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Investigating The Migration Of Quantum Leadership On Innovation Performance Of Knowledge Workers

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Abstract

With the advent of the era of knowledge economy, the innovation performance of knowledge employees is an important part of corporate competitiveness. As one of the important factors affecting the behavior and performance of knowledge workers, leadership plays a very important role in promoting the innovative performance of knowledge workers. This paper takes social information processing theory and resource preservation theory as the theoretical basis, takes quantum leadership as the independent variable, and knowledge workers innovation performance as the dependent variable, and constructs a model that includes quantum leadership, knowledge workers innovation performance, innovation environment, knowledge sharing, Theoretical model of five variables of innovation capability. This study selected mature scales of each relevant variable to design a questionnaire, and used software SPSS25.0 and SmartPLS4.9 for quantitative analysis and NV ivo14.0 for qualitative analysis. To test the structural model, SMART PLS software was used in this study. The results of this study show that: (1) Quantum leadership can positively predict the innovation performance of knowledge employees; (2) Innovation environment plays a significant mediating role between quantum leadership and knowledge employee innovation performance; (3) I[1]nnovation capability It plays a significant mediating role between quantum leadership and knowledge workers innovation performance; (4) Knowledge sharing plays a significant mediating role between quantum leadership and knowledge employee innovation performance. Therefore, studying the impact of quantum leadership on the innovation performance of knowledge workers has important theoretical and practical significance for guiding business leaders to achieve effective human resource management and improve corporate innovation performance.

Keywords: *quantum leadership; innovation performance of knowledge workers; innovation environment; innovation capability; knowledge sharing.*

1. Introduction

Today, the world faces numerous overlapping crises and the "severe and long-term challenges" they bring (Tung, 2023).The world is in the midst of unprecedented changes, a complex, uncertain, constantly changing and unpredictable quantum age. The sudden outbreak of the epidemic is considered a "black swan" event, which has impacted the operation of enterprises and challenged their management, especially some small and medium-sized enterprises and entrepreneurial enterprises. In terms of operation, the decline in consumer demand during the overall economic downturn has led to a sharp decrease in

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sales (Belitski et al., 2022), inconvenient transportation has hindered the operation of the supply chain; In terms of management, under the epidemic prevention and control measures, employees have a psychological insecurity of being worried about being fired or receiving salary cuts. Reasonable job allocation and appeasing employees have also become a "test of the times" for managers. In addition, team learning and risk management have also become issues that managers need to consider (He et al., 2020) . In addition to the epidemic, external factors such as technological development and Sino foreign relations have also accelerated the dynamic nature of the environment. Professor Chen proposed that the term "change" alone cannot fully summarize the characteristics of the environment. "VUCA" and "uncertainty" are considered manifestations of the existing environment (Chen, 2018) . In this context, how enterprises can transform their thinking to cope with difficulties and enhance their organizational core competitiveness is a hot topic that the business and academic communities jointly explore.

The management model adopted by most enterprises is based on the scientific management based on Newtonian thinking. As time has changed, this model has increasingly exposed its inherent defects, resulting in reduced management effectiveness and insufficient innovation motivation(Peng, 2017; Ma et al., 2020). American scholar Dana Zohar proposed quantum management based on quantum mechanics in 2016, and this management has achieved practical results in the Chinese company Haier (Zohar and Zhu, 2017;Li et al., 2018) .Zhang Ruimin, CEO of Haier, pointed out that as we enter the quantum era, we need to create a new type of management model and leadership. Combined with leadership theory, quantum leadership as a novel leadership style has gradually attracted the attention of scholars and is considered to have unique vitality in the VUCA era (Senses B, & Temocin P, 2016). Quantum leaders constantly examine the uncertain environment faced by the organization, conduct value guidance, create a harmonious symbiosis, and stimulate employees' potential internal platforms to promote employees to achieve themselves. The expectation of continuous development. At the same time, the uncertain environment highlights the importance of innovation. Enterprises pay more and more attention to innovation and raise it to the level of corporate strategy, and propose various innovation incentive policies. Based on leadership theory, the innovation of employees in the organization will be directly affected by the leader (Li et al., 2020), and then focusing on the impact of a certain leadership style or leadership behavior on the innovation performance of knowledge workers has become a perspective for researchers to study. Leader’s What strategies to adopt and how to exert influence to promote employee innovation have also become a research hotspot.

