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RESEARCH ARTICLE

The impact of error management atmosphere, organizational support, and self-efficacy on employee innovation: The roles of work passion and risk-taking trait

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ABSTRACT

This paper takes error management atmosphere perception, perceived organizational support, and creative self-efficacy as independent variables, employees' working passion as the mediating variable, risk-taking trait as the moderating variable, and employee innovation behavior as the dependent variable. It explores the relationships among error management atmosphere perception, perceived organizational support, creative self-efficacy, employees' working passion, risk-taking trait, and employee innovation behavior. This study, integrating social cognition theory and creativity component theory, systematically explored the connections among various variables. The research indicates that enterprises should have a good atmosphere for error management, and at the same time, they should provide employees with sufficient organizational support. Only in this way can they continuously stimulate the innovative vitality of employees. It provides important insights for enterprise management practices, namely, creating a positive atmosphere of error management is a key way to stimulate employees' innovative potential and enhance the organizational innovation ability.

Keywords: employee innovation behavior; error management atmosphere; social cognition theory; creativity component theory

1. Introduction

In the current era of accelerated global technological revolution and industrial restructuring, the breakthrough development of technologies such as mobile internet, big data, and artificial intelligence is profoundly reshaping the international competition landscape. Innovation, as the core engine driving high-quality economic development, is not only the strategic foundation for building a modern economic system, but also the key path for organizations to achieve sustainable prosperity[1]. From a national strategic perspective, innovation is an inevitable choice for aggregating social wisdom, promoting economic transformation, and enhancing global competitiveness. For enterprises, innovation is the fundamental guarantee for breaking through industry barriers, leading technological changes, and maintaining market

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leadership positions.

Enterprise practice has shown that the release of innovation efficiency is highly dependent on the support of organizational culture[2]. The "tolerance for failure" model of 3M Company provides a classic example. During the research and development of isolation tape, in the face of multiple technical failures, the company ensured the salary and promotion channels of the R&D personnel, transforming mistakes into learning opportunities, and ultimately giving birth to revolutionary adhesive products. This cultural practice confirms the core logic of the error management atmosphere theory - when the organization regards failure as an inevitable part of the innovation process, employees will form a stronger psychological security, thereby focusing cognitive resources on problem-solving rather than risk avoidance, significantly improving innovation efficiency[3].

Huawei's practices have further verified this mechanism. Its continuous investment in innovation has pushed the brand value to the international high-end level. This success stems from the "trial-and-error - iteration" system established by the enterprise: By setting up special research and development funds and establishing cross-departmental collaboration platforms, Huawei not only tolerates the short-term costs brought about by changes in technical routes, but also systematically consolidates the failure experiences into technical assets, forming a closed-loop innovation model of "research and development - feedback - optimization"[4].

In the face of the global reshaping of the industrial chain and the intensification of technological competition, enterprises need to establish a dynamic cycle mechanism of "innovation - tolerance - learning". This requires organizations to establish an innovation guarantee system at the institutional level, and create an open and inclusive atmosphere at the cultural level, making innovation a value orientation running through all levels of the organization. This dual empowerment of culture and system is precisely the key code for benchmark enterprises to continuously lead industry transformation[5].

Therefore, this study combines the social cognition theory with the creativity component theory to reveal how the perception of error management atmosphere, the perception of organizational support, and the sense of innovation self-efficacy affect employees' work enthusiasm and ultimately promote the formation of innovative behaviors. This paper also explores how the adventurous trait acts as a moderating variable to influence the perception of error management atmosphere and the perception of organizational support. At the same time, it also reveals the dynamic relationship among the three key independent variables - the perception of error management atmosphere, the perception of organizational support, and the sense of innovation self-efficacy - and employees' work enthusiasm. In conclusion, this study combines the social cognition theory with the elements of creativity to construct a comprehensive and in-depth analytical framework, which is helpful for better understanding the influencing factors and mechanisms of employees' innovative behaviors in an error management environment. This theoretical background not only provides abundant theoretical support, but also offers beneficial insights and guidance for enterprise innovation management in practice.

The subsequent research in this paper will be carried out in order: Section 2 will comprehensively review the existing literature and propose a hypothesis model based on this to explore the potential relationship between the variables; Section 3 will introduce the research methods in detail, including data collection sources, measurement methods of variables, etc., to ensure the scientific and accurate research; In Section 4, detailed results of data analysis will be presented to verify the validity of the hypothetical model. Finally, Section 5 will summarize the research findings and, based on the insights of the data analysis, propose targeted strategies to guide practice and advance the development of related fields.

2. Literature review and hypotheses development

2.1. The employees' working passion

Error management atmosphere perception is regarded as an important indicator to predict the satisfaction degree of employees' basic psychological needs[6]. Autonomy needs, that is, individuals desire to have choice and psychological freedom when engaging in activities. In a highly error-tolerant atmosphere, employees face less pressure and are encouraged to experiment and innovate, thus boosting their motivation levels. Such an environment gives employees more freedom to choose how they work, fulfilling their inherent need for autonomy[7]. Conversely, in a blame-oriented error atmosphere, employees are expected to make zero mistakes, forcing them to adopt conservative strategies and compromising their need for autonomy[8].

Furthermore, in the process of work, individuals always hope that the external environment can meet their basic psychological needs, and gradually form a preference for the work content that is in line with their personal interests and meaningful, thus generating dual work passion. The research shows that the higher the degree of satisfaction of basic psychological needs, the stronger the work willingness of employees, and the more significant the predictive effect on work passion. In the error management atmosphere, employees regard "error" as an opportunity to learn and grow, and such recognition of the value of work behavior strengthens their sense of value of the work content they are interested in and promotes the improvement of work passion[9].

In view of the above analysis, this study proposes the following hypothesis:

H1: The error management atmosphere perception positively influences employees' working passion.

