"Flashy Yet Lacking Substance" or "Lives Up to its Name"? A Study on the Impact of Organizational Biospheric Values on Green Innovation Performance

Roulin Chen
College of School of Economics and Management, Changchun Normal University, Changchun 130000, Jilin, China
chenroulin@ccsfu.edu.cn

Xiaowei Mou*
School of Business, Changchun University of Humanities, Changchun 130000, Jilin, China
mouxiaowei@ccsfu.edu.cn

Abstract: Purpose –Drawing on the new environmental paradigm of values theory, the purpose of this study is to address problems of "being green" from internal ethics and value perspectives, investigating whether organizational biospheric values can impact the green innovation performance, and providing references for enterprises to achieve green innovation performance via organizational environmental ethics and Top Management Team (TMT) faultlines. Design/methodology/approach – A time-lagged research design was used to test hypotheses with data covering 152 heavily polluting enterprises listed on the Shanghai Stock Exchange from 2018 to 2022. Regression analysis using the PROCESS macro in SPSS is used to test the hypotheses. Findings – The results show that the organizational biospheric values promote the performance of green innovation in both product and process, and the organizational environmental ethics plays mediation role partly. Furthermore, the physiological faultline of TMT negatively moderates the impact of the organizational biospheric values on organizational environmental ethics. Practical implications – The findings provide implications for enterprises, especially those of heavily polluting industies, to increase the awareness of organizational environmental ethics and values, and improve green innovation behaviors, all of which helps enterprises increase green innovation performance and seek a stable balance between economic development and environmental benefits. Originality/value – The study breaks the limitation of the existing literature which focuses on the influence of external push factors (e.g. environmental regulation), and bring new visions in enhancing green innovation performance, not only extending the new environmental paradigm of values theory, but also enriching the current studies in green management. Furthermore, this study also provides references for developing countries where heavily polluting industries pose threat to the natural environment.
Keywords: Organizational Biospheric Value; Organizational Environmental Ethics; TMT Faultling; Green Innovation Performance

1. INTRODUCTION

With the rapid development of China's economy over the past 20 years, environmental issues have become increasingly prominent. In the 2017 national air pollution data, the average concentration of $PM_{2.5}$ in most cities in the central and eastern regions continued to increase. In response to this, the 2019 Government Work Report focuses on the relationship between pollution prevention and control and enterprises, emphasizing that as a key player vis-à-vis pollution prevention and control, enterprises need to recognize the synergy between pollution prevention and control and high-quality economic development, continuously innovate and reform environmental governance methods, and assist the country in its three major battles for blue skies, clear waters, and clean land. Therefore, under the current rigorous environmental protection campaign, how enterprises can transform their original production, operation methods and effectively promote sustainable development has become the most urgent demand for enterprises (Chen & Cao, 2025). Even many companies have taken measures to obtain environmental benefits and sustainable development advantages, "turning into the green" is not that easy for the whole manufacturing industry. Several companies still only view green innovation as a simple environmental behavior, such as purchasing clean equipment or using environmentally friendly packaging for products, without fundamentally understanding the significance of green innovation from value perspectives. This can easily lead to the corporate dilemma of "policies from the top, countermeasures from the bottom", and even trigger speculative behavior such as "greenwashing," thereby making it difficult to truly enhance green innovation performance. Therefore, how can this information asymmetry and speculative behavior issues be overcome to enable companies to truly achieve green management? How can companies voluntarily and actively participate in environmental practices, and how can environmental moral standards be implemented in corporate performance output? What role do corporate top management teams (TMTs) play in this process? How does the differentiation within TMTs affect the implementation of green management in companies? These are urgent questions calling for answers in organizational environmental management research. To solve this environmental dilemma, the construction of corporate values is the foundation for implementing strategic actions, which is believed to impact the output performance levels of enterprises and help enterprise to change the

polluted behavior from the root (Corrocher & Solito, 2017). Unlike traditional environmental values, the organizational biospheric value incorporates the sustainable development of the biosphere into the concept of corporate values based on the reflections of the sustained attention to the quality environment of the biosphere. The level of recognition that corporations have for organizational biospheric value determines the breadth and depth of their environmental strategic planning and organizational behavior, which stimulates enterprises to focus on the entire biospheric system and deeply establish corporate biosphere system innovation, making imitation difficult for competitors and thus impacting the enterprise performance. Therefore, it is of both theoretical and practical significance to explore the impact of the organizational biospheric value on the performance of green innovation from the perspective of corporate values. Although there have been numerous studies on corporate green innovation and biospheric values, certain limitations still remain:

