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Research on the Influence of Transformational Leadership on the Performance of Patent Transformation in Universities

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Abstract

Based on the realistic situation of patent transformation in universities of China, this paper discusses the influence mechanism of transformational leaders on the transformation performance of patents. The research shows that the transformational leadership and market orientation degree are positively correlated with the performance of patent transformation. The transformative leadership significantly affects the market orientation degree and patent management ability, and vision incentive is the key variable that plays a positive role in market orientation in transformational leadership. The market orientation degree plays a partial intermediary role between transformational leadership and patent transformation performance. Finally, the theoretical contribution and practical significance of the research results have been discussed.

Key words: transformational leadership; university; patent transformation performance; market orientation; patent management

1. INTRODUCTION

According to the modern property right theory, the patent system, as a property right incentive system, does not stimulate the simple invention and creation itself, but the invention and creation with market value. Based on this, the issue of patent transformation in universities has been widely mentioned, and has become an important topic facing the science and technology work in universities in China. A large number of university patents were shelved, resulting in a great waste of resources. Under the background of the construction of intellectual property power, the innovation-driven supporting role of colleges and universities is obviously insufficient. In view of the problem of poor patent transformation in universities, most

scholars put forward solutions from the aspects of influencing factors, transformation mode and mechanism[1], especially emphasizing that the connection with the market end should be strengthened, and the problem should be solved through model innovation and system and mechanism reform[2]. More in-depth researches reveal that lack of trust in leaders is an important factor to curb knowledge transfer[3], and the leader for knowledge transfer necessary organization culture and support environment has a great influence[4]. Transformational leadership (TL) is an important resource of the organization. Organizational practice and staff participation can promote the transfer and diffusion of innovation resources, and thus realize resource transformation[5]. In the 1990s, TL research was formally introduced into the higher education system[6], and some scholars have found that universities need more TL[7]. Compared with transactional leaders, transformational leaders have a greater influence on various variables such as leadership performance, work performance and organizational commitment, and a more significant impact on teachers' innovative work behavior[8]. In addition, the TL of universities is defined as the ability of school leaders to influence teachers' beliefs and specific behaviors in the process of realizing school change, and to promote organizational change. It is a kind of ability to grasp the mission of the school and encourage teachers to strive around the mission[9]. At present, scholars rarely discuss how to improve the performance of patent transformation in universities from the perspective of leaders. In view of this, this study will focus on the university patent transformation performance (PTP), and explore the relationship between the TL and the university PTP.

2. STUDY DESIGN

2.1 Study hypothesis

(1) TL and innovation performance

Leadership is an activity that can influence others or organizations, but whether such influence is effective, that is, the question of leadership effectiveness, has always been a focus of the study of leadership theory. Leadership effectiveness is generally divided in terms of process and output. According to the existing studies, the measurement of leadership effectiveness mainly includes two indicators: performance and emotional response. In studies of leadership effectiveness, it is often believed that transformative leadership styles are often more effective than transactional leadership styles, both in terms of innovation and performance. Under the influence of transactional leaders, employees only achieve the predetermined performance, while transformational leaders can improve the motivation of members to obtain the desired results, which will produce the performance beyond the expectations[10]. TL behavior can also positively affect the communication satisfaction and openness of the organization, and then positively affect the school-running performance[11]. In addition, the vision, systems established, and systems constructed by leaders for all levels of the organization all contribute to the transformation of knowledge into competitive advantage[12]. Based on the above theory, this study assumes that H1: TL has a positive relationship with PTP.

(2) TL and market orientation (MO)

There are two kinds of connotation of MO, one is "cultural view", which emphasizes the basis of culture; the other is "behavior view", which focuses on the actual implementation of the organization. Kohli and Jaworski defined the MO as the generation of market information about the current and future requirements of customers within the scope of the organization, through the information dissemination of various departments and the responsiveness of the whole organization to the market information[13]. Gonzalez further expanded its scope in the non-profit organization, defined the MO of non-profit organizations as a management philosophy and organizational culture, and believed that the MO of non-profit organizations needs to adopt a strategic perspective of management[14]. Strategic leadership theory believes that leadership style represents a higher level of ability and shows many forms along with the experience, personality and values of leaders, which can influence organizational innovation strategic choice[15]. At the cultural level, leadership style has a significant impact on the effectiveness of cultural management and control. TL style is conducive to the effectiveness of cultural management and control[16]. At the behavioral level, based on motivation theory, existing studies have proposed that TL will affect the internal motivation of team members, thus acting on their innovative behavior[17]. Based on the above theory, this study assumes H2, i.e., there is a positive relationship between TL and the degree of MO (DMO).

