavior and human resource features.

Methods and Materials: This quantitative, cross-sectional predictive study included 684 employees working in public- and private-sector organizations in France. Participants completed a structured questionnaire assessing turnover intention together with organizational behavior and human resource variables, including job satisfaction, organizational commitment, perceived organizational support, work engagement, job autonomy, role clarity, role conflict, work-related stress, organizational justice, supervisor support, work-life balance, compensation satisfaction, career advancement opportunities, recognition and rewards, job security, leadership quality, perceived internal mobility, and HR fairness. The dataset was stratified into training and independent test subsets. An Extreme Gradient Boosting model was developed using stratified five-fold cross-validation and hyperparameter optimization. Predictive performance was evaluated using ROC-AUC, accuracy, precision, recall, specificity, F1 score, balanced accuracy, log loss, and Brier score. SHapley Additive exPlanations were applied to interpret global and individual feature contributions.

Findings: The final XGBoost model demonstrated strong discrimination in the independent test set, with an ROC-AUC of 0.88, accuracy of 0.83, precision of 0.78, recall of 0.76, specificity of 0.87, F1 score of 0.77, and balanced accuracy of 0.82. The test log loss and Brier score were 0.39 and 0.13, respectively. SHAP analysis identified job satisfaction as the most influential predictor, followed by organizational commitment, work-related stress, career advancement opportunities, perceived organizational support, work-life balance, compensation satisfaction, leadership quality, recognition and rewards, and perceived HR fairness. Lower satisfaction, weaker commitment and support, higher stress, and fewer career opportunities consistently increased predicted turnover intention.

Conclusion: Explainable XGBoost provided accurate and interpretable prediction of employee turnover intention, demonstrating that modifiable organizational and HR-related conditions were more influential than demographic characteristics and may therefore represent priority targets for evidence-based retention strategies.

Keywords: Employee Turnover Intention; XGBoost; Explainable Artificial Intelligence; SHAP; Organizational Behavior; Human Resource Management; Employee Retention.

1 Introduction

Employee turnover remains one of the most persistent and costly challenges confronting contemporary organizations because it affects workforce continuity, operational efficiency, organizational knowledge, service quality, and long-term competitiveness. Although some degree of employee mobility is inevitable and may even contribute to organizational renewal, excessive voluntary turnover can generate substantial direct and indirect costs through recruitment, selection, onboarding, training, productivity losses, disruption of team functioning, and deterioration of institutional knowledge. Consequently, turnover intention, generally understood as an employee's conscious and deliberate willingness or plan to leave the current organization, has become a central construct in organizational behavior and human resource management research. Turnover intention is particularly important because it frequently precedes actual voluntary turnover and therefore offers organizations an opportunity to identify emerging retention risks before employee departure occurs. Recent literature has increasingly emphasized that employees' decisions to remain with or leave an organization are not driven by a single factor but instead emerge from complex combinations of human resource practices, organizational experiences, psychological states, career expectations, and work-related conditions (Budin, 2024; Wenyan et al., 2024).

Human resource management practices constitute one of the most important organizational mechanisms through which employee attitudes and retention-related outcomes can be influenced. Recruitment quality, training and development, compensation, performance appraisal, promotion opportunities, career management, recognition, employee participation, and supportive work arrangements communicate organizational priorities and shape employees' evaluations of the employment relationship. A broad review of the literature indicates that well-designed HRM practices can reduce turnover intention by enhancing perceived organizational investment, increasing job satisfaction, strengthening organizational commitment, and improving employees' sense of future opportunity within the organization (Wenyan et al., 2024). Similarly, evidence from private-sector employment contexts indicates that HRM systems that are viewed as fair, developmental, and responsive to employee needs can contribute to workforce stability, whereas inadequate compensation, limited development opportunities, weak recognition systems, and

unsatisfactory management practices can increase employees' willingness to seek alternative employment (Aduda et al., 2022). Thus, turnover intention is increasingly conceptualized not simply as an individual preference but as an organizational outcome that can be shaped by the quality and configuration of human resource practices.

Strategic HRM research has further demonstrated that retention outcomes are frequently mediated by employee attitudes and psychological experiences. Rather than influencing turnover intention through direct and isolated pathways, HR practices often affect employees' attachment to the organization by shaping job satisfaction, work engagement, organizational commitment, psychological empowerment, and perceived organizational support. Strategic HR practices have been associated with stronger talent retention when employees experience higher job satisfaction and work engagement, while psychological empowerment may strengthen the positive effects of these practices (Shahzad et al., 2024). Likewise, high-involvement work practices can reduce turnover intention by increasing employee engagement and creating stronger psychological involvement in work and organizational processes (Islam et al., 2023). Evidence also suggests that appraisal quality and training practices may enhance organizational loyalty and reduce turnover intentions through psychological empowerment, indicating that employee perceptions of competence, influence, and autonomy are important mechanisms connecting HR practices with retention outcomes (Nawaz et al., 2023).

Organizational commitment has repeatedly emerged as a particularly important explanatory mechanism in turnover research. Employees who feel emotionally attached to their organization, identify with organizational goals, and perceive membership as personally meaningful are generally less likely to consider leaving. Research examining the relationship between HR practices and turnover intention has shown that organizational commitment can mediate the effects of human resource systems on employees' intention to leave (Ashraf et al., 2023). Affective commitment has similarly been identified as a mechanism through which HRM practices influence turnover intention, reinforcing the importance of emotional attachment in translating organizational practices into retention outcomes (Aimeur, 2024). Compensation systems may also affect turnover intention through commitment, suggesting that employees interpret pay not merely as an economic exchange but also as a signal of recognition, fairness, and organizational valuation (Berber & Gašić, 2024). These findings imply that

predictive models of turnover intention should include not only formal HRM characteristics but also the organizational attitudes through which employees interpret and respond to those practices.

Job satisfaction represents another central construct in turnover theory and empirical research. Employees who are satisfied with their jobs are generally more likely to remain with their organizations, whereas dissatisfaction may stimulate withdrawal cognitions, job-search behaviors, and eventual turnover. Flexible work arrangements, for example, have been associated with lower turnover intentions through their positive relationship with job satisfaction, demonstrating how structural features of work can influence retention through employees' subjective evaluation of their jobs (Berber et al., 2022). Talent management research has similarly shown that job satisfaction can influence the relationship between organizational talent practices and employee turnover, particularly when employees perceive that their skills, contributions, and career development are recognized (Obum et al., 2023). Psychological well-being may also mediate the association between HR practices and turnover intention, indicating that employees' broader experience of functioning and well-being at work should be considered alongside conventional organizational indicators (Yunikawati et al., 2021).