(1)Existing researches on biospheric values tend to be macroscopic, focusing on the social and ecological aspects of building a framework for ecological civilization and is rarely applied to management studies. Few studies have investigated how the construction of organizational biospheric values affects the performance of green innovation practices in specific product production processes, which is crucial for guiding green practices and unlocking innovation potential.

(2)Previous research on green innovation has mainly focused on the consciousness and behavior of green innovation, analyzing its impact on corporate strategic layout and competitive advantage. However, as green innovation is not always actively generated, few studies have explored the driving factors and mechanisms from the perspective of values.

(3)Although studies on TMT faultlines have overcome the limitations of TMT heterogeneity, few have explored the detailed impact of faultlines on green innovation performance and environmental management, rendering it difficult to provide practical guidance for enterprise green management practices.

Therefore, to fulfill the research gap and help enterprises improve environmental behaviors, this study takes organizational biospheric values as the research entry point to analyze both the mediation role of organizational environmental ethics and the moderation role of TMTfaultlines. From the perspective of internal values, it clarifies the formation path of green innovation performance and provides a reference for corporate green innovation and transformation.

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

2.1 Theoretical Foundation and Concept Definition

Stern and Dietz (1994) incorporated values and norms into the analysis framework of environmental behavior based on the integration of psychology value theory, norm activation theory, and environmental sociology theory, proposing the causal chain of "values-beliefs-norms-environmental behavior" for the influence of environmental responsibility on corporate behaviors (Rajgopal & Rappaport, 2021). Under this causal chain, values are the basic principles for judging things and guiding practice, beliefs are the process of transforming values into norms, norms are the direct results of beliefs, and environmental behavior is the process of forming environmental performance. With environmental protection values in mind, staff and enterprises can hold the belief of pro-environment cognition, thus establishing proactive norms for their production behaviors, and impacting the green innovation performance (Stern & Dietz, 1994). In other words, moral norms can be activated not only by the social-altruistic values, but also by biopheric values, and environmental protection norms are rooted in individuals' intrinsic values, which exert subtle influence on the overall performance. For macroeconomic society, enterprises are its micro-level individuals and constituents, hence, this study elevates the new environmental paradigm of value theory to the enterprise level, reflects the enterprise's environmental ethics norms as the result of establishing environmental beliefs, and quantifies the output as the quantitative result of environmental behavior, thereby reconstructing the "values-norms-output" model of enterprises and exploring the deep-seated value factors and mechanisms that affect the output of the green innovation performance of enterprises.

2.2 Concept Definition

"Biospheric values" is proposed by combining value theory and ecology, which the moral orientation of individuals when faced with environmental problems by evaluating the costs and benefits of the biospheric system (Stern & Dietz, 1994). This study extends the research perspective of biospheric values to the organizational level, defining "organizational biospheric values" as a direction established by the enterprise that closely links the organization and employees to the protection of the entire ecological system, considering not only the welfare of human populations but also the interests of non-human species (Chen & Lee, 2022). Currently, research on biospheric values mainly focuses on exploring the meaning