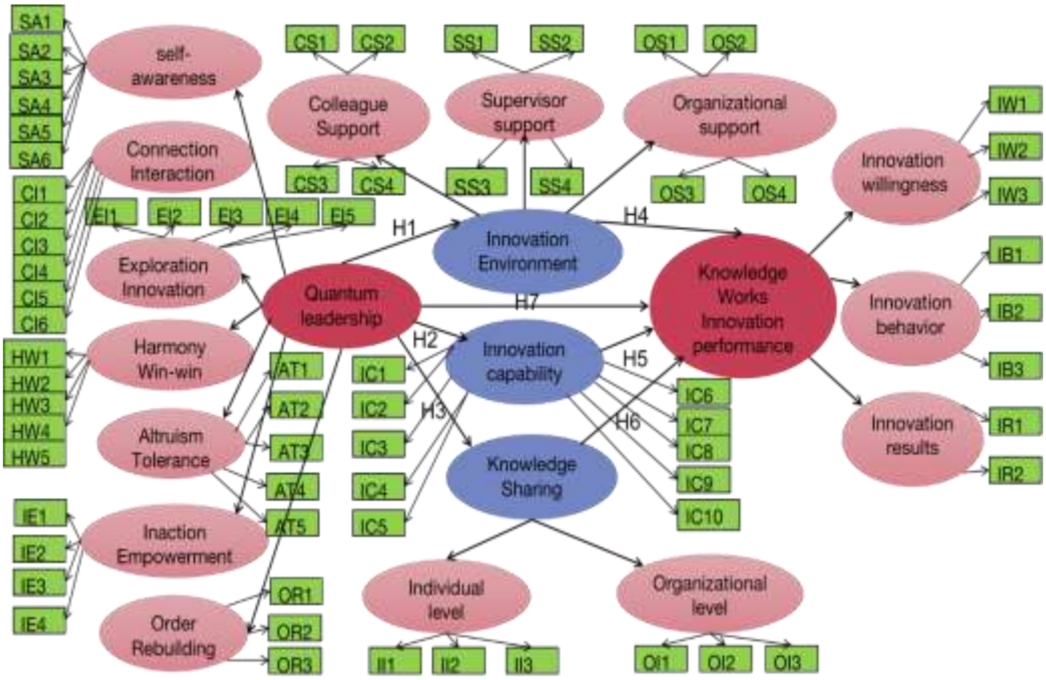

Figure 1.1 Conceptual framework

2. LITERTURE REVIEW

2.1 Social information processing theory

Pfeffer and Salancik proposed the Social Information Processing Theory (SIP) based on the "Need-Satisfaction Model" and believed that as environmental adaptors, people will adjust their attitudes and behaviors based on the social environment, current situation, etc. etc. (Pfeffer and Salancik, 1978). At the same time, individuals are also interpreters of the environment. People will selectively receive information from the environment, and then conduct a series of processing processes such as information decoding, memory, attribution, and judgment, and give social information meaning in the process of interpretation. The environment not only provides various types of information, but also affects an individual's dependence on information - the more uncertain and complex the environment, the more people rely on the information provided by the environment (Song Yu, 2020).

According to social information processing theory, employees' attitudes and behaviors in the workplace are based on information processing in the work environment. Common sources of information in organizations include leaders, colleagues, etc., and the ways of obtaining information include direct channels (through direct communication with other members of the organization) and indirect channels (through organizational atmosphere and organizational culture perception) (Bhave et al., 2010). In the workplace, common ways in which the social environment affects employee attitudes and behaviors include: the environment has information describing work characteristics. For example, when colleagues complain about work, employees will either disagree with their colleagues' ideas, or they will convert their colleagues' ideas into their own. ; The environment will highlight certain information, attract employees' attention and then affect attitudes. For example, in the leader's frequent conversations, employees can understand the concerns and expectations of their superiors; the social environment provides some clues about how other members of the organization evaluate the work environment, such as When a leader criticizes an employee who has made a mistake, the employee may think that the leader lacks compassion for his subordinates, or that the leader has high demands on his work;

employees form and deepen their understanding of their own needs in the process of social interaction, and thus evaluate the work environment, such as when colleagues ask When work lacks job autonomy, it not only indicates that job autonomy is an important feature of the job performed, but also indicates that colleagues value this feature.

2.2 Quantum leadership

In the 21st century, Dana Zohar, the founder of quantum management, Zohar & Zhu (2017) Considers Quantum Leadership to be a principle that involves individuals becoming leaders of organizations, with a particular emphasis on ethics based on values, vision and mission. Ma(2017)believes that quantum leadership should emphasize integrity, uncertainty, participation, inclusiveness, and the realization of vision and value. Cheng(2017)believes that quantum leadership is to look at the source of influence and leadership style of leaders through quantum thinking, which includes three key words: responsibility, motivation and service. Ye (2019)believes that a quantum leader should be a service-oriented leader who relies on examples and role models instead of authority to lead, is good at learning and growing, and can effectively deal with uncertain situations. Scholars such as Peng (2019) believe that quantum leadership emphasizes "contradictory compatibility" and "subject participation", advocates "cooperative network construction" and "playing the leading role of employees", pays attention to the creation of interactive relationships among stakeholders, and believes that the connotation characteristics of quantum leadership It can be characterized by uncertainty, relationality, participation, compatibility and process. Chen (2021)believes that quantum leadership means that the leader adopts a bottom-up leadership style, pays attention to the relationship between people and people, and the relationship between people and the environment. sharing, co-creation, and win-win results, and then integrate and sublimate into a community of shared future. Wu (2022)believes that quantum leaders adopt a bottom-up leadership approach for spiritual guidance and empowerment, pay attention to the spiritual growth of themselves and employees, and build a community of employees, enterprises, and the environment.

