TPM Vol. 32, No. S9, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

IMPACT OF TRANSFORMATIONAL LEADERSHIP ON THE INNOVATION PERFORMANCE OF RESEARCH AND DEVELOPMENT TEAMS: CHINESE AUTOMOTIVE INDUSTRY

ZHU AIJUN[1], CHAIYAWIT MUANGMEE[1], NUSANEE MEEKAEWKUNCHORN[1], TATCHAPONG SATTABUT[1]

[1]FACULTY OF MANAGEMENT SCIENCE, BANSOMDEJCHAOPRAYA RAJABHAT UNIVERSITY, BANGKOK, THAILAND, 10600

Abstract: This study considers the Chinese automotive industry as a case study. During the accelerated transformation of the automotive industry, the influence of the innovation performance of R&D teams is crucial. Data were collected from 407 respondents. Descriptive statistics, factor analysis, correlation analysis, and structural equation modeling (SEM) were used to analyze the data. The results show that transformational leadership mainly enhances the innovation performance of R&D teams by creating an organizational innovation atmosphere and promoting knowledge sharing rather than merely achieving this goal through direct influence. Moreover, a strong innovation atmosphere significantly improves innovation efficiency and effectiveness, whereas knowledge sharing is supportive but relatively weak in promoting innovation performance. Organizations should focus on transformational leadership behaviors, strive to create an innovative environment, and strengthen knowledge-sharing mechanisms to maximize innovation outcomes.

Keywords: Transformational Leadership, Organizational Creative Climate, Knowledge Sharing, Innovative Performance of Research and Development Teams.

INTRODUCTION

As an important part of the automotive industry chain, the auto parts industry has a large and continuously growing market (Barnes and Morris, 2008). With the continuous expansion of the global automotive market and advancements in automotive technology, the auto parts industry has ushered in unprecedented development opportunities (Chen et al., 2024). In particular, with the rapid development of new energy vehicles, intelligent driving, and other emerging fields, the demand for the auto parts industry has diversified, bringing new growth points (Barnes and Morris, 2008). According to the Spherical Insights (2024) report, the global automotive components market was valued at USD 1,964.51 billion in 2023 and is expected to reach USD 3,429.54 billion by 2033. In 2023, the use of electric cars showed a year-on-year increase, reaching 3.5 million, which was 3.5 million more than in 2022 (IEA, 2024). This increase translates to a 35% increase in sales. Five years ago, in 2018, the number of utilized electric vehicles was five times lower than that in 2023. In 2023, a new record of over 250,000 new registrations per week was set, surpassing the annual total for 2013. An average of 1.8 million electric vehicles were sold in 2023, which is a 4% growth from the previous year and 16% higher than in 2018 (IEA, 2024). The rapid growth of the new energy vehicle market has increased the demand for related components in recent years.

The rapid development of new energy vehicles has significantly impacted the parts markets. With the popularity of new energy vehicles, such as battery electric vehicles and plug-in hybrid vehicles, the demand for core components, such as batteries, motors, and electronic control systems, has increased significantly (Madaram et al., 2024). The higher technological content and added value of these components have driven the overall growth of the automotive parts market. The rapid development of intelligent driving technology has also created new growth points in the auto parts market (Leminen et al., 2022). Automatic driving systems require the support of key components, such as high-precision sensors, radars, cameras, and computing platforms. The development and production of these components require high technical strength and capital investment, but also bring higher market returns (Sadaf et al., 2023).

Technological innovation is an important driving force behind the continued growth of the auto parts market (Sadaf et al., 2023). With the continuous development of new energy vehicles and intelligent driving technology, higher requirements have been proposed for the performance, reliability, and safety of parts and components (Leminen et al., 2022). This can only meet market demand and maintain competitive advantage through continuous technological innovation (Farida and Setiawan, 2022). R&D strength is the core of the competitiveness of auto parts enterprises (Khilari et al., 2022). Enterprises with strong R&D capabilities can launch new products and technologies faster to meet market demand and increase market share (Farida and Setiawan, 2022). Simultaneously, R&D strength is an important guarantee for enterprises to cope with market

changes and resist risks. This indicates that technological innovation and R&D strength play a decisive role in the market competitiveness of auto parts enterprises (Khilari et al., 2022). Therefore, auto parts enterprises should increase R&D investment, strengthen technological innovation, and improve product quality and performance to cope with market changes and maintain their competitive advantages (Miller, 1994).

Transformational leadership is a leadership style that can stimulate employees' potential and promote organizational change and innovation (Afsar and Umrani, 2020). In research and development teams in the automotive parts industry, transformational leaders can stimulate the innovation consciousness and motivation of team members through their unique leadership styles and behaviors and enhance the team's innovation performance (George and George, 2024). This leadership style is important for promoting technological innovation in teams and coping with industry changes. The dual-mediating effect of management innovation and knowledge sharing states that a transformational leadership style can significantly contribute to the innovative performance of teams (Zhang et al., 2023). For example, one study found that transformational leadership promotes the realization of technological innovation and enhancement of corporate competitiveness by inspiring employees to innovate, encouraging knowledge sharing and teamwork, and improving employee performance and creativity (Kim and Lee, 2011). Transformational leaders stimulate the innovative potential of employees through their open and inclusive mindset, keen insights into employees' needs, and motivational abilities, which in turn enhances the innovative performance of teams (Choi et al., 2016).

Chinese enterprises need to play a leadership role in improving the innovative performance of R&D teams, especially the transformational leadership style, which has a greater impact on upgrading enterprises. Transformational leadership theory influences the innovative performance of R&D personnel and teams regarding virtue modeling, vision, motivation, Charisma leadership, and individualized consideration. The decline in the virtue of the transformational leadership style and individualized consideration, through the social exchange theory, will affect the organization's team motivation, as well as make the employees feel the supervisor's care, enhance the organization's innovation atmosphere positively, and ultimately affect the innovation performance of the R&D team. Visionary motivation and charismatic leadership in transformational leadership influence employees' knowledge-sharing behaviors through behavioral reasoning theory, ultimately affecting the innovation performance of research and development teams. The theoretical significance of this study helps enrich and expand the application of transformational leadership theory in the auto parts industry. This study provides new perspectives and ideas for research in related fields. The results can provide practical guidance and reference for automotive parts enterprises to optimize their leadership styles and enhance their teams' innovative performance, which will help them maintain their leading position in the fierce market competition..

LITERATURE REVIEW

Concepts and Theories of Transformational Leadership Behavior Theory

Based on Bass's concept of transformational leadership behavior, many scholars have further expanded and deepened this concept (Bass and Riggio, 2006). Issa et al. (2024) pointed out that leaders' transformational behavior facilitates knowledge flow and sharing within an organization. The process of knowledge transfer is due to the fact that leadership behavior greatly facilitates employees' knowledge transfer. The knowledge transfer process is due to the fact that the leader's transformational behavior greatly facilitates the exchange and communication of employees.