Career development and talent management are especially relevant in contemporary labor markets characterized by increased professional mobility and changing expectations regarding employability. Employees may be more likely to remain in organizations that provide meaningful opportunities for training, development, advancement, internal mobility, and long-term career progression. Talent management practices can strengthen commitment and retention when employees perceive that organizations actively invest in their future and provide opportunities to apply and develop valued competencies (Tej et al., 2021). Systematic evidence likewise indicates close relationships among talent management, employee engagement, and turnover intention, suggesting that the development and retention of talent require an integrated organizational approach rather than isolated retention interventions (Llorens et al., 2024). Where employees perceive a lack of progression, limited developmental support, or insufficient recognition of potential, turnover intention may become a rational response to constrained career prospects.

Employer attractiveness and internal employer branding also contribute to employees' decisions about whether to

maintain organizational membership. Internal employer branding can influence talent retention by shaping employees' perceptions of organizational identity, value proposition, and the extent to which employment expectations are fulfilled (Ahmed et al., 2022). Sustainable human resource management and effective internal communication may further enhance employer attractiveness and thereby reduce turnover intention while supporting employee performance (Gomes et al., 2023). These findings highlight the signaling function of HRM: employees evaluate not only specific policies but also what those policies communicate about organizational culture, fairness, support, and long-term relational commitment. When HR systems are coherent and consistently implemented, employees may perceive the organization as trustworthy and desirable; when practices are fragmented or inconsistent, retention risks may increase.

Perceived organizational support, trust, motivation, and socially responsible HRM represent additional relational dimensions of turnover intention. Socially responsible HRM practices can foster talent retention by strengthening employees' trust and motivation, particularly when organizational actions are perceived as ethically responsible and supportive of employee welfare (Rawshdeh et al., 2023). Similarly, the perceived strength of an HRM system can influence employees' thriving at work and turnover intentions because strong HR systems provide clearer signals about organizational expectations, priorities, and employment conditions (Jing et al., 2024). High-performance work systems may likewise affect employee responses through their combined influence on performance expectations, involvement, development, and reward structures (Chen, 2024). These perspectives suggest that turnover intention is embedded in a broader system of organizational signals and employee interpretations rather than being determined solely by objective employment conditions.

At the same time, contemporary HRM operates under conditions of increasing uncertainty and disruption. Economic volatility, digital transformation, evolving employee expectations, hybrid work arrangements, workforce internationalization, and changing professional norms have complicated traditional approaches to retention. HRM functions in sectors such as banking increasingly confront challenges involving technological change, workforce capability development, retention, employee expectations, and organizational adaptability (Gautam & Saud, 2024). Research in the public sector has similarly

shown that workplace disruptions can require HR practices specifically designed to strengthen employee resilience and preserve organizational functioning under uncertainty (Kim et al., 2022). The COVID-19 pandemic also demonstrated the importance of adaptive HRM practices, particularly in public organizations and educational institutions where organizations were required to manage rapid changes in work arrangements, employee expectations, and organizational processes (Mughal et al., 2023). These developments increase the importance of predictive approaches capable of simultaneously integrating multiple organizational and workforce characteristics.

Turnover intention is also influenced by labor-market and mobility dynamics extending beyond the immediate organization. Employees may consider leaving not only for another employer but also because of broader geographical or professional mobility intentions. Research examining employee emigration intentions has demonstrated that organizational and psychological mechanisms can shape decisions to leave both the organization and the broader employment environment, highlighting the importance of understanding turnover within wider mobility processes (Tafolli & Hameli, 2024). Context-specific studies have also shown that turnover can become particularly salient among employees working in labor markets where public- and private-sector employment differ considerably in perceived stability, rewards, career opportunities, and employment conditions (Alshehhi, 2024). Such contextual variation reinforces the need to examine turnover intention within specific national employment environments rather than assuming that predictors operate identically across all labor markets.

Different cultural and institutional contexts may also shape how employees evaluate HR practices and organizational relationships. Research conducted in multinational and culturally diverse employment contexts has emphasized the importance of aligning human resource practices with employees' values and expectations when attempting to minimize turnover intention (Bawasa et al., 2023). Similarly, the effectiveness of HRM practices depends not merely on whether specific practices formally exist but on whether employees perceive the overall HR system as effective and meaningful (Alkhamis, 2024). This distinction is important because two employees exposed to similar formal policies may interpret them differently based on leadership behavior, organizational communication, fairness perceptions, career expectations, and previous workplace experiences. Therefore, a comprehensive

assessment of turnover intention should incorporate both structural HR variables and subjective organizational behavior indicators.

Despite substantial progress in identifying correlates and antecedents of turnover intention, much of the existing literature has relied on traditional statistical approaches that typically estimate average linear relationships between a limited number of variables. These methods remain highly valuable for theory testing and causal inference, but they may be less well suited to prediction when relationships are nonlinear, predictors interact in complex ways, or the relative importance of variables changes across different employee profiles. Employee turnover intention is inherently multifactorial. For example, low compensation satisfaction may not necessarily produce high turnover intention when organizational commitment and career opportunities are strong, while moderate job satisfaction may become problematic when combined with high stress, limited supervisor support, poor work-life balance, and perceived unfairness. Such conditional relationships are difficult to represent using simple additive models.

Machine-learning methods provide an alternative predictive framework because they can identify complex, nonlinear, and interactive relationships without requiring all functional forms to be specified in advance. Among ensemble learning approaches, Extreme Gradient Boosting, commonly referred to as XGBoost, is especially suitable for structured organizational datasets because it combines multiple decision trees sequentially, corrects previous prediction errors, incorporates regularization, and can handle heterogeneous predictor distributions. In turnover research, a machine-learning approach can integrate demographic, employment, behavioral, and HRM variables within a single predictive architecture. However, predictive accuracy alone is insufficient for organizational decision-making. A highly accurate model that cannot explain why an employee is classified as having elevated turnover intention may have limited practical and scientific utility, particularly when HR practitioners need to identify actionable factors rather than merely produce risk scores.

Explainable artificial intelligence offers an important response to this limitation. SHapley Additive exPlanations provide a mathematically grounded method for decomposing individual model predictions into contributions attributable to each input feature. In the context of turnover intention, SHAP can identify both which predictors matter most globally and how particular values of those predictors increase or decrease the predicted likelihood

of turnover for individual employees. This distinction is especially important because variable importance alone does not reveal whether high or low values of a feature contribute to risk, nor does it capture heterogeneity in effects across employees. By combining XGBoost with SHAP, turnover research can move beyond conventional prediction toward interpretable prediction, enabling researchers and HR professionals to distinguish dominant risk factors, protective factors, nonlinear relationships, and employee-specific combinations of organizational conditions.

The existing literature strongly supports the relevance of human resource practices, commitment, engagement, satisfaction, psychological empowerment, organizational support, talent management, and workplace conditions in explaining turnover intention (Alhajaj & Ahmad, 2023). At the same time, the findings across studies indicate that no single HR practice is sufficient to explain employee retention, and the relationships among HR systems, employee attitudes, and turnover are frequently mediated, moderated, or context dependent. This complexity creates a strong rationale for an integrated predictive approach capable of processing multiple organizational behavior and HR features simultaneously while maintaining interpretability. Although prior studies have advanced understanding of specific pathways linking HRM practices to turnover, there remains a need for models that prioritize predictive performance and transparent explanation at the same time, particularly in European employment settings such as France.