(3) TL and patent management ability (PMA)

TL style has a significant positive impact on mutation innovation[18], and has a stronger incentive for the development of new knowledge or new technology to meet new market needs[19]. Compared with transactional leaders, transformational leaders can enable subordinates to produce more creativity. Transformational leaders encourage employees to go beyond their personal interests, receive their team missions, cultivate their interests and enhance their creative ability[20]. In many knowledge transfer drivers, leadership is considered the key point, transformative leadership style will form an effective social network, promote the existing knowledge resources and allocation[21]. Based on the above theory, this study assumes H3 as a positive relationship between change leadership and PMA.

(4) MO and PTP

Domestic scholars' research on patent transformation in universities found that market factors are not only the important factors driving patent transformation, but also the key factors for the construction of patent transformation system and mechanism[22]; the value of technological innovation should be realized through the market, so as to give full play to the basic guiding role of innovative resource allocation in technology research and development direction, capital input, technical scheme selection and price setting of technical factors[23]. As a part of the overall performance of the organization, PTP and MO are generally positively correlated with enterprise organizational performance[24]. Vázquez[25] and Hu[26] also showed that MO significantly and positively affects the organizational performance of non-profit organizations. Kara[27], Hammond[28] and Rivera[29] analyzed educational institutions,

which showed a significant positive correlation between MO and overall performance. Based on the above theory, this study assumes H4: there is a positive relationship between MO and patent conversion performance.

(5) PMA and PTP

Most of the research on patent management and innovation performance at home and abroad focuses on enterprises. Hufker believes that patent management is the application of different patent strategies, including market strategy, defense strategy, cooperation strategy, etc.[30]. Enterprises cannot adopt the "unchanged" method to manage their patents[31]. Generally speaking, patent management can be divided into three links: patent acquisition, patent protection and patent commercialization[32]. In the process of patent management, patent management activities such as patent acquisition[33], patent application timing[34], patent quality level[35], patent portfolio[36], patent development and profitability[37] can significantly affect innovation performance. In addition, scholars also emphasized the significant impact of open innovation ability and business transformation ability on the coupling effect between enterprise patent management and technology innovation performance[38]. Based on the above theory, this study assumes H5, i.e., PMA and PTP have a positive relationship.

(6) MO and PMA

Market oriented and innovation oriented effective synergy can help enterprises better understand the current and future customers, competitors and other environmental conditions, and in meet customer demand will have a more comprehensive ability to adapt and environmental management ability[39]. Further research found that market oriented customer oriented connotation has a positive impact on innovation ability[40]. Li took the technological innovation ability of national high-tech zones as the research object, and found that the average growth rate of market-oriented collaborative incentive for the improvement of the technological innovation ability of national high-tech zones was 2%[41]. Based on the above theory, this study assumes that H6, a positive relationship between the DMO and PMA.

(7) The intermediary role of MO

For the "black box" between TL and leadership effectiveness, many exploratory studies have been carried out, including individual intermediary variables such as "creative working atmosphere", "innovation culture" and "employee interactive response", as well as intermediary variables at team level, such as "knowledge sharing and integration", "team culture" and "team cooperation". Based on the above theory, this study assumes H7: the DMO plays a mediating role between TL and PTP.

(8) The intermediary role of PMA

The level of informatization is an important driving factor for technology innovation and technology transfer, and it is found that the level of informatization plays a positive regulatory role in the direct and indirect influence of transformative leadership on team innovation performance[42]. As the dependent and independent

variables of TL and innovation performance, its significance has been verified by relevant scholars. Although no scholars have discussed the role of PMA as the mediation variable on the relationship between PMA and innovation performance, the mediation effect of PMA is still worth further discussion. In addition, although most scholars discuss the MO category as the intermediary variable between TL and leadership effectiveness, some scholars point out that MO does not directly affect core competence and enterprise performance, and MO must improve core competence through innovation, and then improve performance[43]. Based on the above theory, this study assumes H8: PMA plays a mediating role between TL and PTP, and between the DMO and PTP.