This study uses the Quantum Leadership Scale developed and compiled by domestic scholars Xin et al. , and the scale has a good level of reliability (Cronbach's α coefficient is 0.932). The scale not only fits the Chinese cultural background, but also embodies the characteristics of the VUCA era. It is divided into 7 dimensions, Self-awareness, Connection Interaction, exploration innovation, harmony win-win, altruism tolerance, empowerment inaction , and rebuilding Order.

2.3 Innovation performance

Bearman(2012) perfected the concept of innovation performance on the basis of predecessors, supplemented the concept of proficiency, that is, the employee's ability to innovate for proficiency. Tan(2014) pointed out that employee innovation performance is not only the novel idea that employees have for work, but also the behavior of implementing this idea and ensuring that this behavior can bring value to the organization. Muhammad Abbas(2015) believes that employee innovation performance is not a single behavior of employees, but runs through the entire life cycle of employees. Cao et al. (2017) started from employees and believed that the most important thing to achieve employees' innovation performance is to break the rigid thinking.

Han Yi, a Chinese scholar, regards innovation performance as one of the dimensions of work performance. Combining with the scale and role theory of Janssen et al., he proposes that employees' innovation performance is mainly divided into innovation intention, innovation behavior and innovation results, and designs 8 items The evaluation scale(Han et al., 2007), which has also been extensively demonstrated in domestic innovation performance empirical studies (Wang & Wan, 2020; Hou et al., 2021). At the same time, Yao and Heng (2013) a drew on Han Yi's Innovation Performance Scale and developed a new innovation performance measurement scale with knowledge workers as the research subject. This study uses Employee innovation performance mainly adopts the 8-item test compiled by Han et al. (2007) with Chinese employees as the research object. The scale has a good level of reliability (Cronbach's α coefficient is 0.896), from innovation intention, innovation behavior and Analysis of innovation results.

2.4 Innovation Environment

Scholars regard organizational environment as the perception of organizational members to the characteristics of the internal environment (Schneider, 1975), and develop a fair environment, interpersonal Detailed research on scope, innovation environment(Bock et al., 2005). Innovation environment is divided into two levels: organization and team (Newman et al., 2020). There are many studies on organizational innovation environment. Chinese scholars (Wang & Zhu, 2006) pointed out that the organizational innovation environment has the characteristics of persistence and subjective consistency. Gu et al.(2014) combined the views of Amabile and Qiu, and regarded organizational innovation environment as organizational characteristics perceived by organizational members in terms of environmental freedom, organizational support, ability development, and learning growth. Shanker et al. (2023) confirmed that organizational innovation environment will positively affect organizational performance, while Managers' Innovation behavior acts as an intermediary variable.

Through consulting authoritative journals, it is found that, the scales of TCI, KEYS, ICQ and SOQ are widely used. The most widely used is the TCI designed by West(1996). TCI is mainly used to measure the innovation environment of the organization. Although the number of items is small, the reliability and validity have been well verified; followed by the KEYS scale developed by Amabile (1996), which is also widely used in business research field. On the other hand, domestic scholars Qiu (2009), Liu (2009), Yang et al. (2013),Yang (2013) revised the KEYS scale and developed the organizational innovation environment scale in the Chinese organizational environment, which has a good reliability and validity, and the application is relatively extensive. The organizational innovation environment in this study mainly adopts the individual-level organizational innovation environment scale developed by Liu and Shi (2009), which has a good reliability level (Cronbach's α coefficients are all above 0.8). The scale is divided into three dimensions: colleague support, supervisor support and organizational support, with a total of 12 items.

2.5 Knowledge Sharing

The definition of knowledge sharing can be divided into three types: the first category includes: De Vries (2006) , Yi (2009), Wang & Noe (2010) , Amayah (2013), Du (2018), Tang et al. (2018) defined knowledge sharing from the perspective of internal employees or individuals; the second category includes: Ritala et al. (2015) , defined knowledge sharing from the perspective of enterprises; the third category Including: Senge (1997), Hendrik (1999), define knowledge sharing from the perspective of abstract knowledge supply side and demand side. There are also some scholars who have studied the connotation of knowledge sharing from other perspectives such as: innovation perspective (Eriksson, 2000). Knowledge sharing involves two forms of explicit and tacit knowledge among employees or departments of an enterprise. In summary, researchers agree more with the definition proposed by Sheng (2012), that is, knowledge sharing is the exchange and discussion of individual knowledge by enterprise members with other individuals through various sharing methods and means, so as to achieve common sharing and transform it into enterprise knowledge resource activity.Bock et al. (2005) developed a comprehensive understanding of factors that support or inhibit individuals' knowledge sharing intentions.