Accordingly, the aim of this study was to develop and explain an XGBoost-based machine-learning model for predicting employee turnover intention among employees in France using organizational behavior and human resource features and to identify the most influential predictors through SHAP-based explainability analysis.

2 Methods and Materials

This study employed a quantitative, cross-sectional predictive design to develop and interpret a machine-learning model for identifying employee turnover intention based on organizational behavior and human resource characteristics. The study population consisted of employees working in private- and public-sector organizations in France. Participants were recruited from organizations operating in sectors including information technology, financial services, manufacturing, retail, healthcare, education, professional services, and public administration

in order to obtain sufficient heterogeneity in occupational and organizational characteristics. Eligible participants were required to be at least 18 years of age, currently employed in France, have worked for their current organization for a minimum of six months, and be able to complete the questionnaire in French. Employees who were self-employed, temporary interns, or had less than six months of organizational tenure were excluded because their employment circumstances could differ substantially from those of established organizational employees. Data were collected through an online questionnaire distributed through organizational human resource departments, professional networks, and employee mailing lists. A total of 752 questionnaires were initially received. After screening the responses for eligibility, duplicated submissions, extensive missing data, and response patterns indicating insufficient engagement with the questionnaire, 68 cases were excluded. The final analytical sample therefore consisted of exactly 684 employees working in France. Participation was voluntary, and respondents were informed about the study objectives, confidentiality of their responses, anonymity of the collected data, and their right to discontinue participation at any stage without any consequences. Electronic informed consent was obtained before access to the questionnaire was granted. No directly identifying information was included in the analytical dataset. The relatively heterogeneous sample was considered appropriate for developing a predictive model intended to capture turnover intention across different occupational and organizational contexts rather than within a single company or industry.

Data were collected using a structured questionnaire comprising employee demographic and employment characteristics, human resource management features, organizational behavior variables, and turnover intention as the target outcome. Demographic and employment-related variables included age, gender, educational level, marital status, organizational tenure, total work experience, employment contract type, occupational level, managerial responsibility, organization size, sector of employment, weekly working hours, remote or hybrid working status, monthly income category, promotion history, training participation, and recent changes in job responsibilities. These characteristics were included because turnover decisions may reflect both individual employment circumstances and differences in employees' positions within organizational structures. Human resource features assessed employees' perceptions and experiences concerning

compensation satisfaction, benefits, training and development opportunities, career advancement, performance appraisal quality, recognition and rewards, promotion opportunities, workload, flexible working arrangements, job security, perceived internal mobility, and perceived fairness of human resource practices. Organizational behavior features included job satisfaction, organizational commitment, perceived organizational support, work engagement, job autonomy, role clarity, role conflict, work-related stress, organizational justice, supervisor support, coworker support, psychological safety, perceived leadership quality, work–life balance, and person–organization fit. These constructs were assessed using multi-item Likert-type statements adapted from established organizational behavior and human resource measurement approaches, with responses generally ranging from 1, indicating strong disagreement or a very low level of the characteristic, to 5, indicating strong agreement or a very high level of the characteristic. Negatively phrased items were reverse-coded before composite scores were calculated so that higher scores consistently reflected higher levels of the respective construct where conceptually appropriate. Internal consistency was evaluated for each multi-item construct before inclusion in the predictive analysis.

Employee turnover intention constituted the primary outcome variable. Turnover intention was measured through items assessing the extent to which employees had recently considered leaving their organization, intended to search for alternative employment, and expected to leave their current employer within the foreseeable future. Responses were combined into an overall turnover-intention score. For the machine-learning classification analysis, turnover intention was operationalized as a binary target variable representing low versus high turnover intention. Employees whose scores indicated a clear intention to consider or pursue organizational exit were classified in the high-turnover-intention group, whereas employees reporting no or limited intention to leave were classified in the low-turnover-intention group. The classification threshold was determined according to the scale's response structure and was specified before model estimation to prevent outcome-driven threshold selection. Prior to analysis, the dataset was examined for implausible values, duplicate cases, missing information, and inconsistent response patterns. Continuous variables were retained in their original metric because tree-based boosting algorithms do not require conventional feature standardization, while categorical characteristics were transformed into machine-readable indicators. Missing

values were treated using a preprocessing strategy fitted exclusively on the training data to prevent information leakage between the training and evaluation subsets.

Data analysis combined conventional descriptive statistics with supervised machine learning and explainable artificial intelligence techniques. Initial analyses were conducted to describe the characteristics of the 684 participants and examine the distribution, completeness, and variability of the predictor variables. Means and standard deviations were calculated for continuous variables, while frequencies and percentages were calculated for categorical variables. Pairwise relationships among continuous predictors were inspected to identify highly redundant features, and the prevalence of high turnover intention was examined to determine the degree of class imbalance. The final dataset was randomly divided into training and test subsets using stratified sampling so that the proportion of employees with high and low turnover intention was preserved across the two subsets. Eighty percent of the observations were assigned to the training dataset and 20% to the independent test dataset. All preprocessing procedures, including missing-value treatment, categorical encoding, feature preparation, and model tuning, were conducted using information from the training data only. The independent test set remained unseen throughout model development and was used exclusively for final assessment of predictive performance.

Extreme Gradient Boosting, implemented through the XGBoost algorithm, was used as the principal prediction method. XGBoost was selected because employee turnover intention is likely to be associated with nonlinear relationships and complex interactions among organizational, behavioral, demographic, and human resource characteristics that may not be adequately represented by conventional linear models. The algorithm sequentially constructs an ensemble of decision trees, with each new tree attempting to reduce errors generated by the preceding ensemble while regularization mechanisms constrain unnecessary model complexity. Hyperparameters including the number of boosting trees, learning rate, maximum tree depth, minimum child weight, subsampling ratio, column-sampling ratio, and L1 and L2 regularization parameters were optimized within the training dataset. Stratified five-fold cross-validation was used during hyperparameter optimization to reduce the dependence of model performance on a particular data partition and to limit overfitting. Early stopping was incorporated where appropriate so that additional boosting iterations were

discontinued when predictive performance no longer improved. When class imbalance was present, class weighting within XGBoost was used to increase the contribution of the minority outcome class without modifying observations in the independent test set.

Predictive performance was evaluated on the held-out test sample using complementary classification indices. The area under the receiver operating characteristic curve was considered the principal discrimination metric because it reflects the ability of the model to distinguish employees with high turnover intention from those with low turnover intention across alternative probability thresholds. Accuracy, precision, recall, specificity, F1 score, and the confusion matrix were additionally examined to provide a comprehensive assessment of classification performance. Because identifying employees at elevated risk of turnover requires attention not only to overall accuracy but also to successful detection of positive cases, recall and the F1 score were interpreted alongside the area under the receiver operating characteristic curve. Predicted probabilities were also assessed to determine whether the model produced sufficiently differentiated estimates of turnover intention rather than merely reproducing the majority class.