Organizational support is a form of social exchange. If an organization can provide employees with sufficient instrumental support, emotional support and other supports, employees will have a more positive attitude and devote more energy to the organization[10]. One of the positive effects of organizational support is to return the organization with extra-role behavior, and employee innovation behavior is one kind of extra-role behavior. Organizational support perception can enhance the belief that employees' efforts can be rewarded, and thus promote employees to exhibit more employee innovation behaviors[11]. When employees feel the importance, care and recognition from the organization, their hearts will inspire a strong sense of belonging and responsibility, and this emotional resonance will be transformed into practical actions in the work, which is infinite enthusiasm and unremitting pursuit of work.

In view of the above analysis, this study proposes the following hypothesis:

H2: The perceived organizational support positively influences employees' working passion.

Creative self-efficacy refers to the self-belief or expectation of an individual in creative activities, which reflects the ability of an individual to complete creative tasks in a specific field or environment. When employees have a high sense of creative self-efficacy, they tend to have confidence in their creativity and innovation ability, believing that they can generate new ideas, solve complex problems, and create valuable products or services[12]. This confidence comes not only from their past successful experiences, but also from their deep awareness and positive evaluation of their own abilities. This strong sense of self-efficacy will further stimulate employees' passion for work[13].

In view of the above analysis, this study proposes the following hypothesis:

H3: Employee's creative self-efficacy positively influences employees' working passion.

First of all, passion for work provides employees with a strong internal motivation to innovate. When employees are passionate about their work, they are not only more focused and engaged, but also actively seek out new challenges and opportunities. This positive psychological state enables employees to maintain a high degree of interest and curiosity when facing innovative tasks, and thus be more willing to invest time and energy to explore new ideas and methods[14]. This kind of inner motivation is the key to the continuous and in-depth innovation behavior of employees.

Passion not only inspires innovative thinking in employees, but also enables them to think outside the traditional framework and from multiple perspectives when faced with problems. This creative way of thinking helps employees to discover the nature of problems and come up with novel solutions. At the same time, passion for work also enhances the perseverance and resilience of employees, enabling them to persevere in the process of innovation even when they encounter difficulties until they find a satisfactory answer[15].

Moreover, passion for work promotes cooperation and communication among employees. In a passionate working atmosphere, employees are more willing to share their ideas and creativity, and have in-depth discussions and cooperation with colleagues. This positive interaction not only helps employees to be inspired and inspired by others, but also fosters a more open and inclusive innovation culture within the team.

In view of the above analysis, this study proposes the following hypothesis:

H4: Employees' working passion positively influences employee innovation behavior.

2.2. The mediating role of employees' working passion

The positive perception of an error management atmosphere means that employees don't have to worry about being harshly punished or criticized for making mistakes, but instead are encouraged to learn from their mistakes and see them as opportunities for growth and innovation. This atmosphere encourages employees to remain open and positive in the face of challenges and uncertainties, to try new things and explore unknown areas. This change in mentality is the breeding ground for passion in work[16].

Employees' working passion, as the inner driving force, can stimulate the innovation potential of employees. When employees are passionate about their work, they are more willing to put in the time and energy to think deeply, solve problems, and even proactively seek opportunities for improvement. In the process of innovation, passion for work not only provides continuous motivation, but also promotes flexibility and creativity in thinking, enabling employees to persevere in the face of difficulties until they find a satisfactory solution. Therefore, the perception of error management atmosphere indirectly promotes the innovation behavior of employees by stimulating their work passion[17].

In view of the above analysis, this study proposes the following hypothesis:

H5: Employees' working passion plays a mediating role between the error management atmosphere perception and employee innovation behavior.

Work passion plays a crucial intermediary role between organizational support and employee innovation behavior. Specifically, when employees feel fully supported by the organization, this positive emotional experience translates into a strong passion for work. Passion for work not only inspires employees' love and devotion to work, but also encourages them to face challenges and actively seek opportunities and possibilities for innovation. Driven by this passion, employees are more willing to think outside the traditional framework, think from multiple perspectives, and come up with novel solutions, thereby driving innovation behavior.

The perceived organizational support provides employees with a safe, healthy and positive working environment, enabling them to work with peace of mind and enjoy the fun of work[18]. When employees see that their efforts and contributions are recognized and appreciated by the organization, their self-esteem and self-confidence are greatly boosted, and this accumulation of positive emotions further translates into lasting enthusiasm for their work. This enthusiasm is not only reflected in the serious commitment to daily work, but also in the active participation and promotion of innovative activities.

In view of the above analysis, this study proposes the following hypothesis:

H6: Employees' working passion plays a mediating role between perceived organizational support and employee innovation behavior.

First, creative self-efficacy is an employee's belief that they can succeed in a creative task. When employees believe they have the skills and knowledge needed to innovate and have a positive attitude about their ability to solve problems, their sense of creative self-efficacy increases. This sense of self-efficacy stems not only from past successful experiences, but also from a deep awareness and positive evaluation of current abilities. A high sense of creative self-efficacy makes employees more confident when facing innovative challenges and more willing to try new methods and ideas[19].

However, high creative self-efficacy alone is not enough to guarantee that employees will exhibit innovation behavior. At this time, the role of passion for work is particularly important[20]. Employees' working passion, as a mediating variable, transforms creative self-efficacy into actual innovation behavior. When employees have a high sense of creative self-efficacy and are enthusiastic about their work, they are more likely to exhibit innovation behavior at work. These behaviors may include coming up with new ideas, optimizing workflows, and developing new products or services[21]. Passion for work makes employees more courageous and determined in the face of innovative challenges, they are willing to take risks to try new methods, even in the face of failure, can persevere until they find a satisfactory solution.

In view of the above analysis, this study proposes the following hypothesis:

H7: Employees' working passion plays a mediating role between creative self-efficacy and employee innovation behavior.

2.3. Error management atmosphere perception and employee innovation behavior

When employees are in an error management environment that encourages learning from mistakes, promotes open communication, and values improvement and innovation, they will be more confident in facing challenges at work[22]. This kind of atmosphere not only teaches employees that mistakes are inevitable, but more importantly, it teaches employees how to learn from mistakes and how to turn those lessons into a driving force for personal growth and organizational development[23].