Domestic scholar Jin (2013) studied the relationship between rational behavior theory and enterprise employees' knowledge sharing behavior. Lin (2006) developed a research model to explore how organizational support promotes knowledge sharing intentions through organizational cognitive effects of innovation characteristics (relative advantage and compatibility) and interpersonal trust. Wang & Liang (2014) explored the impact of knowledge sharing on corporate performance and the mediating role of intellectual capital. Xu (2018) discussed the core issue of the impact of industry-university-research partner matching on cooperation performance on the basis of understanding the essential characteristics of industry-university-research cooperation, knowledge flow and sharing, and constructed partner matching (cooperation start)-- The basic logical framework of knowledge sharing (cooperative behavior process)-cooperative performance (cooperative result) is to build a complete path from the source of cooperation to the result of cooperation. Explicit knowledge sharing and tacit knowledge sharing play an important mediating role in the impact of partner matching on cooperation performance. Wang (2016) exploratorily divided knowledge sharing into general knowledge contribution, general knowledge collection, key knowledge contribution, and key knowledge collection. Based on the early research on knowledge sharing theory by other scholars, from the two perspectives of sharing content and sharing direction, a multi-dimensional measurement scale for knowledge sharing among knowledge workers was developed that is in line with my country's cultural situation. In addition, some scholars divide knowledge sharing into four dimensions based on other standards, such as: knowledge sharing between individuals, knowledge sharing within teams, knowledge sharing within organizations, and knowledge sharing between organizations (Hedlund, 1994); Formal/informal tacit knowledge sharing (Jin, 2010). After reviewing previous literature, this study used a two-dimensional scale that divides knowledge sharing behavior at the individual and organizational levels (Lu et al., 2006).

2.6 Innovation capability

Shalley et al. (2004) believed that the level of basic theory is directly related to innovation capability. Shuang et al. (2006) believed that the amount of basic knowledge reserves, the academic theories required in the process of realizing innovation, and past experience are the basis of Innovation behavior and the foundation of the development of other individual abilities. Zhou (2013) defines employee innovation capability as employees absorb and transform acquired innovative knowledge, technology, and innovative spirit into internal stability in their daily work qualities and the ability to demonstrate them. The main environmental factors include superior encouragement, work autonomy, resources, pressure and support(Zhou,2015;Ma,2018).

When Liu & Zou (2013) studied the relationship between transformational leadership, psychological empowerment and employee innovation capability, he referred to the theory proposed by George and Zhou in 2001 dimensions of employee creativity are considered to be a single-dimensional variable, and a total of 13 indicators are proposed to measure employee innovation capability; Yang et al.,(2015) also chose the dimension of employee innovation capability proposed by George when selecting employees of large state-owned enterprises to study how incentive methods affect employee innovation capability Divide the way. Ding et al. (2009) selected a high-tech enterprise in Xi'an to study the relationship between leadership behavior and employee innovation capability, and chose the single-dimensional 6-index employee innovation capability classification method proposed by Farmer et.al. Wang& Hong (2010) chose Tierney's 7-indicator unidimensional division of employee innovation capability in his research on employee creativity supported by leadership, and retained 6 indicators after adjustment. When Zheng et al.(2009) studied the relationship between employee innovation capability and innovation performance, he also chose this dimensional division form to study employee innovation capability. This study selects the classification method used by the more representative George and Zhou, believing that employee innovation capability is a single-dimensional variable, and combines the research needs and interviews.

3.RESEARCH METHODOLOGY

This study intends to use mixed methods, first quantitative, then qualitative.
The first part will conduct descriptive and inferential statistical analysis of the sample data through the data analysis tools SPSS 25.0 and Smart PLS4.9 software. First, the questionnaire collection is reported, and then descriptive statistics of the data are performed, including basic demographic description and data normality test. Finally, SPSS25.0 and Smart4.9 were used to analyze the reliability and validity of the measurement model of this study, and the structural equation model was verified.

The second part combines grounded theory and uses NVivo14.0 software to conduct qualitative analysis of interviews. The researcher will deeply explore the key factors of quantum leadership and knowledge worker innovation performance to provide a solid foundation for theory construction.

4.RESULTS AND FINDINGS

4.1 Quantitative analysis

4.1.1 Evaluation of Measurement Model

This section will use SPSS25.0 and SmartPLS4.9 for inferential statistical analysis. First, a measurement model will be constructed and evaluated. The measurement model will mainly be analyzed for reliability and validity. In this analysis, the cross-loading of each item on each latent variable, composite reliability CR, extracted average variance AVE, etc. will be evaluated and analyzed.