Concepts and Theories of Social Exchange Theory (SET)

The relationship between leadership and employee behavior can be explained by the social exchange theory (Cook et al., 2013). The relationship between employees, their leaders, and organizations is often described as an exchange. Social Exchange Theory describes the constant occurrence of reciprocal relationships between individuals (Cropanzano and Mitchell, 2005). In human social life, many factors affect our life processes, and social exchange is an important aspect of these factors. Through social exchange, we can build positive connections with others. From the perspective of psychologists, social exchange is one of the basic principles that human social life follows (Cook et al., 2013). Whether it is business behavior in economic life or people's communication activities in social life, all are affected by exchange; it can be said that social exchange determines our life to some extent. Social exchange theory, which was first proposed by American sociologist Homans in 1958, systematically expounds the principles and methods of social exchange (Homans, 1958).

Concepts and Theories of Behavioral Reasoning Theory (BRT)

BRT theory is developed based on different behavioral intention models (Ahmad and Harun, 2024). BRT theory has been supported by many scholars and has been widely used and studied in the fields of social sciences and organizational behavior. BRT theory emphasizes the important role of behavioral reasoning in results and regards it as an important link between individual beliefs, values, overall motivation (including attitude, subjective norms, and sense of control), behavioral intention, and actual behavior, and the theoretical description is relatively accurate (Sreen et al., 2021). In popular understanding, "intention" is defined as people's expectations of their own behavior in a given context, and "belief" refers to a person's judgment of

the subjective possibility of discernible aspects of their own world (Ahmad and Harun, 2024). Transformational Leadership Behavioral Theory explains that transformational leadership, through charismatic leadership, influences the personal and organizational performance of R&D teams and influences the organizational climate through evocative power (Chunhui et al., 2023).

Hypothesis development from literature

As revealed by Afsar and Umrani (2020), transformational leadership positively affects employees' IWB and learning motivation, mediating the link between transformational leadership and innovative work behavior. They further suggest that task complexity and an innovative climate moderate the relationship between transformational leadership and employees' innovative work behaviors. The strong association between transformational leadership, motivation to learn, and innovative work behavior suggests that managers' transformational leadership traits are important in enhancing employees' innovative work behavior (Basit and Hasan, 2022). Organizations should take care to create a climate that supports innovation, encourages individuals to learn new knowledge and skills, and provides employees with opportunities to apply what they have learned.

H1：Transformational leadership has a direct effect on organizational, creative climate

Transformational leadership, personal-organizational fit, and knowledge-sharing behavior on teachers' IWB and explore the role of knowledge-sharing behavior and personal-organizational fit as mediating variables (Sudibjo and Prameswari, 2021). Moreover, Sudibjo and Prameswari (2021) stated that transformational leadership has no direct positive effect on innovative work behavior, while it positively affects innovative work behavior through knowledge-sharing behavior. Another study by Żywiołek et al. (2022) examined the effects of Transformational Leadership (TFL) and employee adaptability on employee creativity. They revealed that TFL stimulates employees' creativity and has a positive effect on employees' adaptability. The mediation results confirmed that employee adaptability mediated the relationship between technical knowledge and creativity in the hotel industry in developing countries. In addition, the findings show that knowledge sharing plays a key role in the link between technical leadership and employee resilience.

H2：Transformational leadership has a direct effect on knowledge sharing

Chung and Li (2021) examined the potential impact of transformational leadership on followers' innovative behavior and investigated the moderating effect of team learning on this relationship. The multilevel analysis confirmed a nonlinear relationship (inverted U-shape) between team leaders' transformational leadership and team members' IB. This implies that innovative behavior is negatively related to excessive transformational leadership and positively related to moderate levels of leadership. In addition, the statistical analysis confirmed the positive multilevel moderating effect of team learning.

H3：Transformational leadership has a direct effect on the innovation performance of research and development teams

Mutonyi et al. (2022) indicated that organizational climate is important for employees' creative performance. Organizational climate was positively and significantly associated with the two creative performance variables in this study. In addition, this study shows that individual creativity plays a mediating role in the relationship between organizational climate and individual creative behavior (Xerri and Brunetto, 2013).

H4: *Organizational creative climate has a direct effect on the innovation performance of research and development teams*

Moreover, Muhammed and Zaim (2020) focused on a type of intra-organizational knowledge sharing called peer knowledge sharing. This study examined how peer knowledge sharing affects firms' financial and innovative performance and the mechanisms by which this relationship is realized. Their results indicate that the extent of employees' knowledge-sharing behaviors with their colleagues and managers' leadership support positively influenced the organization's knowledge management success, which in turn positively influenced the organization's innovation and financial performance. The study found that perceived supervisor support from immediate managers is an important factor contributing to respondents' peer knowledge-sharing behaviors. The invariance test of the proposed model for male and female respondents suggests that the contribution of peer knowledge sharing to knowledge management success may differ between the two groups.

H5：Knowledge sharing has a direct effect on the innovation performance of research and development teams