In such an environment, employees no longer fear failure and frustration in the innovation process, but see every attempt as a valuable learning opportunity. They have the courage to put forward new ideas and new plans, dare to challenge traditional concepts and methods, and constantly seek breakthroughs and progress.

In view of the above analysis, this study proposes the following hypothesis:

H8: The error management atmosphere perception positively influences employee innovation behavior.

2.4. Perceived organizational support and employee innovation behavior

The perceived organizational support has a profound and positive influence on the innovation behavior of employees, which promotes the innovation motivation and innovation results of employees at multiple levels.

Organizational support gratitude sends employees intrinsic motivation. When employees feel valued and recognized by the organization, they will cherish their job opportunities more and devote more effort to their work[24]. This intrinsic motivation encourages employees to constantly pursue progress, constantly challenge themselves, and strive to improve their innovation ability and level. They are willing to contribute to the future development of the organization and are willing to devote more time and energy to innovation.

In view of the above analysis, this study proposes the following hypothesis:

H9: The perceived organizational support positively influences employee innovation behavior.

2.5. The moderating effect of risk-taking trait

In an organizational environment with a strong atmosphere of error management, risk-taking traits are fully nourished and developed. The error management atmosphere itself emphasizes a positive attitude towards mistakes and encourages employees to identify, analyze and solve problems at work, rather than blindly avoiding or covering up mistakes[25]. This atmosphere creates a safe and inclusive learning environment for employees, enabling them to experiment and innovate without fear of punishment or blame[26].

For employees with risk-taking traits, the error management atmosphere not only provides the ground for trial and error, but also promotes communication and collaboration. In such an environment, employees can freely share ideas, discuss problems, and find solutions together. This open and inclusive atmosphere inspires innovative thinking among employees and facilitates the constant emergence of new ideas and approaches[27].

The error management atmosphere, adjusted by risk-taking characteristics, has a positive and far-reaching impact on employees' innovation behavior. It not only stimulates the innovation motivation of employees, promotes the communication and cooperation within the organization, but also improves the innovation ability and flexibility of employees. Therefore, when building an organizational culture conducive to innovation, it should be fully considered the risk-taking characteristics of employees, and strive to create an error management atmosphere that encourages trial and error and learning from mistakes, so as to stimulate the innovative potential of employees and promote the sustainable development and progress of the organization.

In view of the above analysis, this study proposes the following hypothesis:

H10: Risk-taking trait has a positive moderating effect between error management atmosphere perception and employee innovation behavior.

In the organizational environment, when the risk-taking trait is combined with the perceived organizational support, they together constitute a powerful motivation to positively regulate and promote the innovation behavior of employees.

Risk-taking traits enable employees to show higher courage and determination in the face of the unknown and uncertainty. Instead of being afraid of failure, they see it as an opportunity to learn and grow, a mindset that makes them more open to new ideas and challenges, which stimulates innovation behavior. When employees feel supported by the organization, their risk-taking traits are further reinforced[28]. The

perceived organizational support, including the recognition of leaders, the assistance of colleagues and the provision of resources, makes employees feel their value and status in the organization. Such positive feedback enhances their self-confidence and sense of belonging, and makes them more willing to take risks and try new methods and technologies.

The interaction between risk-taking traits and the perceived organizational support is reflected in employees' continuous pursuit of innovation. When employees achieve success and recognition in the organization, their risk-taking traits are further stimulated, making them more willing to continue to make innovative attempts. The perceived organizational support helps employees constantly adjust and improve their innovation plans by providing continuous feedback and support, so as to improve the success rate and quality of innovation.

In view of the above analysis, this study proposes the following hypothesis:

H11: Risk-taking trait has a positive moderating effect between perceived organizational support and employee innovation behavior.

Based the above hypothesis, the specific hypothetical model is as follows in **Figure 1**:

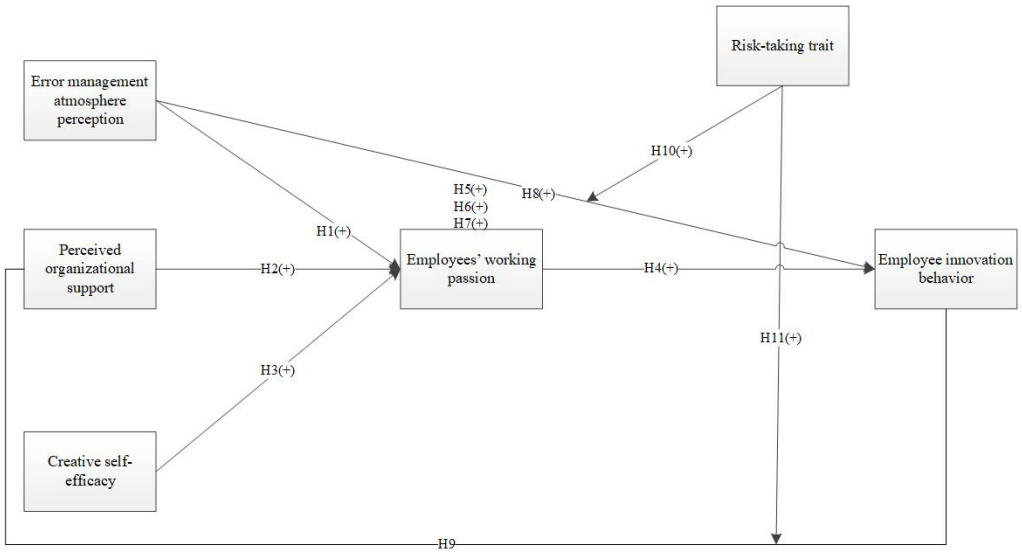

Figure 1. Hypothetical model.