TABLE 4.1: CONSTRUCT RELIABILITY AND VALIDITY

First order construct	Cronbach's Alpha	rho_a	CR	AVE
Self-awareness	0.896	0.897	0.923	0.706
Connectivity Interaction	0.928	0.929	0.944	0.737
Exploration Innovation	0.877	0.887	0.910	0.669
Harmony Win-Win	0.927	0.928	0.945	0.775
Altruism Tolerance	0.811	0.814	0.866	0.565
Inaction Empowerment	0.894	0.894	0.926	0.759
Order Rebuilding	0.905	0.908	0.940	0.840
Innovation willingness	0.907	0.907	0.942	0.843
Innovative behavior	0.923	0.923	0.951	0.867
Innovation results	0.894	0.895	0.934	0.825
Colleague Support	0.902	0.903	0.931	0.772
Supervisor support	0.941	0.942	0.958	0.851

Organizational support	0.913	0.916	0.939	0.793
Innovation capability	0.947	0.947	0.954	0.677
Individual level	0.894	0.894	0.934	0.825
Organizational level	0.859	0.860	0.914	0.780

All Cronbach's Alpha value is between 0.811 and 0.952, indicating that each latent variable has high internal consistency. The rho_a value is between 0.814 and 0.954, indicating that each latent variable has high internal consistency. The Composite Reliability values of all variables in this study are between 0.890 and 0.937, which also shows that each latent variable has high internal consistency. In this study, the AVE values of all variables ranged from 0.576 to 0.698. The AVE values of all constructs are greater than the recommended value of 0.5, and the AVE requirements of this study were met.

Table4.2: Results of Convergent Validity of first-order variables

	AT	CI	CS	EI	HW	IB	IE	IL
AT	-							
CI	0.565	-						
CS	0.403	0.312	-					
EI	0.691	0.409	0.341	-				
HW	0.698	0.619	0.301	0.651	-			
IB	0.302	0.353	0.364	0.348	0.297	-		
IE	0.633	0.466	0.396	0.511	0.466	0.380	-	
IL	0.199	0.293	0.258	0.305	0.204	0.603	0.325	-
IR	0.354	0.382	0.383	0.323	0.368	0.762	0.398	0.545
IW	0.281	0.363	0.312	0.321	0.276	0.771	0.381	0.539
IC	0.251	0.360	0.370	0.361	0.302	0.539	0.511	0.643
OL	0.231	0.377	0.303	0.317	0.282	0.634	0.401	0.761
OR	0.534	0.417	0.433	0.393	0.352	0.351	0.687	0.265
OS	0.432	0.345	0.738	0.328	0.329	0.393	0.391	0.286
SA	0.554	0.493	0.270	0.578	0.618	0.317	0.455	0.187
SS	0.374	0.353	0.745	0.369	0.314	0.351	0.443	0.303

Table4.3 Results of Convergent Validity of first-order variables（Continued form）

	IR	IW	IC	OL	OR	OS	SA	SS
IR	-							
IW	0.701	-						
IC	0.547	0.519	-					
OL	0.596	0.550	0.762	-				
OR	0.436	0.310	0.458	0.309	-			
OS	0.425	0.380	0.351	0.311	0.438	-		
SA	0.299	0.283	0.294	0.188	0.313	0.288	-	

SS	0.362	0.381	0.382	0.354	0.423	0.707	0.327	-

HTMT (heterotrait-monotrait ratio) is the heterotrait-monotrait ratio, which is the ratio of inter-trait correlation to intra-trait correlation. It is the ratio of the square root of the product of the mean value of indicator correlations between different facets relative to the mean value of indicator correlations between the same facets. If the HTMT value is less than 0.85 (sometimes 0.9 is used as the standard), it indicates that there is discriminant validity between the two factors. Analyze the table below: From the HTMT analysis results, all HTMT values are less than 0.85, which means that there is good discrimination between factors and the scale has good discriminant validity.

From the above research, it can be seen that the reliability and validity of the measurement model in this study have met the conditions. The results of the measurement model are shown below:

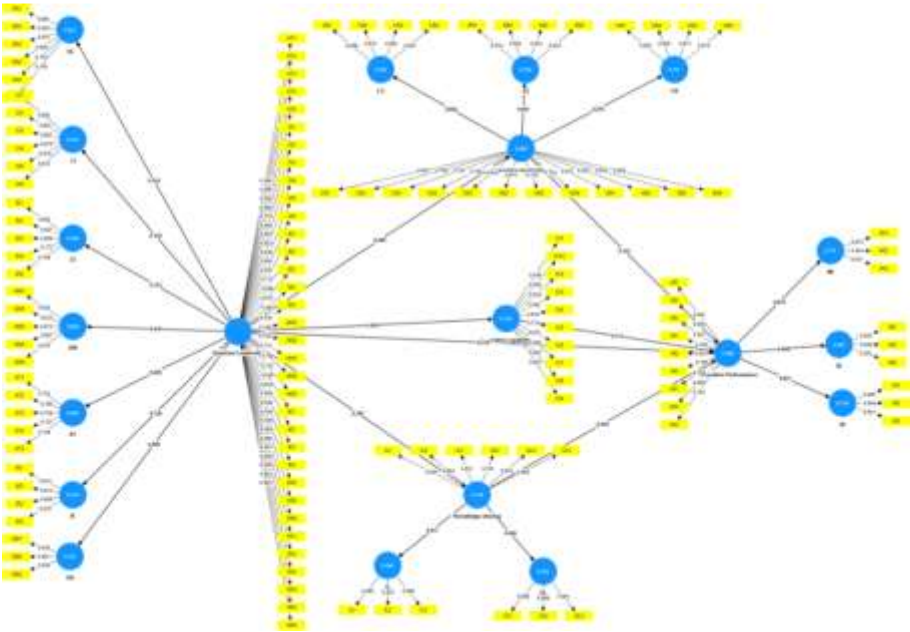

Figure 4.1 results of the measurement model in SmartPLS4.9

4.1.2 Assessing the significance and relevance of the structural model relationships

The next step involves examining the relevance and importance of the structural relationships involved in the model. The correlation between model variables is tested by analyzing the path coefficient of the structural model. As can be seen from Table 4.4, there is a significant positive correlation between Innovation Performance and Knowledge sharing, and the correlation coefficient is 0.637. Innovation environment has a significant positive correlation with Knowledge sharing, and the correlation coefficient is 0.337. Quantum Leadership is positively correlated with Knowledge sharing, and the correlation coefficient is 0.355. Innovation capability has a significant positive correlation with Knowledge sharing, and the correlation coefficient is 0.703.

Table4.4 the significance and relevance of the structural model relationships

	Knowledge sharing	Innovation Performance	Innovation environment	Quantum Leadership	Innovation capability
Knowledge sharing	1				

Innovation Performance	.637**	1			
Innovation environment	.337**	.433**	1		
Quantum Leadership	.355**	.456**	.489**	1	
Innovation capability	.703**	.558**	.388**	.431**	1

4.1.3 Coefficient of Determination (R^2 Value)

In general, the Coefficient of Determination is between 0 and 1, and the closer the R^2 Value is to 1, the more explanatory the model is. The R^2 values of the variables in this study are shown in Figure 4.2 and Table 4.5: The R^2 Value of Innovation Performance is 0.496, indicating that 49.6% of Innovation Performance is determined by Innovation capability, Innovation environment, Knowledge sharing, Quantum Leadership to explain. The R^2 Value of Innovation capability is 0.193, indicating that 19.3% of Innovation capability is explained by Quantum Leadership. The R^2 Value of the Innovation environment is 0.240, indicating that 24.0% of the Innovation environment is explained by Quantum Leadership. The R^2 Value of Knowledge sharing is 0.128, indicating that 12.8% of Knowledge sharing is explained by Quantum Leadership.