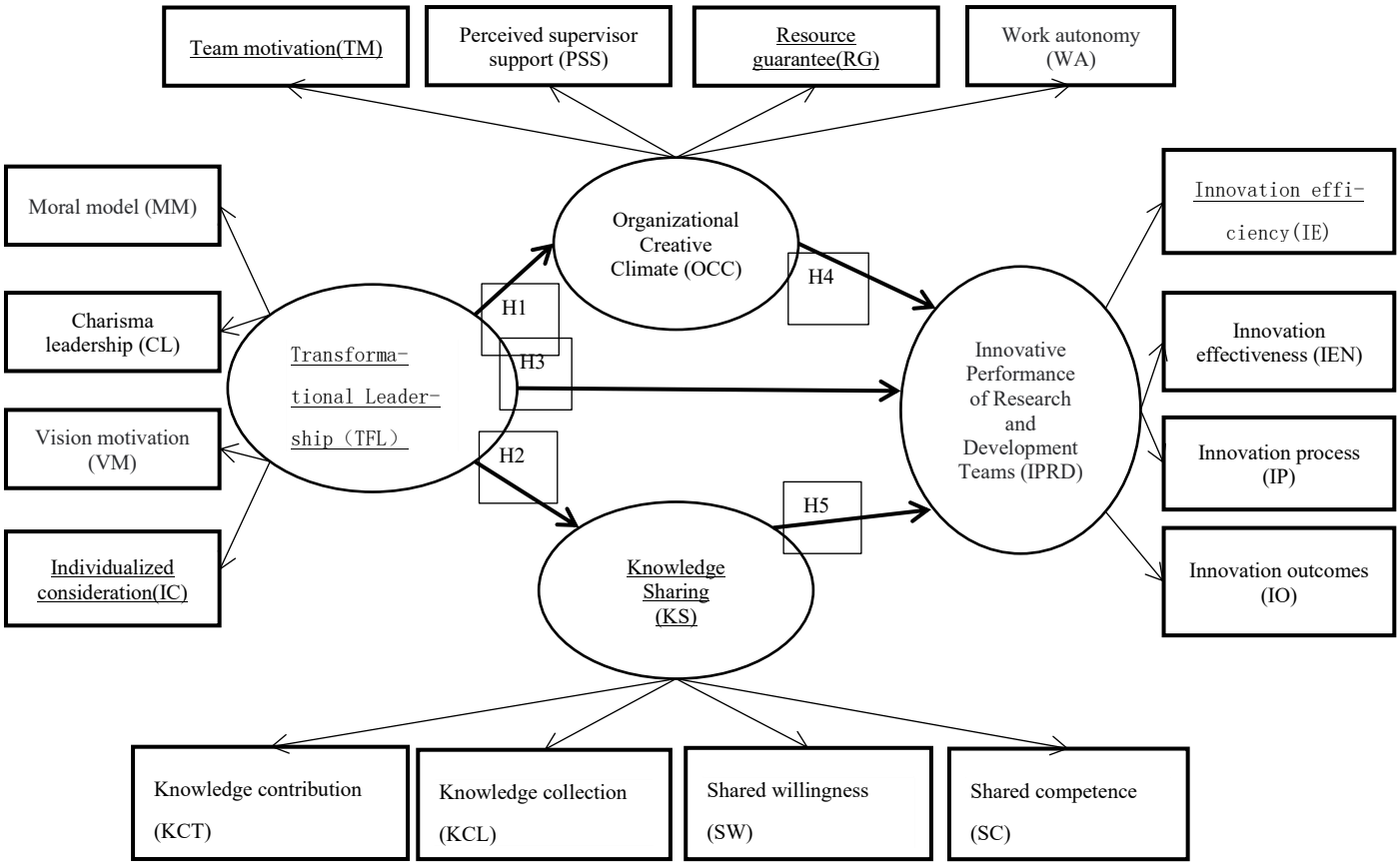

Figure 1. Research Framework

RESEARCH METHODS

The Population and the Sample

Jiangsu Province is a major hub of China's auto parts industry, with 8,418 enterprises concentrated in Suzhou, Wuxi, Changzhou, Nanjing, and Yangzhou. In 2023, the industry achieved 1.16 trillion yuan in sales, reflecting a 10.5% year-on-year growth and highlighting its strong innovation capacity (China Briefing, 2024). To comply with the IATF 16949 quality standards, enterprises must maintain strong R&D capabilities (Bozola et al., 2023). However, financial constraints may limit R&D investments. This study focuses on key enterprises listed in the 2024 Jiangsu Province Auto Parts Key Enterprises Directory to ensure the reliability of the data. The research targeted 8,418 R&D managers, including CEOs, CTOs, CFOs, and COOs. A total of 407 samples were selected from five key cities: Suzhou (182), Changzhou (79), Wuxi (77), Yangzhou (38), and Nanjing (30). These cities account for 80.3% of the province's auto parts industry output, which aligns with the Pareto 80/20 principle. This study adopts probability proportional to sampling, which is more effective than stratified or simple random sampling (Cheung, 2021). Based on Lindeman et al. (1980) criterion, a minimum of 400 samples (20 variables × 20) is required, and the final 407 samples met statistical validity.

Questionnaire Development

This study collected data through in-depth interviews and questionnaires to examine the factors influencing R&D innovation performance. In-depth interviews with experts followed a structured process, identifying key themes: Transformational Leadership (TFL) integrity, collective interests, employee development, and leadership support; Organizational Creative Climate (OCC) innovation incentives, leadership encouragement, and resource allocation; and Knowledge Sharing (KS)—peer learning, formal knowledge exchange, and AI's role in innovation. The questionnaire survey collected 407 valid samples via an online survey, and the data were analyzed using frequency analysis, descriptive analysis, CFA, correlation analysis, and SEM modeling. Key abbreviations include Transformational Leadership (TFL), Organizational Creative Climate (OCC), Knowledge Sharing (KS), and Innovation Performance of R&D Teams (IPRD). The findings comprehensively reveal the impact of leadership, organizational climate, and knowledge-sharing factors on R&D innovation. The validity of the 30 samples was analyzed. Transformational Leadership consisted of 17 questions, with a Cronbach's alpha of 0.978; organizational creative climate consisted of 17 questions, with a Cronbach's alpha of 0.971; knowledge sharing consisted of 23 questions, with a Cronbach's alpha of 0.889;

and innovative performance of research and development teams consisted of 17 questions, with a Cronbach's alpha of 0.80. Therefore, the validity of the scale is considered to be very good.

Data Analysis

In the questionnaire analysis, statistical software was used to analyze the data. The specific analysis methods included frequency, descriptive, confirmatory factor (CFA), and structural model analyses (SEM). Confirmatory Factor Analysis (CFA) is a statistical analysis method used to determine how well the measured data fit the underlying theoretical model, and it is often employed after Exploratory Factor Analysis (EFA). Confirmatory factor analysis tests the hypothesized relationship between observed variables and latent constructs, based on a theoretical framework. The CFA results are reported with several fit indices, such as χ^2 (Chi-Square), P-value, SRMR (Standardized Root Mean Square Residual), CFI (Comparative Fit Index), TLI (Tucker-Lewis Index), RMSEA (Root Mean Square Error of Approximation), all together to inform how well the model fits the data. The study employed AMOS 26 software to analyze the data. The measurement model for Transformational Leadership (TFL), Organizational Creative Climate (OCC), Knowledge Sharing (KS), and Innovation Performance of R&D Teams (IPRD) was assessed based on factor loadings, R^2 values, composite reliability (CR), and average variance extracted (AVE). A threshold of 0.70 for factor loadings was considered a strong construct representation (Muangmee et al., 2023). This study employed Structural Equation Modeling (SEM) to analyze the data, using multiple fit indices to assess the model's alignment with the observed data.

RESULTS

Respondents' Information

A descriptive analysis of the respondents' information indicates that female (60.44%) respondents dominate male (39.56%). Regarding age distribution, the largest group was aged between 31 and 40 years (42.26%), followed by those aged between 41 and 50 years (27.52%). The sample included 19.41% of respondents aged 20 to 30, while the lowest percentage (10.81%) was those aged 51 and older. Data on marital status showed that most of the respondents were married (57.74%), and the rest were single (37.59%). The level of educational attainment is high, with more than half (50.37%) holding a bachelor's degree. In addition, 29.73% had a college degree, 11.55% had a master's degree, 8.35% had a doctorate, and only 4.67% had a high school education. This demographic data indicates that most respondents were educated and middle-aged.