3. Research methods

3.1. Data collection

Yunnan Province of China, as a radiating center facing South Asia and Southeast Asia, has adopted an industrial layout of "one core, one region, two clusters and multiple nodes" (with Kunming as the core bearing area, the Yunnan Central New Area as the industrial expansion area, the silicon material cluster in Qujing-Baoshan, and the intelligent terminal cluster in Yuxi-Honghe as the support, as well as the border economic cooperation zones in Dehong-Zhaoqing and other places as nodes). This has resulted in a distinctive electronic information manufacturing map. Therefore, this study has established a multi-dimensional sample screening system covering the entire territory of Yunnan Province, strictly following policy frameworks such as the "Yunnan Province '14th Five-Year' Science and Technology Innovation Plan", the "Yunnan Province '14th Five-Year' Information Industry Development Plan", and the "Yunnan Province High-Quality Manufacturing Development Three-Year Action Plan (2023-2025)". The research scope has expanded from Kunming City to the entire Yunnan Province.

Yunnan's industrial policies and development models align closely with national strategies for regional coordination and open innovation, such as the Belt and Road Initiative. Its experience in balancing core-city development with peripheral region integration offers insights applicable to other provinces or regions pursuing similar goals. Yunnan's silicon material and intelligent terminal clusters, along with its border economic cooperation zones, represent cutting-edge sectors with high growth potential. Studying these clusters enables us to identify patterns of technological innovation and supply-chain optimization that are relevant to global value chains. In summary, Yunnan Province offers a unique yet representative case for examining the interplay between policy, industry, and geography in driving high-quality manufacturing development. Its experiences and lessons are not only locally significant but also hold broader implications for regions seeking to leverage their strategic positions in global trade networks. We will further elaborate on these points in the revised manuscript to strengthen the rationale and highlight the study's contributions to both theoretical and practical knowledge.

The survey was conducted from June to July 2025, and it was planned to distribute and collect questionnaires through various channels. Firstly, the questionnaires were distributed within the working groups of the target enterprises (for example, via email or WeChat groups), through enterprise associations or relevant enterprise employees. Secondly, using the existing resources, the questionnaires were distributed to respondents who met the research eligibility criteria, taking into account their enterprise characteristics and professional roles. This article ensures the representativeness of the sampling method through multi-dimensional strategies: Firstly, stratified random sampling is adopted, based on the key variables of the research target (such as regional economic level, enterprise size, industry type), the overall population is divided into several layers to ensure that each sub-group has a reasonable proportion in the sample; Secondly, systematic sampling is combined, samples are randomly selected at fixed intervals within each layer to avoid periodic biases; At the same time, the sample size allocation is adjusted through a pre-survey to increase the sampling density in layers with greater variability, in order to improve the estimation accuracy; Finally, statistical tests (such as chi-square test) are used to compare the distribution characteristics of the sample and the overall population, to verify their consistency, and through sensitivity analysis to evaluate the stability of the results under different sampling schemes, thereby comprehensively ensuring the representativeness of the sample to the overall population. Additionally, the Questionnaire Star platform was utilized to promote anonymous online participation, thereby increasing the response rate and the diversity of data. A total of 750 questionnaires were distributed, and 705 responses were received. Among these 705 returned questionnaires, 673 were valid.

3.2. Measurement

This research scale contains 6 subscales: error management atmosphere perception, perceived organizational support, creative self-efficacy, employees' working passion, risk-taking trait, and employee innovation behavior. All scales in this study were rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). This study selected the error management atmosphere scale developed by Van Dyck, et al.[29]. In this study, the scales used by Eisenberger, et al.[30] were used to measure perceived organizational support. This study selected the creative self-efficacy scale developed by Tierney and Farmer[31]. This study selected the risk-taking trait scale developed by Gomez-Mejia and Balkin[32]. When exploring the specific measurement indicators of work passion, this study made in-depth reference to the scale developed by Kong and Ho[33], and made careful design and adjustment on this basis. This study choose the scale developed by Lin and Chen[34] as the basic tool to measure employee innovation behavior.

4. Result Analysis

4.1. Demographic variable

From the **Table 1**, it can be seen that in terms of gender, there are 342 males, accounting for 50.8%, and 331 females, accounting for 49.2%. The gender ratio is nearly balanced. In terms of age, it covers multiple age groups, among which the 31 - 40 age group has the largest number, accounting for 56.0%, and constitutes the main part. The 21 - 30 age group accounts for 24.4%, the 41 - 50 age group for 10.8%, the 51 - 60 age group for 8.8%, and the 60 and above age group for 2.6%, showing a distribution feature dominated by the middle-aged and young. In terms of education level, those with a bachelor's degree or below account for 54.8%, ranking first; those with a bachelor's degree account for 31.6%, ranking second; those with a master's degree or above account for 11.0%, indicating that the educational level of the group is concentrated at the bachelor's degree and below levels. In terms of occupation, the "other" occupation accounts for as high as 82.9%, while those in research and development, planning, and design occupations account for only 6.7%, 5.7%, and 4.7% respectively. The occupational distribution is relatively wide and scattered. Finally, in terms of monthly income, the 4001 - 7000 yuan range accounts for the largest proportion, at 47.7%; the 7001 - 10000 yuan range accounts for 31.6%; the 10001 - 13000 yuan range accounts for 10.4%; the 13001 - 16000 yuan range accounts for 6.2%; and the proportion of those with income higher than 16001 yuan is 4.1%, indicating that the income of the group is mainly at the medium level.

Table 1. Demographic variable.