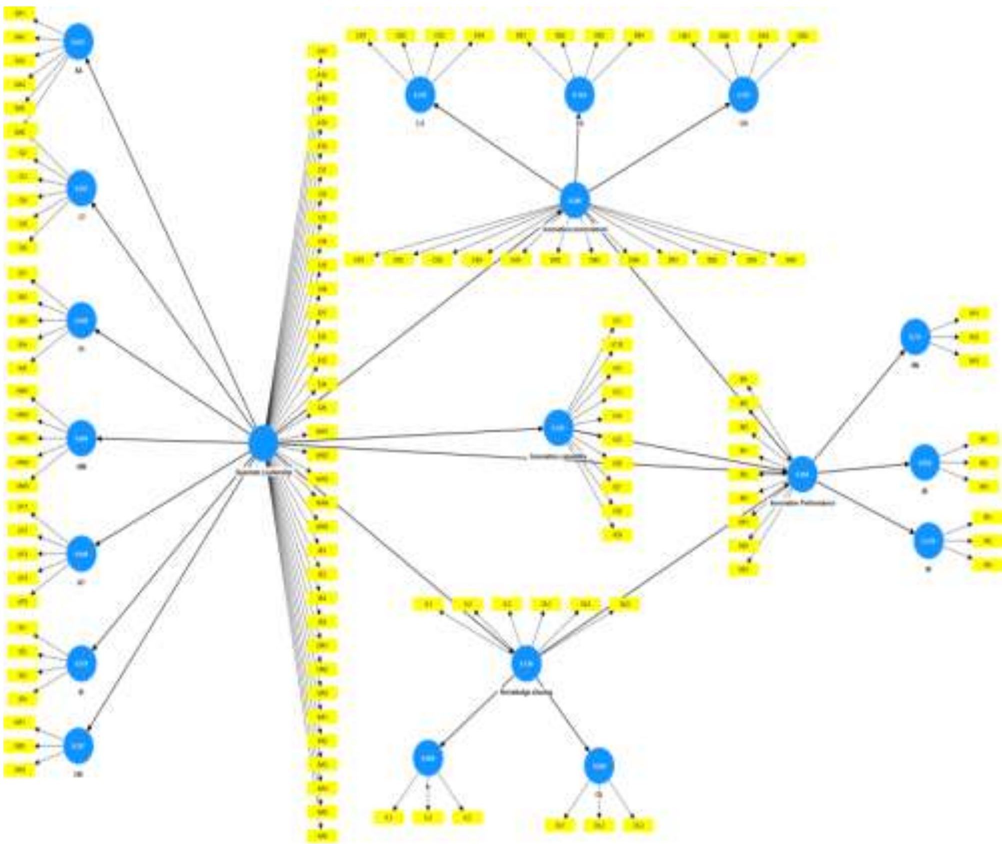

Figure 4.2 R squared value in SmartPLS4.9

Table4.5 Effect Size Rating

	R-square	R-square adjusted	f-square	Effect Size Rating

Innovation Performance	0.496	0.491		
Innovation capability -> Innovation Performance			0.012	small effect
Innovation environment -> Innovation Performance			0.033	Small to Medium effect
Knowledge sharing -> Innovation Performance			0.198	Medium effect
Quantum Leadership -> Innovation Performance			0.043	Small to Medium effect
Innovation capability	0.193	0.191		
Quantum Leadership -> Innovation capability			0.239	Medium effect
Innovation environment	0.240	0.238		
Quantum Leadership -> Innovation environment			0.315	Medium effect
Knowledge sharing	0.128	0.126		
Quantum Leadership -> Knowledge sharing			0.147	Small to Medium effect

The Q^2 value is the predictive correlation or value used to predict the model. The results show that Q^2 can predict the points of endogenous factors and their individual factors. In addition, the Q^2 value should be higher than zero to show the level of correlation. The Q^2 values for this study are shown in Table 4. 6 below: In this study, all variables had Q^2 values above 0. The Q^2 value of Innovation Performance is 0.325, the Q^2 value of Innovation capability is 0.128, and the Q^2 value of Innovation environment is 0.149. The Q^2 of Knowledge sharing is 0.084.

Table4. 6 Predictive Relevance

	SSO	（SSE）	Q^2 (=1-SSE/SSO)
Altruism Tolerance	2000.000	1304.888	0.348
Connectivity Interaction	2400.000	1433.816	0.403
Colleague Support	1600.000	642.887	0.598
Exploration Innovation	2000.000	1257.655	0.371
Harmony Win-Win	2000.000	975.834	0.512
Innovative behavior	1200.000	347.689	0.710
Inaction Empowerment	1600.000	975.895	0.390
Individual level	1200.000	373.816	0.688
Innovation results	1200.000	456.162	0.620
Innovation willingness	1200.000	425.549	0.645
Innovation Performance	3600.000	2431.316	0.325
Innovation capability	4000.000	3489.780	0.128
Innovation environment	4800.000	4086.141	0.149
Knowledge sharing	2400.000	2197.920	0.084

Organizational level	1200.000	433.512	0.639
Order Rebuilding	1200.000	835.082	0.304
Organizational support	1600.000	633.934	0.604
Quantum Leadership	13600.000	13600.000	0.000
Self-awareness	2400.000	1479.746	0.383
Supervisor support	1600.000	526.852	0.671

For the test of direct effects, as shown in Table 4.7 below: Innovation capability has a significant positive impact on Innovation Performance (β=0.144, t=2.598>1.960,p=0.009<0.05), H1 is verified. Innovation environment had a significant positive effect on Innovation Performance (β=0.151, t=3.907>1.960,p=0.000<0.05), and H2 was verified. Knowledge sharing had a significant positive effect on Innovation Performance (β=0.430, t=8.072>1.960,p=0.000<0.05), and H3 was verified. Quantum Leadership had a significant positive effect on Innovation Performance (β=0.167, t=4.253>1.960,p=0.000<0.05), and H4 was verified. Quantum Leadership significantly positively affected Innovation capability (β=0.459, t=11.388>1.960,p=0.000<0.05), and H5 was verified. Quantum Leadership significantly positively affected the Innovation environment (β=0.490, t=12.975>1.960,p=0.000<0.05), and H6 was verified. Quantum Leadership significantly positively affected Knowledge sharing (β=0.358, t=8.081>1.960,p=0.000<0.05), and H7 was verified.

Table4.7 Hypothesis testing

hypothesis	path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
H1	Innovation capability -> Innovation Performance	0.144	0.145	0.055	2.598	0.009
H2	Innovation environment -> Innovation Performance	0.151	0.152	0.039	3.907	0.000
H3	Knowledge sharing -> Innovation Performance	0.430	0.430	0.053	8.072	0.000
H4	Quantum Leadership -> Innovation Performance	0.167	0.166	0.039	4.253	0.000
H5	Quantum Leadership -> Innovation capability	0.459	0.461	0.040	11.388	0.000
H6	Quantum Leadership -> Innovation environment	0.490	0.491	0.038	12.975	0.000
H7	Quantum Leadership -> Knowledge sharing	0.358	0.360	0.044	8.081	0.000

In this study, the Total indirect effects of Quantum Leadership on Innovation Performance are shown in the table below: The total indirect effects of quantum leadership on innovation performance are 0.294 (t=9.213>1.960,p=0.000<0.05).