from the perspective of employees. However, individual values are influenced by the enterprise's internal environment, and enterprises are also regarded as microcosmic entities that respond to social environmental pressures, therefore, exploring this concept from the organizational level has stronger theoretical and practical significance. Based on it, this study aims to explore the impact of organizational biospheric values on corporate environmental norms and behaviors, finding out how organizations can improve their green innovation performance under the guidance of organizational biospheric values. The definition of "organizational environmental ethics" in this article is mainly based on Ahmed's research, which understands it as the paradigm of moral norms within a company regarding environmental protection (Ahmed et al., 1998). Unlike corporate values, organizational environmental ethics refers to not only norms but also the moral principles and requirements that a company must follow in dealing with its business and natural relationships. It is also the material manifestation of a company's beliefs, including ethical training, coordination, communication, punishment, and supervision with an environmental orientation. Currently, researches on organizational environmental ethics mainly focus on its direct impact on a company's competitive advantage, but few analyze the driving forces behind the formation of organizational environmental ethics norms. For "green innovation performance", this study categorizes it into product and process dimensions (Chan et al., 2016; Chang, 2011). "Green product innovation performance" refers to the innovative and green output of enterprises in the design, manufacture, and sales of products that significantly surpasses other conventional or competitive products by incorporating environmental attributes (Tian & Chen, 2018). "Green process innovation performance" implies the performance level achieved by enterprises through environmental improvement during the production process, such as developing new technologies, updating environmental equipment, and improving clean processes. Although most scholars recognize the necessity of green innovation, some controversies still exist with regard to how to effectively implement green innovation concepts, allocate green innovation resources, promote awareness of the importance of green innovation among all employees, and effectively improve the level of green innovation performance. Therefore, this study will explore how to effectively enhance the cognitive recognition of corporate values from the perspective of organizational biospheric values, aiming to improve green innovation performance. To better explore the effects of different traits of TMTs on corporate strategic behavior, Uddin et al. proposed the concept of

"faultlines" in TMTs to explain the phenomenon of internal disagreement and alienation during the collaboration process (Uddin et al., 2021). Based on the existing literature and dimensions such as age, gender, tenure, and education level, this study divides TMTs into several sub-teams, that is, physiological and task-oriented faultlines. "Physiological faultlines" in TMTs refer to differences that cannot be changed by others due to innate traits such as age and gender. "Task-oriented faultlines" in TMTs refer to differences in members' education level, tenure, and other traits that lead to differences in knowledge and perspectives related to work, thus resulting in the phenomenon of sub-teams (Hutzschenreuter & Horstkotte, 2013). Currently, most studies on situational factors in corporate environmental management explore external factors such as environmental regulations and external stakeholders, while ignoring internal factors, especially the guiding role of different traits of TMTs on corporate strategic behavior (Chhabra & Popli, 2019; Georgakakis et al., 2017). The introduction of the concept of faultlines in TMTs can effectively combine various characteristics of TMT members to form new indicators and better analyze differences in corporate environmental behavior, thereby enabling more detailed research.

2.3. Hypothesis

2.3.1. The influence of organizational biospheric values on the green innovation performance

Based on the Strategic Choice Theory, the construction of a value system determines the choice of enterprise strategic layout (Rajgopal & Rappaport, 2021). In Resource-Based Theory, values, as a form of intangible heterogeneous resource of enterprises, can stably guide innovation practices and gain heterogeneous advantages. With the deepening of the concept of sustainable development, Gansser & Reich regarded values as the root of the new environmental paradigm and believed that actively promoting the concept of biosphere values and considering the sustainable development of the entire biosphere when facing environmental issues is an expression of corporate responsibility for their environment (Gansser & Reich, 2023). This biospheric value provides enterprises with environmental intent and beliefs, influences their environmental attitudes and behaviors in the implementation of specific practices, provides a unique explanation for their pro-environmental behavior, and encourages enterprises to both deepen their green innovation practices and achieve green innovation performance (Lee & Jan, 2015). Specifically, through the