To make the XGBoost predictions interpretable, SHapley Additive exPlanations were calculated for the final model. SHAP analysis was used because it provides theoretically grounded estimates of the contribution of each predictor to an individual prediction while also permitting aggregation of these contributions across the entire sample. Global feature importance was determined using the mean absolute SHAP value of each predictor, allowing the organizational behavior and human resource variables with the greatest overall contributions to turnover-intention predictions to be ranked. SHAP summary analyses were then used to determine whether higher or lower values of major features tended to increase or decrease predicted turnover intention. Dependence analyses were examined for the most influential continuous predictors to identify nonlinear patterns and possible thresholds in their relationships with the model output. Local SHAP explanations were also inspected for selected individual cases to demonstrate how combinations of employee characteristics could produce different predicted probabilities even when employees shared similar demographic profiles. This explainability procedure enabled

the analysis to move beyond reporting predictive accuracy and to identify the organizational and human resource conditions most strongly associated with elevated or reduced predicted turnover intention. All model-selection decisions were based exclusively on the training and validation data, whereas the test dataset was reserved for final evaluation in order to minimize optimistic performance estimates and provide a more reliable assessment of the model's generalizability.

3 Findings and Results

A total of 684 employees working in France were included in the final analysis. Participants ranged in age from 21 to 62 years, with a mean age of 38.74 years ($SD = 9.16$). Of the participants, 352 (51.46%) were men and 332 (48.54%) were women. Regarding educational attainment, 96 participants (14.04%) had completed secondary or vocational education, 214 (31.29%) held a bachelor's degree, 292 (42.69%) held a master's degree, and 82 (11.99%) held a doctoral or equivalent advanced degree. The mean organizational tenure was 7.63 years ($SD = 6.18$), while participants reported an average total work experience of 13.27 years ($SD = 8.21$). Most respondents, 536 employees (78.36%), were employed under permanent contracts, whereas 148 (21.64%) had fixed-term or other contractual arrangements. A total of 167 participants (24.42%) occupied managerial or supervisory positions. Employees were drawn from a diverse range of sectors, including information technology and telecommunications, financial and professional services, healthcare, education, manufacturing, retail and commercial services, and public administration. With regard to work arrangements, 278 employees (40.64%) reported predominantly on-site work, 317 (46.35%) worked under hybrid arrangements, and 89 (13.01%) worked predominantly remotely. Based on the prespecified classification threshold for the turnover-intention scale, 249 employees (36.40%) were classified as having high turnover intention and 435 (63.60%) as having low turnover intention. Stratified partitioning allocated 547 cases to the training dataset and 137 cases to the independent test dataset while maintaining approximately the same outcome-class proportions in both subsets.

Table 1
Descriptive Statistics for Organizational Behavior and Human Resource Features

Variable	Mean	SD	Minimum	Maximum
Turnover intention	2.91	1.04	1.00	5.00
Job satisfaction	3.34	0.81	1.00	5.00
Organizational commitment	3.29	0.79	1.00	5.00
Perceived organizational support	3.25	0.83	1.00	5.00
Work engagement	3.48	0.75	1.00	5.00
Job autonomy	3.52	0.77	1.00	5.00
Role clarity	3.61	0.72	1.00	5.00
Role conflict	2.74	0.84	1.00	5.00
Work-related stress	3.07	0.86	1.00	5.00
Organizational justice	3.18	0.82	1.00	5.00
Supervisor support	3.46	0.88	1.00	5.00
Coworker support	3.71	0.70	1.00	5.00
Psychological safety	3.39	0.76	1.00	5.00
Leadership quality	3.31	0.84	1.00	5.00
Work–life balance	3.22	0.89	1.00	5.00
Person–organization fit	3.37	0.80	1.00	5.00
Compensation satisfaction	3.01	0.91	1.00	5.00
Benefits satisfaction	3.18	0.85	1.00	5.00
Training and development opportunities	3.24	0.87	1.00	5.00
Career advancement opportunities	2.96	0.92	1.00	5.00
Performance appraisal quality	3.12	0.83	1.00	5.00
Recognition and rewards	2.98	0.89	1.00	5.00
Job security	3.56	0.86	1.00	5.00
Perceived internal mobility	3.08	0.88	1.00	5.00
Perceived HR fairness	3.21	0.82	1.00	5.00
Weekly working hours	39.84	5.91	20.00	60.00
Organizational tenure, years	7.63	6.18	0.50	34.00
Total work experience, years	13.27	8.21	1.00	41.00

As shown in Table 1, the participants generally reported moderate levels across most organizational behavior and human resource variables, although meaningful variation was present across the sample. Coworker support had the highest mean among the psychosocial organizational variables ($M = 3.71$, $SD = 0.70$), followed by role clarity ($M = 3.61$, $SD = 0.72$), job security ($M = 3.56$, $SD = 0.86$), job autonomy ($M = 3.52$, $SD = 0.77$), and work engagement ($M = 3.48$, $SD = 0.75$). These values suggested that employees generally perceived relatively favorable interpersonal support, clarity regarding their responsibilities, and a moderate degree of discretion in performing their work. In contrast, career advancement opportunities ($M = 2.96$, $SD = 0.92$) and recognition and rewards ($M = 2.98$, $SD = 0.89$) showed comparatively lower average scores, indicating that

opportunities for upward mobility and perceptions of organizational recognition represented weaker aspects of the employment experience within the sample. Compensation satisfaction was similarly moderate to low ($M = 3.01$, $SD = 0.91$). Work-related stress had a mean of 3.07 ($SD = 0.86$), while role conflict averaged 2.74 ($SD = 0.84$), suggesting substantial between-employee heterogeneity in potentially adverse working conditions. The turnover-intention score itself averaged 2.91 ($SD = 1.04$), consistent with the presence of a substantial subgroup of employees exhibiting elevated intentions to leave. Importantly, the dispersion observed in the principal predictors indicated sufficient variation for machine-learning estimation, reducing the likelihood that prediction would be dominated by variables with severely restricted distributions.