Options	Category	Frequency	Percentage(%)
Gender	Male	342	50.8%
	Female	331	49.2%
Age	21-30	164	24.4%
	31-40	377	56.0%
	41-50	73	10.8%
	51-60	59	8.8%
	Over 60 years old	17	2.6%
Level Of Education	Under a Bachelor Degree	369	54.8%
	Bachelor's degree	213	31.6%
	Master's degree or above	74	11.0%
Position	R & D personnel	45	6.7%
	Planner	38	5.7%
	Designer	32	4.7%
	Others	558	82.9%
Annual income	4001-7000yuan	321	47.7%
	7001-10000yuan	213	31.6%
	10001-13000yuan	70	10.4%
	13001-16000yuan	42	6.2%
	More than 16001 yuan	27	4.1%

4.2. Reliability analysis

As can be seen from **Table 2**, the reliability coefficient of EM is 0.959, greater than 0.9, indicating that the reliability of this dimension is high, and CITC values of analysis items are all greater than 0.4, indicating that there is a good correlation between analysis items. The reliability coefficient of PO content is 0.969, which is greater than 0.9, indicating that the data reliability of this dimension is high, and the CITC value of analysis items is greater than 0.4, indicating that there is a good correlation between analysis items. The

reliability coefficient of CE is 0.970, which is greater than 0.9, indicating that the data reliability of this dimension is high, and the CITC value of analysis items is greater than 0.4, indicating that there is a good correlation between analysis items. The reliability coefficient of EW is 0.966, which is greater than 0.9, indicating that the data reliability of this dimension is high, and the CITC value of analysis items is greater than 0.4, indicating that there is a good correlation between analysis items. The reliability coefficient of RT is 0.967, which is greater than 0.9, indicating that the data reliability of this dimension is high, and the CITC value of analysis items is greater than 0.4, indicating that there is a good correlation between analysis items. The reliability coefficient of EI is 0.969, which is greater than 0.9, indicating that the data reliability of this dimension is high, and the CITC value of analysis items is greater than 0.4, indicating that there is a good correlation between analysis items.

The overall Cronbach α of the questionnaire is relatively high, but there are a few redundant items. During the data collection process, various random errors are inevitable, such as the subjects' negligence and environmental disturbances during questionnaire filling. Redundant items can play a buffering role and reduce the impact of these random errors on the measurement results. Redundant items can reduce the influence of random errors by repeatedly measuring the same concept or trait.

Table 2. Cronbach reliability analysis.

Name	CITC□	Cronbach' s α if item deleted coefficient	Cronbach α of variables	The Cronbach α of the overall scale
EM1	0.868	0.951		
EM2	0.864	0.952		
EM3	0.856	0.952	0.959	
EM4	0.868	0.951		
EM5	0.872	0.951		
EM6	0.890	0.949		
PO1	0.895	0.964		
PO2	0.905	0.963		
PO3	0.901	0.963		
PO4	0.877	0.965	0.969	0.945
PO5	0.856	0.967		
PO6	0.896	0.964		
PO7	0.891	0.964		
CE1	0.868	0.967		
CE2	0.891	0.966		
CE3	0.881	0.966		
CE4	0.888	0.966	0.970	
CE5	0.897	0.965		
CE6	0.868	0.967		
CE7	0.879	0.966		

Name	CITC□	Cronbach' s α if item deleted coefficient	Cronbach α of variables	The Cronbach α of the overall scale
CE8	0.879	0.966		
EW1	0.883	0.961	0.966	
EW2	0.926	0.954		
EW3	0.901	0.958		
EW4	0.900	0.959		
EW5	0.906	0.958		
RT1	0.914	0.958		
RT2	0.922	0.956	0.967	
RT3	0.927	0.955		
RT4	0.912	0.959		
EI1	0.921	0.961		
EI2	0.891	0.964		
EI3	0.912	0.962	0.969	
EI4	0.901	0.963		
EI5	0.889	0.964		
EI6	0.883	0.965		

Table 2. (*Continued*)

4.3. Validity test

The results of the factor analysis for the questionnaire data are shown in the **Table 3** below. The KMO value of the scale is 0.952, and the significance P value of Bartlett's sphericity test is less than 0.001, indicating that the questionnaire has a high degree of validity and is suitable for subsequent analysis.

Table 3. KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.952
Bartlett's Test of Sphericity	Approx. Chi-Square	30445.276
	df	630
	Sig.	0

After conducting KMO and Bartlett's spherical tests, principal component analysis can be performed on the questionnaire items. Then, the exploratory factor analysis of the 36 items in the questionnaire is carried out using the principal component analysis method. The common factors are extracted using the principal component analysis method, and the initial correlation matrix is obtained.

The principal component test was conducted on the 36 items. After setting the standard of extracting eigenvalues greater than 1, 6 components can be extracted. As seen in **Table 4**, the cumulative variance explained by these 6 components reaches 85.631%. This standard is already greater than the basic standard of 60%, indicating that the 6 factors extracted from the 36 items retain more than 60% of the original

information of the original questions. The dimensions after extraction retain the information characteristics of the questions to a great extent. Therefore, it can be proved that the extraction effect of components is good.

Table 4. Total variance explanation table.

	Initial eigenvalue			The extracted sum of squared loads			Rotational load square sum		
Component	**Total**	**Variance percentage**	**Cumulative%**	**Total**	**Variance percentage**	**Cumulative %**	**Total**	**Variance percentage**	**Cumulative %**
1	12.909	35.858	35.858	12.909	35.858	35.858	6.906	19.182	19.182
2	5.53	15.361	51.219	5.53	15.361	51.219	6.094	16.928	36.11
3	4.644	12.9	64.119	4.644	12.9	64.119	5.16	14.333	50.442
4	3.51	9.751	73.87	3.51	9.751	73.87	5.104	14.177	64.619
5	2.366	6.571	80.441	2.366	6.571	80.441	3.908	10.857	75.476
6	1.869	5.191	85.631	1.869	5.191	85.631	3.656	10.155	85.631
7	0.342	0.95	86.582						
8	0.293	0.814	87.396						
9	0.261	0.726	88.122						

4.4. Confirmatory factor analysis

As can be seen from **Table 5** and **Figure 2**, the results of the confirmatory factor analysis model for the overall scale are shown in the table below. The CMIN/DF value is 2.008 < 5, and all the GFI, etc. indicators are greater than 0.8. The RMSEA is 0.042< 0.10, indicating that the overall scale has good convergent validity and composite reliability.

Table 5. Model fitting coefficient table.