construction of a biospheric value, companies can integrate their core business with environmental protection goals and incorporate environmental values into their specific management behaviors. Starting from the goal of protecting the entire biosphere, companies can proactively adopt "intensive" instead of "extensive" production processes, actively increase product recycling attributes, continuously develop clean technologies for products and processes, and increase maintenance and green upgrades for factories and equipment. From the root of values, companies can inspire environmental innovation, which not only reduces energy consumption, waste, and pollution but also helps protect ecology and biodiversity, improve the game between enterprises and the natural environment, but also enhance the level of green innovation of products and processes. Companies with a stronger biospheric value tend to have more likelihood of focusing on the harmonious development of the entire biosphere, transforming the perceived environmental responsibility into environmental behaviors to a greater extent, and proactively reducing energy consumption at each stage of the product lifecycle, which can help achieve a win-win situation of economic and environmental benefits (Perlaviciute et al., 2016; Tian & Wang, 2019). Therefore, the biospheric value is a critical motivating factor for achieving green innovation performance in products and processes. Accordingly, the following hypotheses are proposed:

H1a: The biospheric value system has a positive impact on green product innovation performance.

H1b: The biospheric value system has a positive impact on green process innovation performance.

2.2.2. The Mediating Effect of Organizational Environmental Ethics

According to environmental management studies, the establishment of the organism value system provides a standard for enterprises to evaluate their strategic behavior and develop environmental standards that are consistent with their values to better guide their practices. As emphasized by scholars such as Chen and Chang , the establishment of corporate environmental ethical standards is driven by the consistency between environmental values and business development goals (Chen et al., 2018; Chen & Chang, 2013). Therefore, in promoting the establishment of environmental ethical norms in enterprises, the guiding role of the organism value should be fully considered. By constructing the organism value, enterprises can form a production and operation philosophy based on the principles of ecological sustainability and humanitarianism to

increase their attention to environmental protection for the entire ecosystem, helping them comprehensively establish ethical norms related to environmental protection, including formulating codes of conduct and policy documents on environmental protection to meet ethical and expected environmental requirements, achieving rapid response to environmental issues, and engendering timely inspection of violations (Chen & Chang, 2013). Consequently, the following hypothesis is proposed:

H2: Organizational biospheric values have a positive impact on organizational environmental ethics.

It is considered that establishing organizational norms and requirements makes it easier for enterprises to correct their strategic mistakes and practices that contradict their values and morals, to ensure the benign innovation and development of the enterprise. Consequently, Chen and Chang further explored the role of organizational environmental ethics in innovation management, and found that the wider the content of environmental ethics norms in enterprises, the stronger the internal value perception and behavioral willingness to promote environmental protection behavior, which could promote the reasonable allocation of green resources and capabilities, provide moral guidelines and requirements for enterprise product development and technical support, and facilitate the achievement of green innovation performance in products and technology (Chen & Chang, 2013). Furthermore, Chen et al. conducted a comparative analysis of the effectiveness of organizational environmental ethics, and found that enterprises with environmental ethical motives were more inclined to match resources in favor of the public, transform environmental values into practice, and more likely to stimulate green innovation behavior and enhance performance, when compared to strategic flexibility (Chen et al., 2018). Therefore, the following hypothesis is proposed:

H3a: Organizational environmental ethics have a positive impact on green product innovation performance.

H3b: Organizational environmental ethics have a positive impact on green process innovation performance.

According to the new environmental paradigm of the value theory proposed by Stern et al.(1994), standards are the means by which enterprises translate their values into environmental behavior. By constructing organizational biosphere value, enterprises can focus on the sustainable development of the entire biosphere, promote the establishment of environmental ethics norms and guidelines, and further

encourage internal compliance with environmental ethics, actively developing environmentally friendly product attributes and clean technologies and transforming environmental responsibilities into green innovation output performance. Consequently, the following hypotheses are proposed:

H4a: Organizational environmental ethics mediate the relationship between organizational biospheric values and green product innovation performance.

H4b: Organizational environmental ethics mediate the relationship between organizational biospheric values and green process innovation performance.