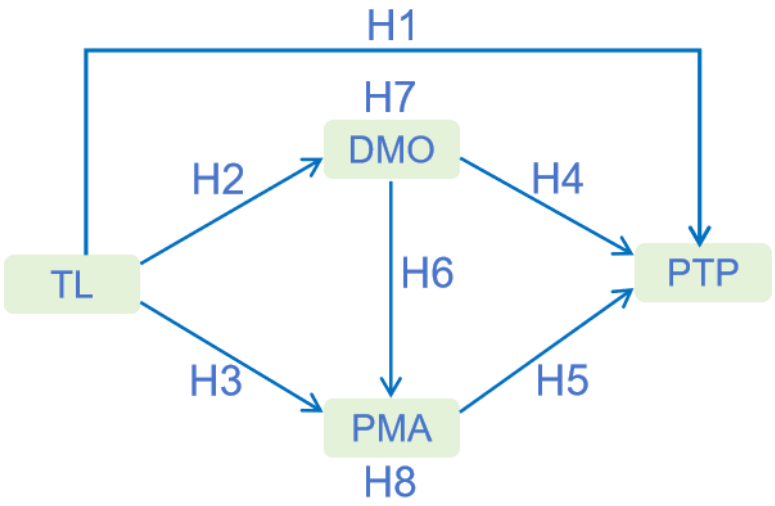

Figure 1 Theoretical architecture of this study.

2.2 Study process and method

In this study, mature or widely used scales were selected for research. All variables were measured by Likert seven-point scale, which represents the transition from 1 to 7 from complete disagreement to complete agreement. The specific contents of the scale are as follows.

(1) Dependent variable: PTP. Different from domestic scholars who generally evaluate the transformation performance of scientific and technological achievements from absolute indicators, conversion rate and relative efficiency, this paper highlights the market-oriented evaluation method and emphasizes the evaluation of the technology transfer and commercialization implementation effect of relevant achievements from the perspective of market value. Drawing on the achievements of Li and other scholars, the market performance of the transformation industry of scientific and technological achievements in universities is divided into explicit and implicit[44]. Among them, the explicit performance regards the commercialization effect of university technology as the core index of PTP, such as the number of patent transformation contracts

and the amount of transformation. Hidden performance is used to emphasize the social impact of universities as important innovation subjects through patent transformation, such as knowledge spillover and the improvement of social reputation.

(2) Independent variable: TL. The TL questionnaire mainly adopts the survey scale. On the basis of Bass TL theory research and the Chinese cultural background, four dimensions of TL measurement were put forward, namely, vision incentive (VI), virtue model (VM), leadership charm (LC) and personalized care (PC)[45].

(3) Mediation variables. The market-oriented measurement scales based on this study are: MKTOR scale for measuring market-oriented cultural view and MARKOR scale for measuring market-oriented behavior view. Cultural view mainly includes the analysis and design: the acquisition of market information, the dissemination and application of market information, and the reaction of market information.

For the PMA variable, this study mainly focuses on the impact of different links of innovation on the performance of patent transformation, and analyzes the surface design measurement items from patent acquisition, protection and commercialization.

3. EMPIRICAL ANALYSES

3.1 Factor analysis

The data were factor-analyzed using SPSS21.0 statistical analysis software. The results of the exploratory factor analysis of 30 items of the measurement scale showed that the item factor load of each variable was between 0.62 and 0.95, and the KMO coefficient was 0.907, indicating a good internal consistency of the scale.

3.2 Reliability and validity analysis

The internal consistency reliability and combination reliability were mainly tested, which was measured by Cronbach's α coefficient. The results showed that the Cronbach's α coefficient of each variable was greater than 0.83, indicating that it has high internal consistency and good reliability. The combined reliability (CR) is greater than 0.84 and higher than the discriminant criterion of 0.7.

Analysis of validity usually tests the construction validity of the measured factors, including convergent validity, discriminant validity. Convergent validity was determined by combined reliability CR value and average variance extraction (AVE). The results showed that the criterion of combined reliability was greater than 0.7 and AVE value greater than 0.5, indicating that the aggregate validity of the scale was good. Statistical values and correlation coefficients for all variables are shown in Table 1 below. By comparing the correlation coefficient between the dimensions with the square root value of the AVE of each dimension involved, the results show that there is sufficient differentiation validity between TL, MO, PMA and PTP.