Table 1. Descriptive Analysis of demographics

Demographics	**Frequency**	**Percentage (%)**
Gender		
Male	161	39.56
Female	246	60.44
Age	79	19.41
20 to 30	79	19.41
31 to 40	172	42.26
41 -50	112	27.52
51and above	44	10.81
Marital Status		
Single	153	37.59
Married	235	57.74
Education		
High school,	19	4.67
College degree	121	29.73
Bachelor degree	205	50.37
Master's degree	47	11.55
Doctoral Degree	34	8.35

Descriptive Statistics of the Study Variables

Overall, the data revealed consistently high levels across all measured latent variables: Transformational Leadership (TFL), Occupational Commitment (OCC), Knowledge Sharing (KS), and Creativity and Efficiency (CE). Within TFL, moral model (MM), charismatic leadership (CL), vision motivation (VM), and individualized consideration (IC) all display mean scores of approximately 3.45 to 3.54, suggesting that leaders in this sample provide strong ethical guidance, inspire through charisma, communicate a clear vision, and offer personalized support (Table 2). For OCC, team motivation (TM), perceived supervisor support (PSS), resource guarantee (RG), and work autonomy (WA) all had mean values above 3.60, indicating a

workforce that is motivated, feels supported by their supervisors, has sufficient resources to do their job, and is relatively free to exercise autonomy in their tasks. In particular, SC showed the highest mean (3.875), suggesting that employees perceive high levels of competence in collaborative settings. Regarding Knowledge Sharing (KS), the findings show a balanced high degree of engagement across all its building blocks. The mean values for Knowledge Contribution (KCT) (Mean = 3.610, SD = 0.962), Knowledge Collection (KCL) (Mean = 3.570, SD = 0.957), Shared Willingness (SW) (Mean = 3.833, SD = 0.887), and Shared Competence (SC) (Mean = 3.875, SD = 0.717). These values indicate a cultural impression of knowledge sharing prevalent in the organization. Moreover, the results indicate that the distribution of the un-normalized frequency was moderately skewed to the left, but the relatively low results in the SK and KU tests indicate that most employees were positive towards knowledge-sharing practices. This indicates that the organization is establishing an atmosphere in which its employees trust their potential to share knowledge, collaborate with one another, and increase overall efficiency. Finally, the CE variables—innovation efficiency (IE), innovation engagement (IEN), innovation performance (IP), and innovation output (IO)—all exceeded a mean of 3.65, indicating a workforce that is both engaged in and capable of producing efficient, high-quality innovations. The standard deviations remained moderate across all measures, implying reasonable variability within the sample. The skewness and kurtosis values suggest that most distributions are slightly left-skewed but generally fall within the acceptable ranges for normality. These results confirm the strong representation of the variables in the research sample, providing a solid foundation for further structural model analysis. Survey Results of Study Transformational Leadership, Organizational, Creative Climate Sharing, and Innovative Performance of Research and Development Teams.

Table 2. Descriptive Analysis of Variables

Latent variable	**Measure variable**	**Max**	**Min**	**Mean**	**SD**	**SK**	**KU**	**Levels**
TFL	MM	1.200	5.000	3.518	0.937	-0.648	-0.322	high level
	CL	1.250	5.000	3.544	1.110	-0.688	-0.999	high level
	VM	1.000	5.000	3.459	1.147	-0.603	-1.212	high level
	IC	1.000	5.000	3.445	1.168	-0.665	-1.103	high level
	Total	1.113	4.825	3.491	0.878	-0.645	-0.247	
OCC	TM	1.500	5.000	3.620	1.040	-0.499	-0.877	high level
	PSS	1.000	5.000	3.723	0.936	-0.987	1.134	high level
	RG	1.000	5.000	3.669	1.045	-1.063	0.674	high level
	WA	1.000	5.000	3.771	1.034	-0.687	-0.086	high level
	Total	1.125	4.938	3.696	0.819	-0.863	0.581	
KS	KCT	1.000	5.000	3.610	0.962	-0.613	-0.250	high level
	KCL	1.250	5.000	3.570	0.957	-0.489	-0.621	high level
	SW	1.143	5.000	3.833	0.887	-0.763	0.141	high level
	SC	1.000	5.000	3.875	0.717	-0.901	1.887	high level
	Total	1.238	4.964	3.722	0.713	-0.719	0.882	
CE	IE	1.000	5.000	3.781	1.019	-0.884	0.418	high level
	IEN	1.400	5.000	3.657	1.032	-0.588	-0.785	high level
	IP	1.000	5.000	3.805	0.911	-1.156	1.378	high level
	IO	1.000	5.000	3.672	1.037	-1.124	0.759	high level
	Total	1.100	5.000	3.729	0.819	-1.095	1.089	

Confirmatory Factor Analysis (CFA)

As shown in Table 3, the statistical analyses examining the fit of the four constructs (TFL, OCC, KS, and IPRD) indicated a satisfactory fit. The χ^2/df ratios clustered around 1 for each model (1.176 for TFL, 1.22 for OCC, 1.109 for KS, and 1.224 for IPRD), suggesting an acceptable alignment between the theoretical framework and empirical observations (Nguyen, 2020). Additionally, all probability values surpassed 0.05, signifying that the proposed models did not meaningfully differ from the actual data, further validating a sound fit. The SRMR values, ranging from 0.028 to 0.031, were well below the accepted limit of 0.08, demonstrating a tight fit (Muangmee et al., 2023). The CFI and TLI indices for each construct exceeded 0.90, with the CFI reaching as high as 0.995 for transformational leadership, implying an excellent model fit. The

RMSEA estimates fell between 0.016 and 0.023, affirming that the models adequately accounted for the data, as scores below 0.05 are commonly viewed as acceptable (Nguyen, 2020).

Table 3. Confirmatory Factor Analysis of the Model

Statistics	**TFL**	**OCC**	**KS**	**IPRD**
χ^2	135.239	140.286	250.687	140.727
Df	115	115	226	115
χ^2/Df	1.176	1.22	1.109	1.224
P-Value	0.096	0.055	0.125	0.052
SRMR	0.028	0.029	0.03	0.031
CFI	0.995	0.994	0.995	0.994
TLI	0.994	0.993	0.995	0.993
RMSEA	0.021	0.023	0.016	0.023

Factor's Loading Results

All loadings exceeded the 0.70 threshold, indicating strong construct representation. The highest loading is 0.876 for Team Motivation (TM) in OCC, while the lowest is 0.697 for Shared Competence (SC) in KS. R^2 Values: All R^2 values were above 0.48, demonstrating that the observed variables explained a substantial portion of their respective latent constructs. Composite Reliability (CR): All CR values surpassed 0.85, ensuring strong internal consistency across the constructs. Average Variance Extracted (AVE): Each construct's AVE exceeded 0.50, confirming good convergent validity. The measurement model met all reliability and validity criteria, indicating that the constructs were robust and suitable for further structural model analysis.