Table 2*Predictive Performance of the Final XGBoost Model*

Performance Metric	Training/Cross-Validation Estimate	Independent Test Estimate
ROC-AUC	0.91	0.88
Accuracy	0.86	0.83
Precision	0.82	0.78
Recall/Sensitivity	0.80	0.76
Specificity	0.89	0.87
F1 score	0.81	0.77
Balanced accuracy	0.85	0.82
Log loss	0.34	0.39
Brier score	0.11	0.13

The final tuned XGBoost model demonstrated strong discrimination between employees with high and low turnover intention. During cross-validation within the training dataset, the model achieved an ROC-AUC of 0.91, while the ROC-AUC obtained on the completely independent test set was 0.88. The relatively small reduction in discrimination from training to testing suggested that the model generalized reasonably well to previously unseen observations and did not exhibit pronounced overfitting. Test-set accuracy was 0.83, indicating that approximately 83% of employees in the held-out sample were correctly classified. The test-set precision of 0.78 showed that more than three quarters of employees classified by the model as having high turnover intention actually belonged to the high-intention category, whereas the sensitivity of 0.76 indicated that the model successfully detected approximately three quarters of employees who truly exhibited high turnover

intention. Specificity reached 0.87, demonstrating particularly strong performance in correctly identifying employees with low turnover intention. The F1 score of 0.77 reflected a satisfactory balance between precision and recall and was especially important given the unequal distribution of high- and low-turnover-intention cases. Balanced accuracy was 0.82, further confirming that model performance was not attributable merely to correct classification of the larger low-turnover-intention group. The test log loss of 0.39 and Brier score of 0.13 additionally indicated that the model generated informative probability estimates rather than only accurate binary classifications. Collectively, these results supported the predictive validity of the XGBoost model and justified subsequent interpretation of its internal prediction structure using SHAP values.

Table 3*Global SHAP Feature Importance for Prediction of High Turnover Intention*

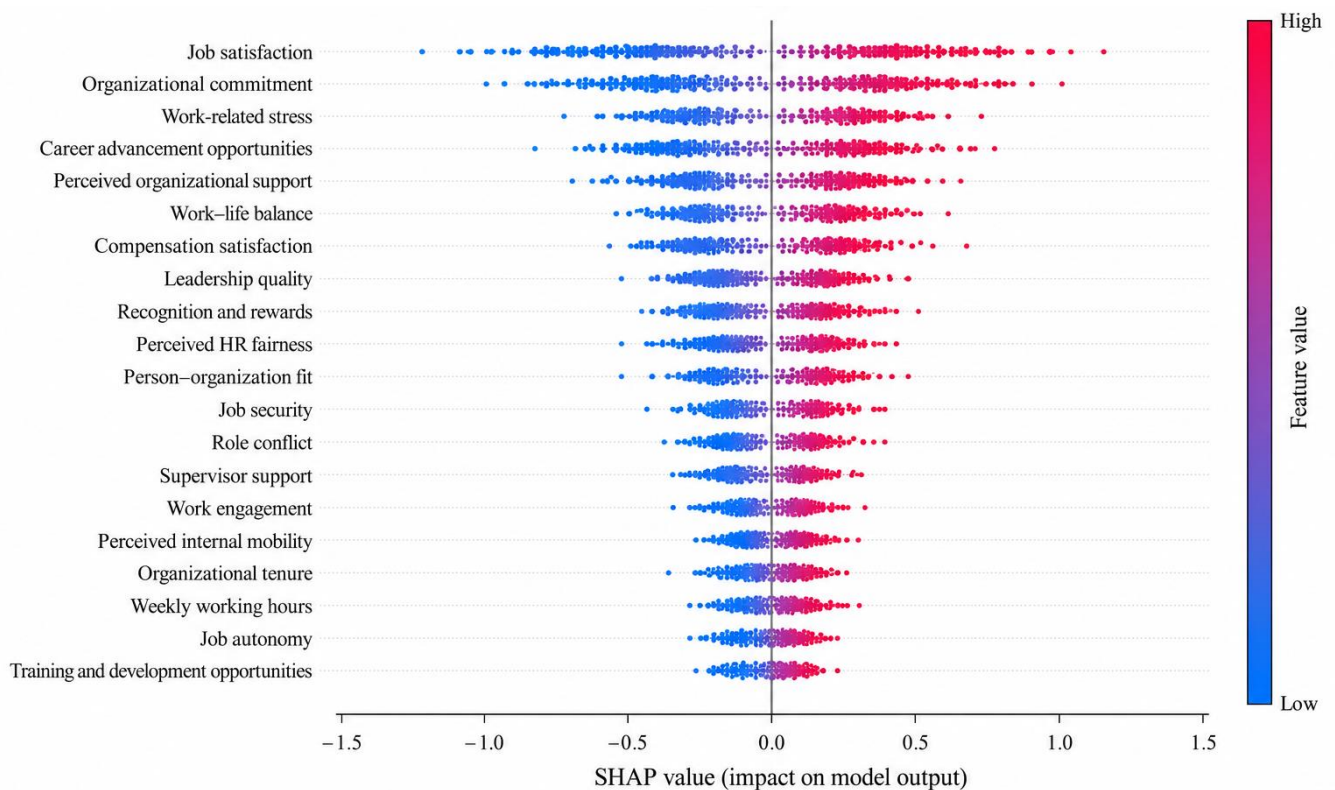
Rank	Predictor	Mean Absolute SHAP Value	Predominant Direction Associated with Higher Turnover Intention
1	Job satisfaction	0.428	Lower satisfaction
2	Organizational commitment	0.389	Lower commitment
3	Work-related stress	0.347	Higher stress
4	Career advancement opportunities	0.316	Fewer opportunities
5	Perceived organizational support	0.288	Lower support
6	Work-life balance	0.264	Poorer balance
7	Compensation satisfaction	0.238	Lower satisfaction
8	Leadership quality	0.211	Lower quality
9	Recognition and rewards	0.194	Lower recognition
10	Perceived HR fairness	0.176	Lower fairness
11	Person-organization fit	0.159	Lower fit
12	Job security	0.141	Lower security
13	Role conflict	0.128	Higher conflict
14	Supervisor support	0.117	Lower support
15	Work engagement	0.103	Lower engagement
16	Perceived internal mobility	0.091	Lower mobility
17	Organizational tenure	0.079	Shorter tenure, predominantly
18	Weekly working hours	0.068	Longer hours
19	Job autonomy	0.059	Lower autonomy
20	Training and development opportunities	0.052	Fewer opportunities

The SHAP analysis revealed that turnover-intention predictions were driven primarily by employees' attitudinal and organizational experiences rather than by demographic characteristics alone. Job satisfaction emerged as the most influential predictor, with a mean absolute SHAP value of 0.428. Lower levels of job satisfaction consistently shifted model predictions toward the high-turnover-intention class, whereas higher levels substantially reduced predicted risk. Organizational commitment was the second most influential predictor, with a mean absolute SHAP value of 0.389, and low commitment was strongly associated with positive SHAP values representing increased predicted turnover intention. Work-related stress ranked third (mean absolute SHAP = 0.347), with elevated stress contributing markedly to higher predicted probabilities of turnover intention. Career advancement opportunities were also highly influential (mean absolute SHAP = 0.316), indicating that perceived limitations in promotion and career progression

represented an important risk factor. Perceived organizational support, work-life balance, compensation satisfaction, leadership quality, recognition and rewards, and perceived HR fairness completed the ten most influential features. The direction of these effects was theoretically coherent: poorer organizational support, work-life imbalance, dissatisfaction with compensation, unfavorable leadership perceptions, insufficient recognition, and perceived unfairness consistently increased the model's estimated probability of high turnover intention. In comparison, employment characteristics such as organizational tenure and weekly working hours contributed to prediction but had smaller global effects than the principal organizational behavior variables. The importance rankings therefore indicated that the model's predictive capability was not primarily based on static employee attributes but instead reflected modifiable organizational and human resource conditions.