Reference index	X2/df	GFI	AGFI	NFI	CFI	RMSEA
Reference value	<5	>0.8	>0.8	>0.9	>0.9	<0.10
Statistic	2.008	0.914	0.901	0.963	0.981	0.042

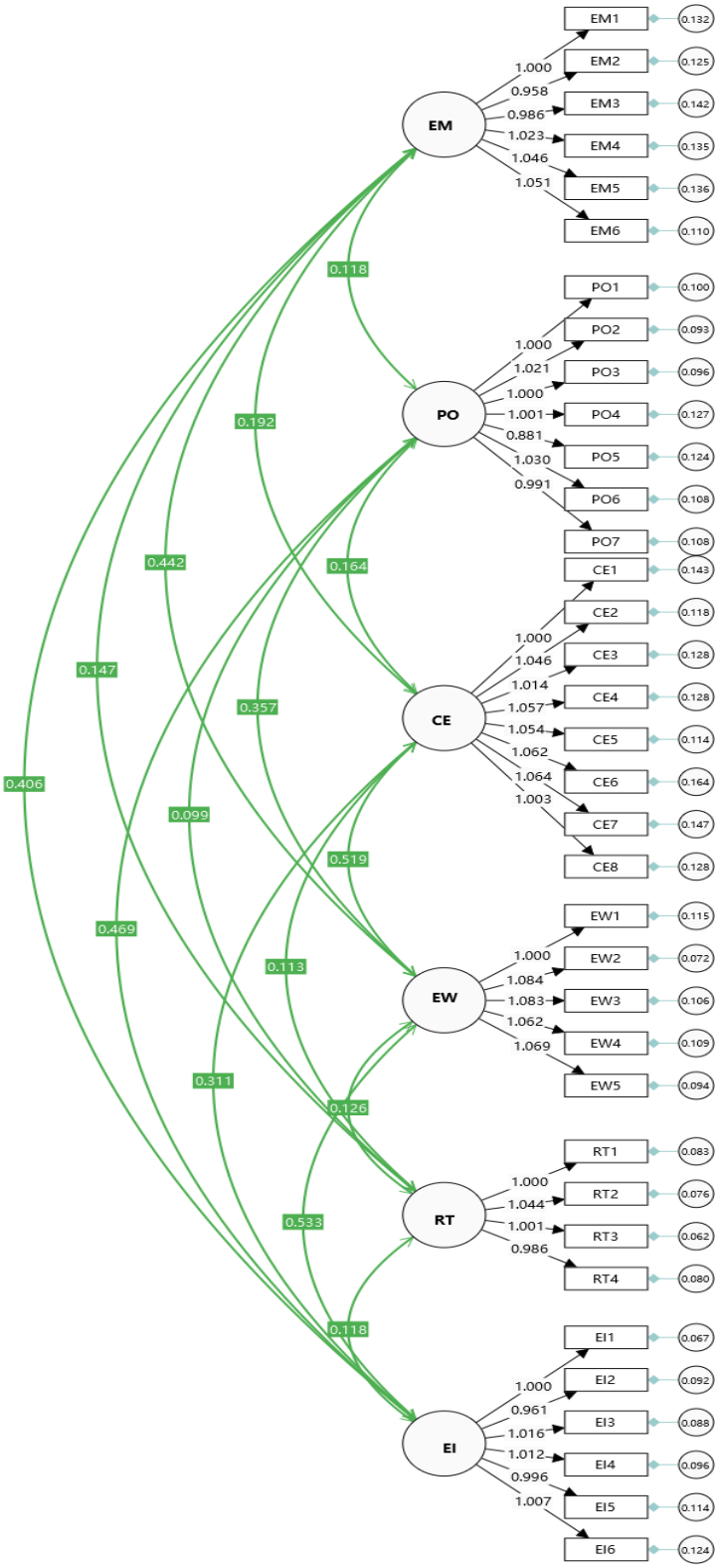

Figure 2. Model results.

The results of convergent validity and composite reliability for each variable of the overall scale are shown in the **Table 6** below. The average variance extraction values (AVE) and composite reliability (CR) of each variable are as follows: CE (AVE = 804, CR = 0.970), EI (AVE = 0.840, CR = 0.969), EM (AVE = 0.759, CR = 0.959), EW (AVE = 0.852, CR = 0.966), PO (AVE = 0.819, CR = 0.970), RT (AVE = 0.882,

CR = 0.968). As seen in **Table 7**, the AVE values of each dimension and the standardized factor loading coefficients of the items are all > 0.5, and the composite reliability (CR) values are all > 0.7, indicating that the overall scale has good convergent validity and composite reliability.

Table 6. The convergent validity and composite reliability of each variable.

Variable	Items	Unstandardized load factor	Standardized load factor	Standard error	T	P	AVE□	CR
CE	CE1	1.000	0.884				0.804	0.970
	CE2	1.046	0.908	0.029	36.142	0.000		
	CE3	1.014	0.896	0.029	35.091	0.000		
	CE4	1.057	0.904	0.030	35.789	0.000		
	CE5	1.054	0.912	0.029	36.598	0.000		
	CE6	1.062	0.881	0.032	33.642	0.000		
	CE7	1.064	0.892	0.031	34.563	0.000		
	CE8	1.003	0.895	0.029	35.101	0.000		
EI	EI1	1.000	0.940				0.840	0.969
	EI2	0.961	0.914	0.022	44.649	0.000		
	EI3	1.016	0.926	0.022	45.830	0.000		
	EI4	1.012	0.919	0.023	44.906	0.000		
	EI5	0.996	0.903	0.024	42.087	0.000		
	EI6	1.007	0.898	0.024	41.361	0.000		
EM	EM1	1.000	0.888				0.795	0.959
	EM2	0.958	0.886	0.028	34.035	0.000		
	EM3	0.986	0.879	0.029	33.542	0.000		
	EM4	1.023	0.891	0.029	34.704	0.000		
	EM5	1.046	0.894	0.030	35.155	0.000		
	EM6	1.051	0.913	0.029	36.634	0.000		
EW	EW1	1.000	0.903				0.852	0.966
	EW2	1.084	0.945	0.025	42.885	0.000		
	EW3	1.083	0.921	0.027	39.830	0.000		
	EW4	1.062	0.917	0.027	39.361	0.000		
	EW5	1.069	0.928	0.026	40.526	0.000		
PO	PO1	1.000	0.913				0.819	0.970
	PO2	1.021	0.922	0.025	41.465	0.000		
	PO3	1.000	0.916	0.025	40.618	0.000		
	PO4	1.001	0.894	0.027	37.740	0.000		
	PO5	0.881	0.871	0.025	35.398	0.000		
	PO6	1.030	0.912	0.026	40.172	0.000		
	PO7	0.991	0.906	0.025	39.352	0.000		
RT	RT1	1.000	0.932				0.882	0.968
	RT2	1.044	0.942	0.022	48.080	0.000		
	RT3	1.001	0.949	0.021	48.759	0.000		
	RT4	0.986	0.933	0.022	45.832	0.000		