Table 4. Factors' Loading

Latent variable	**Measure variable**	**Loading coefficient**	**R^2**	**CR**	**AVE**
TFL	MM	0.800	0.640	0.857	0.601
	VM	0.753	0.567		
	CL	0.774	0.599		
	IC	0.772	0.596		
OCC	TM	0.876	0.767	0.864	0.615
	PSS	0.723	0.523		
	RG	0.724	0.524		
	WA	0.803	0.645		
KS	KCT	0.819	0.671	0.857	0.601
	KCL	0.856	0.733		
	SW	0.717	0.514		
	SC	0.697	0.486		
IPRD	IE	0.747	0.558	0.874	0.635
	IEN	0.807	0.651		
	IP	0.717	0.514		
	IO	0.904	0.817		

Model fit analysis

The Chi-square ratio (CMIN/DF) was 1.134, which was well below the threshold of 2, indicating minimal discrepancies between the model and observed data. Additionally, the p-value was 0.171 (>0.05), suggesting no significant differences between the expected and observed covariance structures, reinforcing the model's validity (Muangmee et al., 2024). Regarding absolute fit indices, the GFI (0.967) surpassed the 0.9 benchmark, demonstrating the model's strong explanatory power over the variance in the dataset. In terms of incremental fit indices, IFI (0.995), TLI (0.994), and CFI (0.995) were all well above 0.9, approaching the

ideal value of 1, signifying substantial improvement over the baseline model and excellent model fit. For error indices, RMSEA (0.018) and SRMR (0.036) were both below 0.05, confirming minimal residual discrepancies and an acceptable error level.

Table 5. Model Fitness

Parameters	CMIN	DF	CMIN/DF	p	GFI	IFI	TLI	CFI	RMSEA	SRMR
Result	112.29	99	1.134	0.171	0.967	0.995	0.994	0.995	0.018	0.036
Standard			<2	>0.05	>0.9	>0.9	>0.9	>0.9	<0.05	<0.05

Results of Model and Hypotheses

The structural model results in the hypothesis testing table provide compelling evidence for the hypothesized relationships between Transformational Leadership, Organizational Creative Climate, Knowledge Sharing, and Innovation Performance of R&D Teams. All five hypotheses (H1–H5) were statistically tested and accepted (Table 6). The initial hypothesis (H1) examines the impact of transformational leadership on the creative climate of the organization. With a path coefficient of 0.534 and a significant t-value of 8.65 ($p < 0.001$), it is evident that transformational leadership plays a fundamental role in cultivating an inventive work environment. Leaders who inspire and motivate their teams while providing intellectual stimulation and supporting individual growth substantially enhance the creative climate of R&D teams. Hypothesis H2 investigates the association between transformational leadership and Knowledge Sharing. The path coefficient of 0.574 and a t-value of 8.35 ($p < 0.001$), the results indicate that transformational leaders facilitate knowledge-sharing practices. Leaders who encourage open communication and build trust among employees enable a culture of knowledge exchange and promote a collaborative atmosphere.

Table 6. Evaluation of the study hypotheses.

Hypothesis	**Path**	**Path Coefficient**	**S.E.**	**t**	**P**	**Accepted/ Rejected**
H1	OCC <--- TFL	0.534	0.06	8.65	***	Accepted
H2	KS <--- TFL	0.574	0.04	8.35	***	Accepted
H3	IPRD <--- TFL	0.203	0.06	2.73	**	Accepted
H4	IPRD <--- OCC	0.428	0.05	6.64	***	Accepted
H5	IPRD <--- KS	0.241	0.1	3.74	***	Accepted

Note: ***=p<0.001 and **=p-value<0.01.

The third hypothesis (H3) tests the direct influence of Transformational Leadership on the Innovation Performance of R&D Teams. Although the relationship is significant (t-value = 2.73, $p = 0.01$), the path coefficient of 0.203 denotes a comparatively weaker direct effect than its impact on Organizational Creative Climate and Knowledge Sharing (Figure 2). This suggests that transformational leadership may indirectly contribute more potently to innovation by influencing organizational climate and knowledge-sharing customs. Hypothesis H4 explores the consequence of Organizational Creative Climate on Innovation Performance of R&D Teams. With a path coefficient of 0.428 and a t-value of 6.64 ($p < 0.001$), the results accentuate the importance of an inventive work environment in boosting innovation in the organization. Organizations that encourage idea generation, risk-taking, and collaboration experience higher levels of innovation performance. A robust creative climate provides employees with psychological safety and motivation to experiment and develop novel solutions. The last hypothesis (H5) examines the relationship between Knowledge Sharing and Innovation Performance of R&D teams. The significant path coefficient of 0.241 and t-value of 3.74 ($p < 0.001$) confirm that knowledge-sharing practices enhance the innovative capacity of R&D teams. When employees actively share insights, expertise, and best practices, they contribute to a collective intelligence that fosters problem solving, efficiency, and the development of innovative solutions.

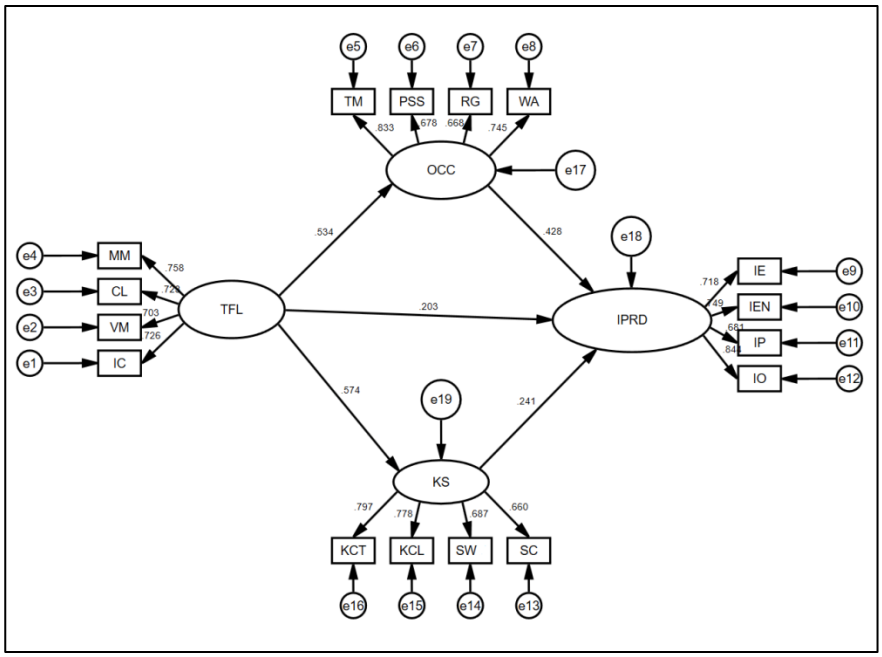

Figure 2. Research model evaluation

This study confirms that Transformational Leadership is a key driver of creative climate and knowledge sharing, significantly contributing to Innovation Performance. While TFL directly impacts innovation, its strongest influence appears to be indirect, through the cultivation of a creative and knowledge-sharing culture. Organizations aiming to enhance R&D innovation should focus on leadership development, foster a collaborative and creative work environment, and implement knowledge-sharing initiatives to maximize innovative outcomes.