Figure 1

SHAP Summary Plot Showing the Direction and Magnitude of Organizational Behavior and Human Resource Features in Predicting Employee Turnover Intention



The SHAP summary analysis demonstrated substantial heterogeneity in both the magnitude and direction of feature

contributions across individual employees. Low job satisfaction generated some of the largest positive SHAP

values in the model, meaning that dissatisfaction produced particularly strong upward shifts in predicted turnover intention for a considerable proportion of employees. Conversely, high job satisfaction generated predominantly negative SHAP values and therefore acted as an important protective factor within the predictive model. A comparable pattern was observed for organizational commitment: employees with lower commitment were concentrated on the positive side of the SHAP distribution, whereas high commitment shifted predictions toward the low-turnover-intention category. Work-related stress showed the opposite directional configuration, with high values predominantly associated with positive SHAP contributions. The distribution of SHAP values further indicated that the influence of these predictors was nonlinear. For example, moderate levels of job satisfaction or organizational support often produced relatively small contributions to prediction, whereas very low scores resulted in disproportionately larger increases in predicted turnover intention. Similarly, deterioration in work-life balance appeared to exert a stronger predictive effect once employees moved into the lower end of the scale. Career advancement opportunities displayed a pronounced asymmetrical pattern: limited advancement opportunities increased predicted turnover intention substantially, whereas very favorable advancement perceptions generated comparatively moderate reductions in risk. This pattern suggested that the absence of career prospects may be more consequential for turnover intention than the incremental benefit associated with already favorable career-development conditions.

Examination of individual SHAP profiles further showed that high turnover intention was generally produced by combinations of adverse organizational conditions rather than by a single isolated feature. Employees with the highest predicted probabilities typically exhibited simultaneous low job satisfaction, low organizational commitment, elevated work-related stress, limited career advancement opportunities, weak perceived organizational support, and unsatisfactory work-life balance. In such cases, positive contributions from multiple risk-enhancing features accumulated and produced predicted probabilities considerably above the classification threshold. By contrast, employees with strong job satisfaction, high commitment, favorable supervisor and organizational support, satisfactory work-life balance, and perceptions of fair recognition frequently received low predicted turnover probabilities even when they possessed potentially unfavorable background characteristics such as shorter organizational

tenure. This finding demonstrated the importance of considering employee turnover intention as a multivariate organizational phenomenon in which multiple features interact within the prediction process.

Additional inspection of SHAP dependence patterns indicated that several important predictors demonstrated threshold-like effects. The protective contribution of job satisfaction became particularly apparent once scores moved above approximately the midpoint of the response scale, whereas very low satisfaction was associated with a sharp increase in predicted turnover intention. Organizational commitment displayed a similar pattern, with the most pronounced increases in predicted risk occurring among employees reporting clearly low commitment. Work-related stress demonstrated an increasingly positive contribution as stress levels increased, although the magnitude of this effect varied depending on employees' simultaneous levels of organizational support and work-life balance. Employees experiencing high stress together with weak organizational support generally showed larger positive SHAP contributions than employees experiencing comparable stress in more supportive organizational environments. This pattern suggested that organizational support may partially buffer the predictive influence of stressful working conditions. Likewise, the negative effect associated with limited career advancement was particularly evident among employees with lower organizational tenure, indicating that early- and mid-career employees who perceived few opportunities for progression constituted an especially important turnover-risk profile.

The explainability analysis also revealed that conventional demographic variables were substantially less influential than organizational and human resource factors. Age, gender, educational level, marital status, and employment sector did not appear among the highest-ranked global predictors once attitudinal, behavioral, and HR-related features were simultaneously considered by the XGBoost model. Organizational tenure showed a modest predictive contribution, with shorter tenure tending to increase turnover-intention predictions, but its mean absolute SHAP value remained substantially below those of job satisfaction, organizational commitment, stress, and career-development opportunities. Weekly working hours also exerted a comparatively modest global influence; nevertheless, particularly long working schedules generally shifted predictions toward higher turnover intention. These findings indicated that while structural and employment characteristics contributed incremental information, the

strongest predictive signals were derived from employees' lived experiences within their organizations.

Overall, the findings demonstrated that the XGBoost model provided both strong predictive performance and substantively interpretable results. The independent test ROC-AUC of 0.88 indicated that the model could effectively discriminate employees with high versus low turnover intention, while the SHAP results clarified which variables were responsible for these predictions. Job satisfaction and organizational commitment emerged as the dominant protective factors, whereas work-related stress represented the strongest risk-enhancing feature. Career advancement opportunities, perceived organizational support, work-life balance, compensation satisfaction, leadership quality, recognition and rewards, and perceived HR fairness also made substantial contributions. The convergence between predictive importance and theoretically meaningful organizational factors indicates that explainable machine learning can provide more than classification accuracy alone; it can reveal actionable combinations of workplace conditions associated with employees' intention to remain with or leave their organizations.

4 Discussion

The present study developed an explainable XGBoost model to predict employee turnover intention among 684 employees in France using organizational behavior and human resource features. The model demonstrated strong predictive performance, with an ROC-AUC of 0.88, accuracy of 0.83, precision of 0.78, recall of 0.76, specificity of 0.87, and an F1 score of 0.77 on the independent test set. These findings indicate that turnover intention can be predicted with a relatively high degree of accuracy when behavioral, attitudinal, and HR-related characteristics are analyzed simultaneously. Importantly, the explainability analysis showed that the model was not primarily driven by demographic characteristics. Instead, job satisfaction, organizational commitment, work-related stress, career advancement opportunities, perceived organizational support, work-life balance, compensation satisfaction, leadership quality, recognition and rewards, and perceived HR fairness emerged as the most influential predictors. These results reinforce the view that employee turnover intention is a multidimensional organizational phenomenon shaped more strongly by employees' perceptions and experiences of work than by static personal characteristics.

Job satisfaction emerged as the strongest predictor of turnover intention in the SHAP analysis, with lower satisfaction contributing substantially to higher predicted turnover risk. This finding is consistent with extensive evidence indicating that employees who evaluate their jobs negatively are more likely to develop withdrawal cognitions and consider leaving their organizations. Previous research has demonstrated that job satisfaction functions as a key mechanism connecting organizational practices with turnover-related outcomes. For example, flexible work arrangements have been shown to reduce turnover intention partly through improved job satisfaction (Berber et al., 2022). Similarly, talent-management practices may reduce turnover when they create more favorable work experiences and improve employee satisfaction (Obum et al., 2023). Research on strategic HR practices has also shown that job satisfaction contributes to talent retention and helps explain how HR systems influence employees' decisions to remain with their employers (Shahzad et al., 2024). The present findings support this literature while adding a predictive perspective by showing that job satisfaction was not merely statistically associated with turnover intention but also represented the single most important feature in the XGBoost model.