Table 7. Pearson correlation and AVE square root values.

	CE	EI	EM	EW	PO	RT
CE	0.896					
EI	0.311	0.917				
EM	0.192	0.406	0.892			
EW	0.519	0.533	0.442	0.923		
PO	0.164	0.469	0.118	0.357	0.905	
RT	0.113	0.118	0.147	0.126	0.099	0.939

4.5. Structural equation model

The evaluation of the structural model should not only test the validity of the structural model, but also verify whether the relationships defined in the theoretical construction stage hold true. The PLS-SEM structural equation model is different from the CB-SEM model, as it does not have sufficient overall fit indices. Generally, the criterion for judging the rationality of the structural equation model based on the PLS modeling method is: whether the parameter estimation is effective, and the strength of the predictive ability of the measurement equation and the structural equation. Therefore, when evaluating the model, it is necessary to first evaluate the predictive effect of the measurement equation. If the predictive effect of the measurement equation is poor, then the evaluation of the structural equation will lose its significance. In Smart-PLS 4.0, the indicators for validating the validity of the structural model mainly include the R2 index, SRMR, and NFI in **Table 8**. Among them, R2 is the square value of the multiple correlation coefficient of the observed variables, indicating the degree to which the internal latent variables explain the external latent variables. The larger the R2, the greater the strength with which the internal latent variables are explained by the external latent variables, and the better the validity of the structural model. Generally, when R2 is greater than 0.02, it indicates a small explanatory power; when R2 is greater than 0.13, it indicates moderate explanatory power; and when R2 is greater than 0.26, it indicates a large explanatory power. SRMR is the standardized root mean square error of the residuals, used to evaluate the average size of the differences in the correlation matrix, and is generally less than 0.1, which is acceptable due to the large differences in the distribution of sample sizes. NFI is the normative fit index, with values closer to 1 being better, and generally, a value greater than 0.9 is used as the judgment standard. From the table below, it can be seen that the R2 of EI and EW is greater than 0.26, indicating a large explanatory power. At the same time, SRMR is less than 0.1, and NFI is greater than 0.9.

Overall, the structural model has good predictive validity, and the initial PLS model performed well. Therefore, this study further conducted 5000 bootstrap samplings and used the two-tailed T-test on the initial model for verification. The relevant path coefficients, standard deviations, T-values, and P-values among the latent variables were obtained. Generally, if the T-value is greater than 1.96 or the P-value is less than 0.05, it indicates that the model has passed the significance test. The path relationship test results of the structural model are shown in the following **Figure 3**.

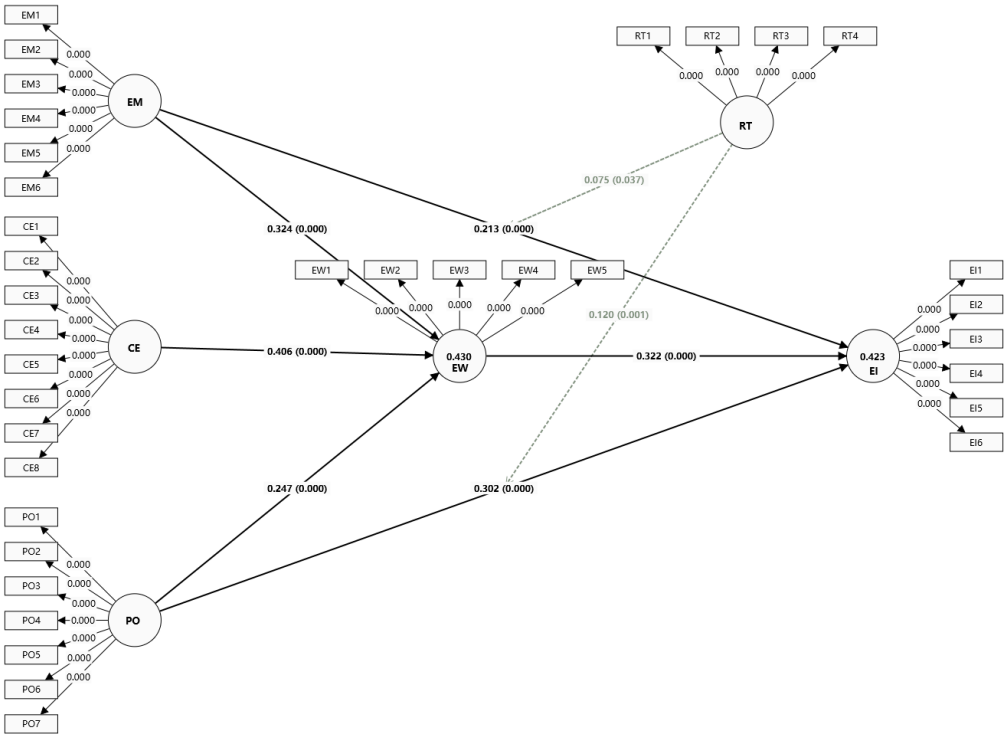

Figure 3. Structural equation model diagram.

Table 8. Model fitting index.