2.2.3. The Moderating Effects of TMT Faultlines

Based on the theory of team faultlines, the cognitive and perceptual biases resulting from innate differences in age, gender, and nationality within TMTs may hinder positive interactions, as well as the recognition and utilization of diverse resources within organizations (Joshi & Roh, 2009; Song et al., 2022). Scholars such as Chen et al. (Chen & Chang, 2013) and Liu and Zhao (Liu Zhiying & Xue, 2017) have found that physiological faultlines within TMTs can cause the team to split into homogeneous sub-teams, resulting in an "us VS them" attitude that is difficult to reconcile, thereby hindering a unified interpretation of organizational values and strategies, reducing team cohesion, and impeding decision-making and strategic actions.When the physiological faultlines within TMTs are large, conflicts and contradictions within the team increase, resulting in higher levels of resource availability but lower levels of information sharing and consensus among the TMTs. When faced with organizational biospheric values, it is difficult for TMTs to reach a consensus on issues related to ecological conservation and enterprise development, thereby increasing the difficulty of formulating ethics standards and supervisory mechanisms related to environmental ethics (Cramton & Hinds, 2004). Conversely, the less apparent the physiological faultlines within TMTs, the less they will affect the standards for unified environmental ethics, and the lower the negative impact on the formation of environmental ethics standards based on organizational biospheric values. Evidently, physiological faultlines within TMTs have a certain degree of influence on the strength of the relationship between organizational biospheric values and the environmental ethics of enterprises. Therefore, the following hypothesis is proposed:

H5: Physiological faultlines within TMTs negatively moderate the impact

of organizational biospheric values on the environmental ethics of enterprises.

Different from physiological faultlines, although task-related faultlines in TMTs refer to the cognitive and conceptual differences among sub-teams regarding their work, there is mutual respect and communication among sub-teams, and interpersonal conflicts will not be triggered in this environment. Cramton and Hinds pointed out in their study that sub-teams of TMTs with task-related faultlines do not have a completely antagonistic relationship and are more likely to cooperate and solve problems of their enterprise together (Cramton & Hinds, 2004). From the perspective of resource cognition, the differences in cognitive characteristics within TMTs often reflect the diversity of team characteristics, which helps to enhance the flexible thinking of TMTs (Ghosh & Klueter, 2022). In addition, Lin et al. proposed that the greater the intensity of the task-related faultlines, the more diverse the knowledge stock of the sub-teams, providing more innovative decision-making choices for the enterprise (Ming et al., 2018). Therefore, when facing organizational biospheric values, TMTs with stronger task-related faultlines are more innovative and have a larger chance to reach a consensus on organizational biospheric values, thus broadening their thinking and forming more comprehensive ethics standards and moral guidelines, urging enterprises to practice environmental protection concepts and enhance the cohesion between organizational biospheric values and environmental ethics. Conversely, when the task-related faultlines in TMTs are weak, it is more difficult to integrate and present deep insights regarding biospheric values, making it challenging to effectively implement the construction of organizational environmental ethics, thereby weakening the relationship between organizational biospheric values and environmental ethics. Therefore, task-related faultlines in TMTs affect the strength of the relationship between organizational biospheric values and organizational environmental ethics to some extent. Based on this, the following hypothesis is proposed:

H6: Task-related faultlines in TMTs positively moderate the influence of organizational biospheric values on organizational environmental ethics.

Based on the above analysis, this study established a theoretical model of "values-norms-environmental behaviors" using the new environmental paradigm of value theory, to explore the mechanism by which organizational biospheric values affect the green innovation performance of enterprises and the mediating role of organizational environmental ethics. This study also analyzes the impact of different types of TMT

faultlines on the practice of organizational biospheric values and the formation of environmental ethic norms and explores the degree to which TMT factors within the enterprise influence its strategic behaviors. The theoretical model is presented in the following section:

3. RESEARCH DESIGN

3.1. Sample Selection and Data Source

Based on the literature review and analysis, this study selected 172 enterprises engaged in heavy-polluting industries and listed on the A-share market of the Shanghai Stock Exchange as the research objects. Taking the relevant data from 2018 to 2022, the relationship between the organizational biospheric values and the green innovation performance of enterprises was analyzed. The sample was screened as follows: 1. Companies with missing data on relevant variables were excluded. 2. Companies with less than 5 years of continuous data were excluded. 3. ST, *ST, SST, and S*ST-listed companies were excluded. 4. To prevent the influence of team size on enterprise practices, companies with high-level management teams of less than 7 people or more than 10 people in any statistical year were excluded. 5. Companies listed after January 1, 2018, were excluded. Consequently, a sample of 152 listed companies was obtained. During the data analysis process, this study obtained relevant data on green innovation performance and high-level management team characteristics from the China Stock Market & Accounting Research Database. Some missing data were supplemented by consulting public corporate annual reports published by the Shanghai Stock Exchange. Relevant data on organizational biospheric values and organizational environmental ethics were obtained partly from the enterprise sustainable development reports and corporate social responsibility reports in the Wind database, and partly from the environmental information disclosure reports analyzed by the Fudan University Center for Environmental Economics Research. Matlab 9.1 software was used for data processing in this study.

3.2. Variable Selection and Model Construction

3.2.1. Measurement of Green Innovation Performance

As green innovation in products is often reflected in green patent applications or grants, this study adopts the number of green patent applications or grants as the indicator to measure the product green innovation performance. As for the measurement of process green

innovation performance, as heavily polluting enterprises often demonstrate their green innovation in the production process through energy conservation and emission reduction, this study uses the ratio of research and development (R&D) investment to energy consumption as the indicator of process green innovation performance. This ratio is positively correlated with the degree of process green innovation in the enterprise.

3.2.2. Measurement of Organizational Biospheric Values

Currently, there are no mature standards for measuring organizational biospheric values in China, and there is a lack of quantitative data related to this concept. Existing research often uses content analysis and questionnaire surveys to measure organizational biospheric values. Specifically, Steg et al. measured biospheric values using four categories: respect for the Earth, harmony and unity of nature, awareness of environmental protection, and cognition of pollution prevention, which is the most common way to categorize the dimensions for measuring organizational biospheric values (Steg et al., 2014). Based on this, to better quantitatively measure organizational biospheric values, this study uses content analysis to analyze corporate social responsibility reports and sustainable development reports and provide scores to evaluate organizational biospheric values based on the measurement categories and description of biospheric values in corporate reports provided by Steg et al.. The scores are used as the measurement index of organizational biospheric values (Steg et al., 2014).

3.2.3. Organizational Environmental Ethics

Similar to the measurement of organizational biospheric values, the current measurement of organizational environmental ethics mainly relies on questionnaire surveys and content analysis, lacking quantitative indicators related to this concept. Weaver measured organizational environmental ethics from the aspects of environmental ethics standards, training, supervisory enforcement, feedback, and punishment (Weaver et al., 1999). Accordingly, Chen and Chang further clarified the content of environmental regulations in environmental ethics standards, specified the contents of environmental procurement and overall environmental auditing in supervisory enforcement, and highlighted the environmental disclosure requirements in organizational environmental ethics (Chen & Chang, 2013). To measure the content of organizational environmental ethics, this study draws on the Corporate Environmental Disclosure Index developed by the Fudan University Center for Environmental Economics

Research, which integrates environmental regulations and systems of enterprises, environmental investment and resource consumption, corporate disclosure of environmental incidents, and the situation of carbon emission reduction. This index is consistent with the content that should be measured in evaluating organizational environmental ethics and has reference significance.

3.2.4. Measurement of TMT Faultlines

This study adopts the quantitative measurement method of TMT faultlines proposed by Thatcher and Zanutto , which has been widely used in academic research (Thatcher et al., 2003). Regarding the measurement of physiological faultlines in TMTs, this study employs age (continuous variable) and gender (categorical variable, a score of zero is assigned for males and one for females) as indicators, while ethnicity is not included due to the small difference within the sample (Song et al., 2022). In terms of measuring task-related faultlines in TMTs, this study uses tenure (continuous variable) and the highest level of education (categorical variable, a score of "1–5" is assigned for associate degrees or below, associate degrees, bachelor's degrees, master's degrees, and doctoral degree or above respectively) as the indicators. Based on the "binary pattern" measurement method employed by many scholars at home and abroad for TMT faultlines indicators, this study divides the team into two sub-teams with no less than two members each and calculates the value of TMT faultlines using the calculation formula developed by Thatcher and Zanutto, which is the sum of squares between sub-teams divided by the total sum of squares(Thatcher et al., 2003).