Organizational commitment was the second most influential predictor, and lower commitment consistently shifted the model toward higher turnover-intention predictions. This result is theoretically coherent because employees with weaker emotional attachment and lower identification with organizational goals are more likely to consider alternative employment opportunities. Previous studies have shown that organizational commitment can serve as a critical mediator between HR practices and turnover intention (Ashraf et al., 2023). Affective commitment has likewise been identified as a mechanism through which HRM practices reduce employees' intentions to leave (Aimeur, 2024). In addition, compensation practices may affect turnover intention partly by strengthening or weakening employee commitment (Berber & Gašić, 2024). The current findings therefore support the interpretation that commitment is not simply one among many employee attitudes but a central retention-related mechanism. From a predictive standpoint, the strong SHAP contribution of organizational commitment suggests that organizations seeking to identify employees at risk of turnover should monitor the degree to which employees feel psychologically attached to and invested in the organization.

Work-related stress was the strongest risk-enhancing variable among the leading predictors. Higher stress increased the predicted probability of high turnover intention, and the SHAP dependence patterns indicated that this effect could become more pronounced when accompanied by poor work–life balance or weak organizational support. This finding is consistent with broader HRM research emphasizing that adverse working conditions can undermine resilience, engagement, and organizational attachment. Workplace disruption and uncertainty have been shown to create substantial pressures that require adaptive HR practices to maintain employee resilience (Kim et al., 2022). Similarly, contemporary HRM environments are characterized by technological, organizational, and workforce challenges that may intensify stress and increase retention difficulties when organizations fail to provide adequate support (Gautam & Saud, 2024). The current results suggest that stress should not be considered an isolated occupational-health concern; rather, it functions as an important predictor of withdrawal orientation. Employees experiencing sustained stress may perceive departure as a viable strategy for restoring psychological equilibrium, particularly when other protective organizational resources are insufficient.

Career advancement opportunities were the fourth most influential predictor, with limited perceived opportunities substantially increasing turnover-intention predictions. This finding supports the view that career stagnation is a major driver of voluntary mobility. Employees who do not perceive a credible future within their current organization may search for advancement elsewhere even when other employment conditions are acceptable. Prior evidence indicates that talent management, training, development opportunities, and career-oriented HR practices are strongly related to employee retention and commitment (Tej et al., 2021). Systematic evidence likewise suggests that talent management and engagement are closely connected to turnover intention, particularly when employees perceive that their abilities are underutilized or that future progression is constrained (Llorens et al., 2024). Training and appraisal practices can also reduce turnover intention through psychological empowerment, suggesting that development-related HR practices influence employees' sense of competence, growth, and future potential (Nawaz et al., 2023). The current findings extend this literature by indicating that limited career advancement opportunities may exert a disproportionately strong predictive effect,

especially among employees with shorter organizational tenure.

Perceived organizational support was another highly influential variable. Lower support was associated with increased predicted turnover intention, whereas stronger organizational support generally shifted model predictions toward retention. This pattern is consistent with social exchange perspectives, according to which employees who perceive that their organization values their contributions and cares about their well-being are more likely to reciprocate with commitment and continued membership. Research on socially responsible HRM has shown that supportive practices can strengthen employee trust and motivation and thereby contribute to talent retention (Rawshdeh et al., 2023). Similarly, the strength and consistency of perceived HRM systems have been linked to employees' thriving at work and reduced turnover intention (Jing et al., 2024). The present results indicate that organizational support has independent predictive value even after accounting for job satisfaction, commitment, stress, career opportunities, and other HR-related variables. This suggests that employees evaluate not only the specific benefits they receive but also the broader relational message communicated by organizational policies and managerial behavior.

Work–life balance also emerged as an important predictor, with poorer balance associated with greater turnover intention. This finding is consistent with changes in contemporary employment relationships, particularly the growing importance of flexibility, autonomy, and the compatibility of work with nonwork responsibilities. Evidence has shown that flexible work arrangements can reduce turnover intentions, with job satisfaction serving as an important explanatory mechanism (Berber et al., 2022). Changes in workplace arrangements during periods of disruption have also highlighted the need for HRM systems to accommodate employee well-being and resilience (Kim et al., 2022; Mughal et al., 2023). In the present study, the SHAP patterns indicated that deterioration in work–life balance was particularly influential at the lower end of the scale, suggesting a nonlinear effect whereby severe imbalance may produce a more substantial increase in turnover risk than modest differences around average levels. This reinforces the value of machine-learning approaches for identifying threshold-like patterns that may be difficult to detect using conventional linear models.

Compensation satisfaction, leadership quality, recognition and rewards, and perceived HR fairness also

made meaningful contributions to the XGBoost predictions. Their combined importance suggests that turnover intention reflects employees' broader evaluation of whether the employment relationship is fair, rewarding, and supportive. Compensation has been repeatedly linked to retention, particularly through its effects on commitment and employees' perceptions of organizational value (Berber & Gašić, 2024). HRM practices more generally have been shown to influence employee outcomes through their perceived effectiveness rather than their mere formal existence (Alkhamis, 2024). Similarly, strategic HR practices may strengthen retention when they enhance engagement, satisfaction, and psychological empowerment (Shahzad et al., 2024). The present findings indicate that employees appear to interpret rewards, leadership behavior, recognition, and fairness as interconnected components of the organizational exchange relationship. When several of these dimensions are unfavorable at the same time, the cumulative effect on predicted turnover intention becomes substantially stronger.

The importance of HR fairness in the model is especially noteworthy because fairness perceptions often shape employees' evaluations of multiple organizational systems simultaneously. Employees may judge the fairness of promotion procedures, compensation decisions, performance appraisal, workload distribution, recognition, and access to developmental opportunities. When these processes are perceived as inconsistent or inequitable, employees may question the legitimacy of organizational decisions and become more willing to leave. Research on HR practices and turnover intention has emphasized that well-designed systems are more effective when employees regard them as credible, coherent, and beneficial (Wenyan et al., 2024). Likewise, organizational commitment has been shown to mediate the relationship between HR practices and turnover, implying that unfair or unsatisfactory practices may weaken attachment and increase withdrawal intentions (Ashraf et al., 2023). The current findings provide additional support for the relevance of fairness by showing that it retained meaningful predictive importance even within a model containing many overlapping organizational variables.

The results also showed that person–organization fit, job security, role conflict, supervisor support, work engagement, perceived internal mobility, organizational tenure, weekly working hours, job autonomy, and training opportunities contributed to prediction, although to a lesser extent than the dominant variables. These findings align with the broader

literature suggesting that turnover intention emerges from multiple interconnected dimensions of the employment experience. High-involvement work practices, for example, have been linked to work engagement and reduced turnover intention (Islam et al., 2023). Internal employer branding may also increase retention by strengthening identification with the organization and reinforcing the perceived value of continued membership (Ahmed et al., 2022). Sustainable HRM and internal communication can enhance employer attractiveness and reduce turnover intention by improving employees' overall perceptions of the employment relationship (Gomes et al., 2023). These studies support the present finding that turnover risk cannot be reduced to a single HR practice but instead reflects a broader system of organizational signals and employee responses.