DISCUSSION

Innovation has long been a competitive advantage, particularly for automakers developing cutting-edge technologies. Firms must cultivate workplaces conducive to creativity, expertise sharing, and adaptability to maintain industry leadership amid rapid change. Leadership is significant in shaping such environments because it guides team dynamics, knowledge circulation, and problem-solving processes. Transformational leaders seem to be key to fostering organizational climates that welcome novel ideas, collaboration, and improved innovation performance in research and development teams. This study explores these linkages in the Chinese automotive manufacturing sector. It provides insight into how supervision impacts invention within groups developing new designs and engineering, revealing the creative climate and knowledge transfer as potential drivers bringing leadership's effects to execution.

Transformational Leadership and Organization Creative Climate

The findings in the preceding section demonstrated that Transformational Leadership has a significant positive effect on establishing an Organizational Creative Climate. Leaders who lead through inspiration and intellectual stimulation and consider each employee's needs individually forge a work environment that encourages innovative thinking and collaboration. By inspiring employees with a shared vision for the future, transformational leaders help cultivate a culture in which creative ideas can emerge and blossom. These results echo prior research highlighting the importance of nurturing a strong creative climate to enhance organizational innovation (Shin et al., 2017). An atmosphere conducive to creativity allows workers to experiment freely, without fear of failure. Additionally, recent studies emphasize how digital technologies are increasingly crucial enablers of business model reinvention, underscoring that leadership-driven creativity is key to ensuring that companies can adapt nimbly to rapidly changing industries (Al Maazmi et al., 2024). This reinforces the idea that transformational leadership not only boosts immediate innovation outcomes but also cultivates an agile workforce capable of sustaining competitiveness for years to come (Karimi et al., 2023).

Transformational Leadership and Knowledge Sharing

Transformational Leadership significantly enhances Knowledge Sharing, reinforcing that leadership plays a pivotal role in fostering an open and collaborative work culture, as shown by the study's findings. When leaders inspire and enthusiastically support their teams, they establish an atmosphere in which personnel feel encouraged to exchange ideas, experiences, and know-how, resulting in improved organizational learning and innovation. These results align with previous examinations, such as Carmeli et al. (2013), who also identified a robust bond between leadership and knowledge-sharing behaviors. However, they underscored that structural mechanisms, such as incentive structures, trust-building initiatives, and technological

assistance, are crucial to fully leverage the advantages of knowledge exchange. Furthermore, our outcomes indicate that the direct impact of Transformational Leadership on Innovative Performance is relatively delicate, proposing that knowledge sharing alone is inadequate to propel innovation. This is consistent with Jiang and Chen (2016) argument that leadership cultivates innovation through direct impact and by shaping an empowering environment that bolsters inventiveness and experimentation. Similarly, Zhang et al. (2024) found that knowledge-sharing behavior positively affects innovation only when combined with a powerful organizational learning culture and digital collaboration tools. In the Chinese automotive industry, where technological advances and innovation are key competitive factors, these discoveries have significant implications for leadership progression and corporate strategy. The industry is experiencing swift changes driven by electric vehicle technologies, automation, and artificial intelligence-powered manufacturing. To maintain development and remain globally competitive, Chinese automakers must prioritize transformational leadership and emphasize knowledge-sharing tactics.

Organizational Creative Climate and Knowledge Sharing

The findings show that Transformational Leadership indirectly improves Innovative Performance by nurturing an Organizational Creative Climate and facilitating Knowledge Sharing. Although the direct impact of transformational leadership on innovation was modest, it implies that leadership alone is not adequate to spur innovation. Rather, cultivating a supportive environment where creativity and knowledge exchange are encouraged is pivotal for translating leadership into tangible and innovative outcomes. This is consistent with Jiang and Chen (2016) study, which emphasized that leadership fosters innovation by molding an atmosphere conducive to experimentation and collaboration. Additionally, Panyasupat et al. (2024) underscore the broader influence of transformational leadership on entrepreneurial intentions, suggesting that leaders play a key role in motivating employees to embrace innovative mindsets. The study also highlights the importance of investing in leadership development programs, particularly for organizations in innovation-driven sectors, such as the Chinese automotive industry, where leaders should focus on behaviors that promote trust, collaboration, and creativity. This agrees with Kassakorn et al. (2024), who argue that trust and perceived value are vital for organizational success, reinforcing the idea that transformational leadership must cultivate these elements to foster an environment conducive to innovation.

Implications for Leadership Development in R&D Teams

The findings of this study emphasize the importance of investing in leadership-training programs that develop transformational leadership qualities. Organizations in the Chinese automotive industry should prioritize leadership behaviors that foster innovation, trust, and collaboration to enhance their overall performance and competitiveness. Transformational leaders are critical for motivating employees, encouraging creativity, and establishing a positive organizational culture that supports long-term growth. Furthermore, Kassakorn et al. (2024) highlighted that trust, perceived value, and service quality significantly contribute to organizational success. This reinforces the idea that leaders must actively cultivate these elements in an innovation-driven work environment. Companies can strengthen their market position and drive sustainable success in an increasingly competitive business landscape by focusing on leadership strategies that enhance employee engagement and organizational trust.

Although this study provides valuable insights, further research is needed to explore additional mediators, such as team collaboration, psychological safety, and digital transformation tools. Muangmee et al. (2023) highlight the importance of digital marketing and technological advancements, suggesting that digital collaboration platforms and AI-driven knowledge management systems could further enhance leadership's impact on innovation. Future studies should examine these factors in different industries and cultural contexts.

CONCLUSION

Main Findings

This study highlights the significant role of Transformational Leadership in fostering innovation within R&D teams in the Chinese automotive industry, particularly through its influence on Organizational Creative Climate and Knowledge Sharing. The findings suggest that although Transformational Leadership does not directly impact Innovative Performance, it plays a critical role in shaping an environment that fosters creativity and knowledge exchange, which are essential drivers of innovation. Leaders who inspire vision, encourage collaboration, and create a culture of trust and openness enable their teams to think innovatively and develop new technological advancements. Organizations can significantly improve their R&D team performance and overall business competitiveness by nurturing a work environment that values experimentation and continuous learning. A strong creative climate encourages employees to engage in problem-solving, share insights, and collaborate on innovative project. Simultaneously, effective knowledge-sharing mechanisms ensure that expertise is transferred efficiently across teams.