$$Fau_g = \frac{\sum_{j=1}^{q}\sum_{k=1}^{2} n_k^g (\bar{x}_{jk}-\bar{x}_j)^2}{\sum_{j=1}^{q}\sum_{k=1}^{2}\sum_{i=1}^{n_k^g}(x_{ijk}-\bar{x}_j)^2} \qquad g = 1,2,3,\cdots,s \quad (1)$$

where g represents the method of categorizing the faultlines, q represents the number of characteristics of TMT members, n_k^g represents the number of members in the sub-team k under the gth categorization paradigm, $\bar{x}_{jk}$ represents the mean value of TMT characteristics j in the sub-team k, $\bar{x}_j$ represents the mean value of all TMT characteristics j, and x_{ijk} represents the value of TMT characteristic $j$of the ith TMT member in the sub-team k. Referring to various studies at home and abroad, as independent directors and supervisors have limited roles in corporate strategy, members holding these two positions in TMTs were excluded from the data collection process. However, as the selected indicators include both continuous and categorical variables, to ensure consistent

data, this study used dummy variables to represent the highest education level and gender variables, set the number of dummy variables to the same as the number of categorical variables, and normalized the variables. Similarly, the variables of tenure and age were also normalized. The maximum faultline intensity among all different situations of grouping was taken as the value of faultlines, and the value range is 0–1. The higher the score, the stronger the faultline intensity of the TMT.

3.2.5. Control Variable Measurement

Based on previous studies on organizational values and green management, enterprise size, enterprise age, and enterprise profitability were used as control variables. The description and measurement of each variable are presented in Table 1.

Table 1(a): Variable Description

Variable Name	Symbol	Explanation
Organizational Biospheric Values	OBV	Measurement of corporate values for protecting the natural environment and biosphere, with a higher value indicating stronger organizational biospheric values of the company.
Organizational Environmental Ethics	CEE	Feedback scores on organizational environmental ethics standards, training, supervision, and other aspects.
Green Product Innovation Performance	GPDI	Number of green patents applied for or authorized.
Green Process Innovation Performance	GPSI	Ratio of R&D investment to energy consumption.
Physiological Faultlines In TMT	TF	Intensity of faultlines in TMT due to age and gender.
Task-Related Faultlines in TMT	TD	Intensity of the task-oriented faultlines in TMTs due to tenure and educational background.
Enterprise Size	SIZE	Natural logarithm of total assets.
Enterprise Age	AGE	Length of time the company has been listed.
Enterprise Profitability	PRO	Ratio of total profits to total assets.

4. EMPIRICAL RESULT ANALYSIS

4.1. Descriptive Statistics and Correlation Analysis

Table 2 shows that the current level of awareness of environmental management values in enterprises is relatively high, and they can formulate clear regulations and measures for environmental ethics, as shown by the

mean of standardized ecosystem values of 0.481 with a standard deviation of 0.233. The mean value of organizational environmental ethics is 0.420 with a standard deviation of 0.286, and among the measured variables, the standard deviation of organizational environmental ethics is relatively high, indicating that there are significant differences in the formulation of environmental ethics regulations among enterprises. Among the various dimensions of green innovation performance, the mean value of process green innovation performance is higher than that of product green innovation performance, indicating that enterprises pay more attention to pollution prevention in the manufacturing process and have generally made environmental adjustments in the production process. In the indicators of TMTs' faultline strength, there is a significant difference in faultline strength among various TMTs in enterprises, with the mean value of physiological faultlines (0.524) significantly higher than that of task-oriented faultlines (0.141). The Pearson correlation analysis results in Table 2 show that the correlation coefficients between the variables are relatively small, with the maximum correlation coefficient being 0.297, which is less than 0.3, indicating that the problem of multicollinearity between variables is not significant. Further regression analysis can be carried out.