Further, TL and various dimensions are significantly and positively correlated with the DMO, PMA and PTP. The DMO and the PMA were significantly and positively correlated with the patent conversion performance. There was also a significant

positive correlation between the DMO and PMA. These analysis results initially support the research hypothesis proposed in this paper and lay the foundation for the next analysis.

Table 1 Descriptive statistics and correlation coefficients of variables (N=295).

variable	mean	standard error	VM	VI	PC	LC	TL	MO	PMA	PTP	
VM	5.51	.777	(.849)	**0.729**							
VI	5.14	.837	.579**	(.842)	**0.759**						
PC	5.15	.847	.569**	.732**	(.892)	**0.773**					
LC	4.80	.861	.446**	.539**	.565**	(.839)	**0.718**				
TL	5.15	.686	.775**	.848**	.887**	.781**	(.842)	**0.812**			
MO	5.41	1.064	.314**	.418**	.379**	.330**	.435**	(.894)	**0.867**		
PMA	4.25	1.106	.238**	.329**	.338**	.305**	.368**	.192**	(.844)	**0.766**	
PTP	4.97	1.015	.352**	.430**	.428**	.429**	.498**	.497**	.359**	(.888)	**0.860**

**. The correlation is significant on layer 0.01 (double tail). The value in parentheses is the Cronbach's α coefficient of the scale; the diagonal value in bold is the square root of the AVE as the factor construct.

3.3 Hypothesis test

In order to further determine that the study variables represent different constructs and the relationship between variables, combined with the hypothesis model of this study, Amos 24 was further used to construct structural equations for all variables, and compare the study hypothesis model with other models to test the study hypothesis. The results are shown in Table 2. Model 1 represents that all items measure the same factor; Model 2 represents that TL measure is a factor, DMO, PMA and PTP test is a factor; Model 3 represents that TL measure is a factor, DMO and PMA is a factor, patent conversion performance measurement is a factor; Model 4 represents that TL measure is a factor, DMO and PTP test is a factor, PMA is a factor; Model 5 represents that the TL measure is a factor, PMA and patent conversion performance test is a factor, MO is a factor; Model 6 represents that TL measure is a factor, MO degree, PMA and PTP are one factor; Model 7 represents one dimension, namely, VM, VI, PC, LC, DMO, PMA and PTP. Model 8 represents VM, VI, PC, LC, TL, DMO, PMA and PTP in one dimension.

According to Table 2, Compared with the other models, Model 8 had the best fit, the fit index significantly outperformed the other models. The absolute fit index χ^2/df of the model was 2.026, the RMSEA and GFI values are determined to be 0.059 and 0.846, respectively; The relative fitting index NFI value of the model (0.859), CFI value (0.923), IFI (0.923) and TLI value (0.915) are all above 0.90, indicating that the relative fit of the model is good.

Table 2 Comparative analysis of model fitting.

model	χ^2/df	GFI	NFI	IFI	TLI	CFI	RMSEA
Model 1	6.661	0.584	0.524	0.565	0.530	0.562	0.139
Model 2	5.541	0.628	0.605	0.652	0.623	0.650	0.124
Model 3	5.053	0.651	0.642	0.691	0.663	0.689	0.117
Model 4	4.604	0.669	0.674	0.725	0.701	0.723	0.111
Model 5	4.544	0.666	0.678	0.730	0.706	0.728	0.110
Model 6	3.551	0.722	0.750	0.807	0.788	0.806	0.093
Model 7	3.260	0.762	0.771	0.829	0.812	0.828	0.088
Model 8	2.026	0.846	0.859	0.923	0.915	0.923	0.059

The data analysis results in Table 3 show that: (1) In the influence path of TL on PTP, TL is significantly affecting PTP, SPC was 0.278 ($p < 0.01$). The H1 is therefore supported; (2) In the influence path of TL on the DMO, TL is significantly affecting the DMO, the SPC was 0.475 ($p < 0.01$), thus H2 is supported; (3) In the influence path of TL on PMA, TL is significantly affecting patent management capabilities, SPC was 0.419 ($p < 0.01$), so H3 is supported; (4) In the path of market-oriented influence on PTP, the DMO significantly affects the performance of patent transformation, the standardized path coefficient (SPC) was 0.351 ($p < 0.01$), thus H4 is supported; (5) In the path of the influence of PMA on PTP, the PMA on the PTP is not significant, so H5 is not supported; (6) In the path of the market-oriented degree on PMA, the DMO on the PMA is not significant, so H6 is not supported.