Managerial Implications

Companies must invest in leadership development programs, enhance employee engagement strategies, and refine their organizational structures to maximize the potential of their R&D teams. Moreover, leveraging

digital tools, AI-driven decision-making, and data-driven innovation management can enhance leaders influence on knowledge flow and inspire creative thinking within their teams.

Limitations & Strengths of the Study

However, this study is limited to the automotive sector, which may restrict the generalizability of the findings to other industries and contexts. Future research should extend the analysis to sectors such as renewable energy, high-tech manufacturing, pharmaceuticals, and artificial intelligence, where leadership styles and innovation dynamics may differ. Incorporating qualitative research methods, such as in-depth interviews and case studies, could provide a more comprehensive understanding of how leadership fosters innovation. Despite these limitations, this study provides valuable insights for business leaders, policymakers, and researchers seeking to enhance leadership strategies in innovation-driven industries in China. In an era of rapid technological advancements and intense global competition, the ability to develop transformational leaders who can cultivate an innovative culture and drive knowledge-sharing mechanisms will be a key differentiator for organizations aiming to sustain long-term innovation and maintain a competitive edge in an ever-evolving market.

FUNDINGS

This study was not funded by any source.

ACKNOWLEDGEMENTS

We sincerely appreciate all respondents who participated in the study. The participants provided us with their precious time while providing valuable insights and answering survey questions, which helped us complete this research.

INFORMED CONSENT DECLARATION

To ensure the rights and dignity of individuals, all respondents provided informed consent to participate in the study. They were informed that the information they provided would not be used in any other way except for research purposes. The research was also conducted in compliance with the relevant ethical principles, and all respondents had the right to withdraw from the study whenever they wished without any form of consequence.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this study.

DATA AVAILABILITY

The study data are accessible to interested researchers who contact the corresponding author. This study has participant-related confidentiality terms that limit the sharing of some available data.

REFERENCES

1. Afsar, B., & Umrani, W. A. (2020). Transformational leadership and innovative work behavior. *European Journal of Innovation Management, 23*(3), 402-428. doi:10.1108/EJIM-12-2018-0257
2. Ahmad, N., & Harun, A. (2024). Reasons for tourist intention to use e-bike sharing services; an application behavioral reasoning theory (BRT). *Tourism Review, 79*(9), 1542-1559.
3. Al Maazmi, A., Piya, S., & Araci, Z. C. (2024). Exploring the Critical Success Factors Influencing the Outcome of Digital Transformation Initiatives in Government Organizations. *Systems, 12*(12). doi:10.3390/systems12120524
4. Barnes, J., & Morris, M. (2008). Staying alive in the global automotive industry: what can developing economies learn from South Africa about linking into global automotive value chains? *The European Journal of Development Research, 20*(1), 31-55. doi:10.1080/09578810701853157
5. Basit, A., & Hasan, M. (2022). The mediating role of work engagement in the relationship between transformational leadership and employee performance. *Leadership & Organization Development Journal, 43*(8), 1263–1281.
6. Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership*. London: Lawrence Erlbaum Associates, Inc.
7. Bozola, P. M., Nunhes, T. V., Barbosa, L. C. F. M., Machado, M. C., & Oliveira, O. J. (2023). Overcoming the challenges of moving from ISO/TS 16949 to IATF 16949: recommendations for implementing a quality management system in automotive companies. *Benchmarking: An International Journal, 30*(9), 3699-3724. doi:10.1108/BIJ-04-2022-0215
8. Carmeli, A., Gelbard, R., & Reiter-Palmon, R. (2013). Leadership, creative problem-solving capacity, and creative performance: The importance of knowledge sharing. *Human resource management, 52*(1), 95-121. doi:https://doi.org/10.1002/hrm.21514
9. Chen, Y., Dai, X., Fu, P., Luo, G., & Shi, P. (2024). A review of China's automotive industry policy: Recent developments and future trends. *Journal of Traffic and Transportation Engineering (English Edition), 11*(5), 867-895. doi:https://doi.org/10.1016/j.jtte.2024.09.001