Table4.8 Total indirect effects

Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Quantum Leadership -> Innovation Performance	0.294	0.296	0.032	9.213	0.000

In this study, Specific indirect effects are shown in the table below: The Specific indirect effects of Quantum Leadership on Innovation Performance through Knowledge sharing is 0.154 (t=5.562>1.960,p=0.001<0.05); The Specific indirect effects of Quantum Leadership on Innovation Performance through Innovation capability are 0.066 (t=2.513>1.960,p=0.001<0.05); The Specific indirect effects of Quantum Leadership on Innovation Performance through Innovation environment are 0.074 (t=3.542>1.960,p=0.001<0.05).

Table4.9 Total indirect effects

path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Quantum Leadership -> Knowledge sharing -> Innovation Performance	0.154	0.155	0.028	5.562	0.000
Quantum Leadership -> Innovation capability -> Innovation Performance	0.066	0.067	0.026	2.513	0.012
Quantum Leadership -> Innovation environment -> Innovation Performance	0.074	0.075	0.021	3.542	0.000

The test of the total effect is shown in Table 4. 10 below: The total effect size of Quantum Leadership on Innovation Performance is 0.461 (t=13.118>1.960,p=0.000<0.05).

Table4. 10 Total effects

path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Quantum Leadership -> Innovation Performance	0.461	0.462	0.035	13.118	0.000

4.3 Qualitative Analysis

4.3.1 Open Coding

Open coding is an important data analysis technique in social science research. Its aim is to conduct in-depth analysis, categorization, and conceptualization of the raw research materials, enabling researchers to better understand patterns and trends within the data. The steps of open coding are as follows:

Data Breakdown and Understanding: The first step in open coding is to break down the raw research data into smaller units, such as sentences or paragraphs, and gain a comprehensive understanding of the content within these smaller units. This involves understanding the themes and background information associated with each unit. 2. Labeling: Each small unit needs to be assigned labels for subsequent categorization and analysis. These labels can be short phrases or words that describe the core content of the small unit. 3. Conceptualization: During the conceptualization phase, researchers further refine these labels and transform them into more abstract concepts or themes. This helps reduce the complexity of the data and better understand its meaning. 4. Categorization: Finally, researchers categorize concepts with similar content or relevance into higher-level categories. This aids in integrating and organizing the data, making it easier to analyze and comprehend.

4.3.2 Axis Coding

These main categories include viewpoints and concepts related to leaders' self-awareness, connectivity, exploration, collaboration, altruism and inclusiveness, empowerment and non-action, and order reconstruction. At the same time, they also encompass viewpoints and concepts related to employees' willingness to innovate, innovative behavior, innovation outcomes, peer support, supervisor support, organizational support, and innovation capability. Additionally, it includes viewpoints on knowledge sharing at both the individual and organizational levels. Through axis coding, the study integrates and categorizes the information from the original coding, allowing for a clearer understanding of the relationships between different concepts. This further exploration of the research direction provides a strong foundation for subsequent analysis and conclusions.

4.3.3 Selective encoding

Selective encoding is a process aimed at systematically handling the relationships between main categories and distilling core concepts that have overarching significance from these main categories. It involves analyzing the relationships between these core concepts across various dimensions to depict an overall theory or phenomenon. In this paper, through repeated comparisons and discussions, the previously summarized 16 main categories were integrated into five key dimensions, which play a crucial role in understanding the processes of innovation and knowledge management within organizations.

5.CONCLUSION AND DISCUSSION

5.1 Research conclusion

Quantum leadership is regarded as a new leadership style, showing characteristics such as continuous self-innovation and adaptability diversity, and showing vitality and rationality in both stable and uncertain situations (Şenses and Temoçin, 2016). This paper uses social information processing theory and resource preservation theory as the theoretical basis, focuses on the relationship between quantum leadership and the innovative performance of knowledge employees, and constructs a theoretical model. After literature analysis, this study selected Innovation Environment, innovation ability, and knowledge sharing as mediating variables.

5.2 Managerial Implications

The uncertain environment presents both opportunities and challenges to enterprises. As the helm of an enterprise, leaders have an increasingly obvious impact on employees' innovative behavior. This study is based on the thinking of carrying forward Chinese traditional culture, based on the quantum leadership behavior advocated in traditional philosophical viewpoints, and analyzes the innovative performance of quantum leadership on knowledge employees in modern enterprise management practice. Through the construction of theoretical models and the testing of empirical models, the research results show that quantum leadership has a significant positive impact on the innovation performance of knowledge employees, and explore the mediating effects of Innovation

Environment, knowledge sharing, and innovation capabilities. This study not only helps to enrich relevant academic research on quantum leadership, but also provides reference for the choice of corporate management leadership style, and provides enlightening suggestions for the management style of knowledge employees and methods to promote the innovative work performance of knowledge employees.

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