Table 3 Fitting results of the structural equation model.

way	path coefficient	S.E.	C.R.	P	SPC	results
DMO <- - -TL	.907	.133	6.019	***	0.475	H2 established
PMA <- - -TL	.717	.133	5.379	***	0.419	H3 established
PTP <- - -DMO	.291	.052	5.575	***	0.351	H4 established
PTP <- - -PMA	.184	.057	3.240	.001	0.201	H5 not established
PTP <- - -TL	.438	.115	3.800	***	0.278	H1 established
PMA <- - -DMO	-.004	.074	-.061	.952	-0.004	H6 not established

Further, the study used the Bootstrap program to test the mediation effect in the model. First, the data samples were self-sampled, randomly selected 2000 Bootstrap samples from the original 295 data, then fitted the model eight, calculated the estimates and mean of 2000 mediation effects, ranked the estimates and selected the 95% confidence interval of 2.5 percent (LLCI) and 97.5 percent (ULCI). If the interval of LLCI and ULCI values does not contain 0, the mediation effect is significant. The results in Table 4 show that the DMO is the partial mediation variable

of TL acting on the translational performance of the patent, and no other mediation effects are significant, assuming H7 is supported and H8 is not supported.

Table 4 Significance test of the mediation effect.

Paths	Estimated standardized indirect effect	95% confidence interval	
		LLCI	*ULCI*
PTP <- - -DMO <- - -TL	0.475×0.351=0.167	0.151	0.294
PTP <- - -PMA <- - -TL	0.419×0.201=0.084	-0.047	0.084
PTP <- - -PMA <- - -DMO	-0.004×0.201=-0.0008	-0.02	0.046
PMA <- - -DMO <- - -TL	0.475×(-0.004)=-0.0019	0	0
PTP <- - -PMA <- - -DMO <- - -TL	0.475×(-0.004)×0.201=-0.0004	0	0

According to the study on the relationship between transformational leaders, VI is a significant variable affecting the DMO in universities, with a SPC of 0.31 ($p < 0.01$). Vision is the vision of leaders about shared organizational values, products, and services. Leaders with a TL style are more likely to propose a strong vision (the extent to which the content of the vision is optimistic, unique, value-oriented, and challenging). To some extent, the traditional management mode of hierarchical science and technology restricts the speed and quality of the sustainable development of science and technology work in colleges and universities. Under the new situation, university administrators need to have the courage to change, actively establish the innovation strategic orientation more in line with the needs of market development, innovate the science and technology management mode, and create a more dynamic innovation ecosystem in colleges and universities.

Table 5 The influence path of TL on the DMO.

Paths	Path coefficient	S.E.	C.R.	P	SPC
DMO <- - -VM	.148	.080	1.845	.065	0.12
DMO <- - -VI	.358	.076	4.728	***	0.31
DMO <- - -PC	.071	.062	1.154	.249	0.07
DMO <- - -LC	.140	.082	1.717	.086	0.11

4. CONCLUSIONS

This paper has discussed the interrelationship between transformational leaders and the performance of universities, and the role of MO and PMA variables in the process of patent transformation in the process of patent transformation in universities. The research expands the application of transformational leaders in the field of science and technology management in universities, and enriches the relevant theories and implementation paths for improving the performance of patent transformation in universities. This study confirmed the transformative leadership for the real problems

in the process of science and technology management in China. The significant positive correlation between transformational leaders and PTP has been verified. Secondly, the patent system is the product of the market economy, and monopoly is the social basis of patent survival. The innovation of colleges and universities should strengthen the basic innovation but must not be separated from the overall environment of economic and social development. Strengthening the DMO can significantly improve the PTP of the innovation of colleges and universities. Thirdly, the DMO is part of the intermediary variable that transformational leaders can positively on the performance of patent transformation. University science and technology managers should broaden their horizons and pay close attention to the realistic demand of national and local economic and social development for innovation, so as to effectively improve the PTP of colleges and universities.

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