10. Cheung, A. K. L. (2021). Probability proportional sampling. In *Encyclopedia of quality of life and well-being research* (pp. 1-3): Springer.
11. China Briefing. (2024). China Regional Focus: Suzhou, Jiangsu Province. Retrieved from https://www.china-briefing.com/news/china-regional-focus-suzhou-jiangsu-province/. Accessed: 2 February 2024
12. Choi, S. L., Goh, C. F., Adam, M. B. H., & Tan, O. K. (2016). Transformational leadership, empowerment, and job satisfaction: the mediating role of employee empowerment. *Human Resources for Health, 14*(1), 73. doi:10.1186/s12960-016-0171-2
13. Chung, D. S., & Li, J. M. (2021). Curvilinear effect of transformational leadership on innovative behavior among R&D teams in South Korea. *Journal of Organizational Change Management, 34*(1), 252-270. doi:10.1108/JOCM-01-2017-0017
14. Chunhui, L., Azar, A. S., & Ahmad, A. (2023). Withdrawn: The Effects of Charismatic Aspects of Transformational Leadership on Personal Outcomes: An Empirical Literature Review. *Education Quarterly Reviews, 6*(2), 212-220.
15. Cook, K. S., Cheshire, C., Rice, E. R., & Nakagawa, S. (2013). *Social exchange theory*: Springer.
16. Cropanzano, R., & Mitchell, M. S. (2005). Social exchange theory: An interdisciplinary review. *Journal of management, 31*(6), 874-900.
17. Farida, I., & Setiawan, D. (2022). Business Strategies and Competitive Advantage: The Role of Performance and Innovation. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(3), 163. doi:https://doi.org/10.3390/joitmc8030163
18. George, A. S., & George, A. H. (2024). Riding the wave: an exploration of emerging technologies reshaping modern industry. *Partners Universal International Innovation Journal, 2*(1), 15-38.
19. Homans, G. C. (1958). Social behavior as exchange. *American journal of sociology, 63*(6), 597-606.
20. IEA. (2024). Trends in electric cars. Retrieved from International Energy Agency, Paris, France: https://www.iea.org/reports/global-ev-outlook-2024/trends-in-electric-cars. Accessed: 20 December 2024.
21. Issa, A. G., Fagbemi, A. S., Ogunbanjo, B., Omorinbola, T. O., Fagbemi, C. A., & Popoola, B. O. (2024). Transformational leadership politics in the twenty-first century: Implications for organizations and organizational policies. *Integral Research, 1*(8), 168-213.
22. Jiang, Y., & Chen, C. C. (2016). Integrating Knowledge Activities for Team Innovation: Effects of Transformational Leadership. *Journal of Management, 44*(5), 1819-1847. doi:10.1177/0149206316628641
23. Karimi, S., Ahmadi Malek, F., Yaghoubi Farani, A., & Liobikienė, G. (2023). The Role of Transformational Leadership in Developing Innovative Work Behaviors: The Mediating Role of Employees' Psychological Capital. *Sustainability, 15*(2). doi:10.3390/su15021267
24. Kassakorn, N., Chaitorn, T., Sawangcharoen, K., Jaima, S., Muangmee, C., & Saqib, S. E. (2024). Exploring post-purchase intentions in Thailands tourism sector: a study on service quality, perceived value, trust, and satisfaction of customer. , . *International Journal of Services Economics and Management, 1*(1), 1-15. doi:10.1504/IJSEM.2024.10064685
25. Khilari, R., Wali, O. P., & Singh, R. K. (2022). Identification and prioritisation of technology management practices for enhancing competitiveness of auto components manufacturing firms in India. *International Journal of Manufacturing Technology and Management, 36*(1), 65-94.
26. Kim, J.-G., & Lee, S.-Y. (2011). Effects of transformational and transactional leadership on employees' creative behaviour: mediating effects of work motivation and job satisfaction. *Asian Journal of Technology Innovation, 19*(2), 233-247. doi:10.1080/19761597.2011.632590
27. Leminen, S., Rajahonka, M., Wendelin, R., Westerlund, M., & Nyström, A.-G. (2022). Autonomous vehicle solutions and their digital servitization business models. *Technological Forecasting and Social Change, 185*, 122070. doi:https://doi.org/10.1016/j.techfore.2022.122070
28. Lindeman, R. H., Merenda, P. F., & Gold, R. Z. (1980). *Introduction to bivariate and multivariate analysis* (Vol. 4): Scott, Foresman Glenview, IL.
29. Madaram, V. G., Biswas, P. K., Sain, C., Thanikanti, S. B., & Balachandran, P. K. (2024). Advancement of electric vehicle technologies, classification of charging methodologies, and optimization strategies for sustainable development - A comprehensive review. *Heliyon, 10*(20), e39299. doi:https://doi.org/10.1016/j.heliyon.2024.e39299
30. Miller, R. (1994). Global R & D networks and large-scale innovations: The case of the automobile industry. *Research policy, 23*(1), 27-46.
31. Muangmee, C., Pongvatnanusorn, V., Sawangcharoen, K., Chaitorn, T., Kassakorn, N., & Saqib, S. E. (2024). Factors Influencing the Success of Processed Agricultural Products: An Empirical Study from Thailand. *Sarhad Journal of Agriculture, 40*(3). doi:https://dx.doi.org/10.17582/journal.sja/2024/40.3.1033.1045
32. Muangmee, C., Sawangcharoen, K., Pongvatnanusorn, V., Chaitorn, T., Kassakorn, N., & Saqib, S. E. (2023). Exploring the Factors Influencing Tourist Destination Loyalty: A Case Study of Homestay Entrepreneurs in Thailand. *Changing Societies & Personalities, 7*(4), 190–205. doi: https://doi.org/10.15826/csp.2023.7.4.258

33. Muhammed, S., & Zaim, H. (2020). Peer knowledge sharing and organizational performance: The role of perceived supervisor support and knowledge management success. *Journal of Knowledge Management 24*(4), 31–751. doi:10.1108/JKM-03-2020-0227
34. Mutonyi, B. R., Slåtten, T., & Lien, G. (2022). Organizational climate and creative performance in the public sector. Creativity and Innovation Management, . *31, 1*, 25–40. doi:10.1108/EBR-02-2019-0021
35. Nguyen, D. (2020). Mediating the role of psychological empowerment between transformational leadership and employee engagement. *Management Science Letters, 10*(16), 4039-4044.
36. Panyasupat, R., Muangmee, C., & Soonsawad, N. (2024). An Entrepreneurship Intention Model of University Students Under Rajabhat University in The Era of Thailand 4.0. *Journal of Graduate Studies Network in Northern Rajabhat Universities, 14*(1), 52-70.
37. Sadaf, M., Iqbal, Z., Javed, A. R., Saba, I., Krichen, M., Majeed, S., & Raza, A. (2023). Connected and Automated Vehicles: Infrastructure, Applications, Security, Critical Challenges, and Future Aspects. *Technologies, 11*(5). doi:10.3390/technologies11050117
38. Shin, S. J., Yuan, F., & Zhou, J. (2017). When perceived innovation job requirement increases employee innovative behavior: A sensemaking perspective. *Journal of Organizational behavior, 38*(1), 68-86. doi:https://doi.org/10.1002/job.2111
39. Spherical Insights. (2024). Automotive & Transportation. Retrieved from Spherical Insights, Ohio, USA: https://www.sphericalinsights.com/reports/automotive-components-market. Accessed: 22 December 2024.
40. Sreen, N., Dhir, A., Talwar, S., Tan, T. M., & Alharbi, F. (2021). Behavioral reasoning perspectives to brand love toward natural products: Moderating role of environmental concern and household size. *Journal of Retailing and Consumer Services, 61*, 102549. doi:https://doi.org/10.1016/j.jretconser.2021.102549
41. Sudibjo, N., & Prameswari, R. K. (2021). The effects of knowledge sharing and person–organization fit on the relationship between transformational leadership on innovative work behavior. *Heliyon, 7*(6), 93–104. doi:10.1016/j.heliyon.2021.e07334
42. Xerri, M. J., & Brunetto, Y. (2013). Fostering innovative behavior: The importance of employee commitment and organizational citizenship behavior. *The International Journal of Human Resource Management, 24*(16), 3163–3177. doi:https://doi.org/10.1080/09585192.2013.775033
43. Zhang, G., Zhang, X., & Wang, Y. (2024). Perceived insider status and employees' innovative behavior: the role of knowledge sharing and organizational innovation climate. *European Journal of Innovation Management, 27*(2), 589-607. doi:10.1108/EJIM-03-2022-0123
44. Zhang, J., Riaz, M., Boamah, F. A., & Ali, S. (2023). Harnessing technological innovation capabilities by the mediating effect of willingness to share tacit knowledge: a case from Pakistani software SMEs. *Kybernetes, 52*(12), 6590-6616.
45. Żywiołek, J., Tucmeanu, E. R., Tucmeanu, A. I., Isac, N., & Yousaf, Z. (2022). Nexus of Transformational Leadership, Employee Adaptiveness, Knowledge Sharing, and Employee Creativity. *Sustainability, 14*(18). doi:10.3390/su141811607