	R-square	R-square adjusted	SRMR	NFI
EI	0.423	0.417	0.024	0.950
EW	0.430	0.427		

From **Table 9**, it can be seen that CE has a significant positive effect on EW (β = 0.406, P < 0.001), EM has a significant positive effect on EW (β = 0.324, P < 0.001), PO has a significant positive effect on EW (β = 0.247, P < 0.001), EM has a significant positive effect on EI (β = 0.213, P < 0.001), PO has a significant positive effect on EI (β = 0.302, P < 0.001), and EW has a significant positive effect on EI (β = 0.322, P < 0.001). Therefore, hypotheses H1, H2, H3, H4, H8, and H9 are all valid.

The interaction term between EW and RT has a significant effect on EI (β = 0.075, P > 0.05), indicating that RT has a positive moderating effect on the relationship between EW and EI; the interaction term between PO and RT has a significant effect on EI (β = 0.075, P > 0.05), indicating that RT has a positive moderating effect on the relationship between PO and EI. Therefore, hypotheses H10 and H11 are valid.

Table 9. Direct path.

Direct path	Path coefficient	Standard deviation	T	P
CE -> EW	0.406	0.032	12.757	0.000
EM -> EI	0.213	0.037	5.795	0.000
EM -> EW	0.324	0.034	9.634	0.000
EW -> EI	0.322	0.040	7.997	0.000
PO -> EI	0.302	0.037	8.187	0.000
PO -> EW	0.247	0.031	7.880	0.000
RT x EM -> EI	0.075	0.036	2.082	0.037
RT x PO -> EI	0.120	0.035	3.405	0.001

As shown in **Table 10**, PO can indirectly affect EI through the medium of EW ($\beta = 0.079$, $P < 0.05$); CE can indirectly affect EI through the medium of EW ($\beta = 0.131$, $P < 0.05$); EM can indirectly affect EI through the medium of EW ($\beta = 0.104$, $P < 0.05$). Therefore, hypotheses H5, H6, and H7 are assumed to be valid.

Table 10. Indirect effect.

Indirect path	Path coefficient	Standard deviation	T	P
PO -> EW -> EI	0.079	0.015	5.306	0.000
CE -> EW -> EI	0.131	0.020	6.657	0.000
EM -> EW -> EI	0.104	0.017	5.992	0.000

5. Conclusion

5.1. Main conclusion

This study, based on the social cognition theory and the theory of creativity composition, constructed a model system to explore the formation mechanism of employee innovation behavior, and revealed that the error management atmosphere perception, the perceived organizational support, and the creative self-efficacy promoted innovative behaviors through both direct effects and the mediating effect of employees' working passion[35]. Moreover, the tendency to take risks played a positive regulatory role between the error management atmosphere, organizational support, and innovative behaviors. The research conclusions provide theoretical basis and practical guidance for organizations to stimulate employees' innovative potential by creating a culture of tolerance for errors, strengthening supportive practices, enhancing the sense of innovation self-efficacy, and adopting differentiated management strategies[36].

5.2. Implications

5.2.1. An inclusive error management culture should be established within the enterprise

An inclusive error management culture should be established within the enterprise. The enterprise should clearly define the core values that allow for trial and error and encourage reflection and review. Through various measures, this concept should be transformed into concrete practices. The enterprise should establish an innovation failure case database and organize cross-departmental case-sharing meetings on a regular basis. This not only showcases the trial-and-error process behind successful innovations but also publicly analyzes the key turning points of failed projects, emphasizing that the organization recognizes that failure is an inevitable part of the innovation process[37].

5.2.2. To stimulate employees' enthusiasm for work

It is necessary to stimulate employees' enthusiasm for work. The enterprise can achieve this by closely integrating external support with employees' intrinsic innovation motivation, deeply integrating personal goals with organizational goals, granting innovation autonomy, and strengthening emotional connections with leaders. In terms of goal consistency, a two-way communication mechanism should be established. In granting innovation autonomy, an "innovation project system" should be implemented, allowing employees to independently form teams, plan projects, and allocate budget resources. Also, an "innovation tolerance period" and "innovation progress board" should be set up to display the milestones of key projects in real time, ensuring autonomy while avoiding resource waste. At the emotional motivation level of leaders, managers should regularly conduct "one-on-one innovation progress dialogues", not only focusing on results but also the process of efforts.

5.2.3. Differentiated risk-taking trait management should be implemented

For employees with high risk-taking traits, more exploratory and innovative tasks can be designed, such as preliminary research on cutting-edge technologies or cross-departmental cooperation projects. They should be given autonomy in resource allocation and a rapid error review mechanism should be established. When projects deviate from expectations, they should be maintained through flexible adjustments rather than termination, to maintain the momentum of innovation. At the same time, phased milestone rewards should be set up to enhance the positive feedback of risk-taking. For employees with lower risk-taking traits, an innovation mentorship system should be implemented. Experienced mentors can assist in decomposing innovation goals into quantifiable sub-tasks. Before expanding, small-scale tests can be conducted to verify the feasibility of the solutions. A step-by-step improvement template and risk assessment checklist should be formulated to provide standardized tools at key nodes, reducing decision-making uncertainty.

5.3. Limitation and future research

This study has revealed the regulatory mechanism of the adventurous trait in the relationships between error management, organizational support and employee innovative behavior. However, future research needs to expand to samples from multiple industries (such as manufacturing, service industry, state-owned enterprises), adopt longitudinal/experimental designs to capture dynamic evolution, construct a complex interaction model including individual traits (fear of failure, growth mindset) and organizational factors (team atmosphere, competition intensity), and determine the innovation path through fuzzy set analysis. At the same time, cross-cultural comparative studies should be conducted to explore the influence of culture on the interpretation of organizational support, and introduce objective indicators or multi-source assessment to reduce methodological biases, in order to enhance the industry universality, mechanism explanatory power and cultural applicability of the research, and provide theoretical support for enterprises to precisely manage innovation.

Conflict of interest

The authors declare no conflict of interest.

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