An important contribution of the present study was the finding that demographic variables had substantially lower predictive importance than organizational behavior and HR features. Age, gender, education, and marital status did not appear among the dominant SHAP predictors. This does not imply that demographic characteristics are irrelevant to turnover, but rather that their contribution was comparatively limited once employees' work experiences and perceptions were included in the model. This finding is valuable because it suggests that organizations may achieve more meaningful retention improvements by focusing on modifiable workplace conditions rather than relying heavily on demographic profiling. In different national contexts, turnover has been associated with employment structures, labor-market conditions, and organizational practices (Aduda et al., 2022; Alshehhi, 2024). However, the current model indicates that within a heterogeneous French employee sample, subjective and organizational factors provided substantially stronger predictive information than most demographic characteristics.

The SHAP analysis further demonstrated that the effects of predictors were not strictly linear or uniform across employees. Several variables displayed threshold-like patterns, and the influence of one feature depended on the broader configuration of other employee characteristics. This finding is highly consistent with the conceptual literature on turnover intention, which increasingly emphasizes multicausal and context-dependent processes (Budin, 2024). It also helps explain why studies examining single predictors may produce inconsistent effect sizes across organizations and populations. For example, compensation dissatisfaction may be tolerable for an employee who experiences strong career growth and high

organizational commitment, whereas the same level of dissatisfaction may substantially increase turnover intention in an employee who also experiences stress, weak leadership, and limited advancement opportunities. The XGBoost-SHAP approach was particularly useful in revealing these individualized configurations.

The findings also support research emphasizing the systemic nature of HRM. High-performance and high-involvement work systems operate through bundles of mutually reinforcing practices rather than isolated interventions (Chen, 2024; Islam et al., 2023). Employees evaluate not only individual HR policies but also the consistency and strength of the overall system (Jing et al., 2024). The present results reflect this logic: employees with the highest predicted turnover probabilities generally exhibited multiple adverse conditions simultaneously, including low satisfaction, weak commitment, high stress, limited advancement, poor work–life balance, and low organizational support. This cumulative pattern suggests that turnover intention is better understood as an emergent outcome of the employment system than as a response to a single dissatisfaction.

The study also has implications for talent retention and employer attractiveness. Employees are more likely to remain when they perceive meaningful career opportunities, organizational investment, supportive communication, and a coherent employment value proposition (Ahmed et al., 2022; Gomes et al., 2023). The findings are also consistent with evidence that effective talent-management practices can reduce turnover through engagement and satisfaction (Llorens et al., 2024; Obum et al., 2023). Furthermore, mobility-related research indicates that employees' intentions to leave can be influenced by broader career and migration considerations, meaning that organizations must compete not only against direct employers but also against alternative professional and geographical opportunities (Tafolli & Hameli, 2024). This reinforces the importance of creating an employment environment in which employees can envision continued growth and meaningful future participation.

5 Conclusion

Overall, the convergence between the present findings and previous HRM and organizational behavior research supports the validity of the model while demonstrating the additional value of explainable machine learning. Existing studies have repeatedly shown that effective HRM,

commitment, engagement, satisfaction, empowerment, trust, development opportunities, and organizational support are central to employee retention (Alhajaj & Ahmad, 2023; Bawasa et al., 2023). The contribution of the present study lies in integrating these dimensions into a single predictive framework and identifying their relative and employee-specific importance. Rather than treating explanatory variables as having uniform average effects, the XGBoost-SHAP framework showed how multiple factors jointly shaped individual predictions. The resulting model therefore provides both analytical performance and substantive interpretability, offering a bridge between machine-learning prediction and organizational decision-making.

A limitation of the present study is its cross-sectional design, which prevents causal conclusions regarding the relationships between organizational factors and turnover intention. Although the XGBoost model successfully identified predictive patterns, prediction should not be interpreted as evidence that modifying a particular variable will necessarily cause a corresponding change in turnover behavior. The outcome was turnover intention rather than verified subsequent organizational exit, and some employees who report strong intentions to leave may ultimately remain, whereas others with initially low intentions may later depart. The sample was restricted to employees working in France, and although participants represented different industries and employment settings, the findings may not generalize directly to other countries with different labor-market institutions, employment protections, cultural norms, compensation systems, or career mobility patterns. The use of self-report measures may also introduce common-method variance and social-desirability effects. Moreover, although the model included a broad range of organizational behavior and HR features, potentially relevant variables such as external labor-market opportunities, occupational scarcity, organizational financial performance, commute burden, family constraints, team-level climate, and macroeconomic conditions were not incorporated.

Future research should employ longitudinal designs in which turnover intention is assessed repeatedly and linked to verified subsequent turnover behavior. Such designs would make it possible to examine whether the predictive importance of specific variables changes as employees move closer to actual departure. Future studies should also externally validate the model in independent French samples and in other European labor markets to determine its transportability across organizational and national contexts. Comparative analyses between sectors could identify

whether predictors such as compensation, work–life balance, career advancement, or organizational support differ in importance across healthcare, finance, technology, manufacturing, education, and public administration. Researchers could also integrate organizational-level, labor-market, and economic indicators into multilevel machine-learning models and compare XGBoost with alternative approaches such as random forests, LightGBM, CatBoost, neural networks, and penalized regression. Further investigation of SHAP interaction values could clarify whether combinations such as high stress and low support or limited career progression and short tenure produce particularly elevated turnover risk. Finally, future research should evaluate the stability and fairness of predictive models across employee subgroups and examine whether models maintain comparable accuracy without producing systematic disadvantages for particular groups.

From a practical perspective, organizations should use turnover-prediction systems primarily as decision-support tools for improving working conditions rather than as mechanisms for labeling or penalizing individual employees. The strongest model predictors indicate that retention efforts should prioritize job satisfaction, organizational commitment, stress reduction, career advancement, organizational support, work–life balance, compensation satisfaction, leadership quality, recognition, and HR fairness. HR departments can use aggregate explainability results to identify organizational units in which several risk-enhancing conditions coexist and then design targeted interventions such as career-path planning, management development, workload redesign, flexible work options, transparent promotion criteria, recognition systems, compensation reviews, and structured employee-support programs. At the individual level, explainable predictions should be interpreted cautiously and combined with confidential dialogue rather than automated employment decisions. Organizations should also periodically audit model accuracy, calibration, fairness, and feature importance because turnover drivers may change over time. The greatest practical value of explainable machine learning lies not in predicting who will leave with certainty, but in identifying modifiable workplace conditions that can be improved before employee dissatisfaction develops into actual organizational exit.

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

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

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

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