Table 2: Descriptional Statistic Analysis and Person Analysis Results

	Mean	**SD**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
SIZE	0.519	0.266	1								
AGE	0.541	0.296	0.292	1							
PRO	0.281	0.157	-0.262	-0.246	1						
OBV	0.481	0.233	0.261*	0.109	-0.053*	1					
CEE	0.420	0.286	0.106	0.174	0.076	0.292**	1				
GPDI	0.422	0.208	0.124**	0.069	0.150	0.191*	0.290*	1			
GPSI	0.369	0.288	0.266*	0.187*	-0.021	0.279**	0.253**	0.219	1		
TF	0.524	0.255	-0.280*	-0.154*	-0.245	-0.297*	-0.218*	-0.211*	-0.271**	1	
TD	0.141	0.252	0.179*	0.283*	0.210	0.112*	0.191	0.139	0.227	-0.088	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2. Hypothesis Testing

First, the data were centralized to avoid collinearity, and then hierarchical regression analysis was conducted on the data. The results of the regression analysis are shown in Table 3. Models 2 and 5 indicate that the organizational biospheric values have a significant positive impact on both green product innovation performance ($\beta=0.318$, $p<0.001$) and green process innovation performance ($\beta=0.322$, $p<0.001$) with good normal distribution, thus verifying Hypotheses H1a and H1b. Model 1 indicates that the organizational biospheric values have a significant positive impact

on organizational environmental ethics (β=0.303, p<0.001) with good normal distribution, thus verifying Hypothesis H2. Model 3 and Model 6 indicate that the organizational environmental ethics have a significant positive impact on green product innovation performance (β=0.306, p<0.001) with good normal distribution and green process innovation performance (β=0.170, p<0.001) with good normal distribution, respectively, thus verifying Hypothesis H3a and H3b. However, the impact of organizational biospheric values on green product innovation performance significantly decreases (0.306<0.318), indicating that organizational environmental ethics partially mediate the relationship between organizational biospheric values and green product innovation performance, thus verifying Hypothesis H4a. Similarly, the organizational biospheric values (β=0.215, p<0.01) and organizational environmental ethics (β=0.104, p<0.05) positively influence green process innovation performance. However, the impact of organizational biospheric values on process green innovation performance significantly decreases (0.215<0.322), indicating that organizational environmental ethics partially mediate the relationship between organizational biospheric values and process green innovation performance, thus verifying Hypothesis H4b.

Table 3: Regression Results (Mediated Effect)

	CEE		**GPDI**			**GPSI**	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
SIZE	0.076	-0.021	-0.016	0.005	0.100	-0.010	0.012
AGE	0.225	0.371*	0.292*	0.178**	0.194*	0.265**	0.150*
PRO	0.224*	0.241**	0.196	0.091	0.292**	0.075	0.106
OBV	0.303***	0.318***		0.206*	0.322**		0.215**
CEE			0.306***	0.138*		0.170***	0.104*
R^2	0.132	0.334	0.192	0.266	0.334	0.372	0.470
A- R^2	0.041	0.264	0.107	0.167	0.264	0.306	0.399
F	2.663***	4.759***	2.253***	2.684***	4.759***	5.633***	6.566***

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 4(a): Regression Results (Moderated Effect)

	CEE			
	Model 8	**Model 9**	**Model 10**	**Model 11**
SIZE	0.076	0.119	0.100	0.083
AGE	0.255*	0.299	0.285*	0.282*
PRO	0.238	0.312*	0.288**	0.311
OBV	0.283*	0.235**	0.259**	0.279*
TF	-0.209**	-0.033*		
TD			0.109*	-0.021

Table 4(b): Regression Results (Moderated Effect)

	CEE			
	Model 8	**Model 9**	**Model 10**	**Model 11**
TF* OBV		-0.053*		
TD* OBV				0.002
R^2	0.243	0.311	0.306	0.310
A- R^2	0.140	0.196	0.212	0.195
F	2.371***	2.705***	3.256***	2.695

* p < 0.05, ** p < 0.01, *** p < 0.001

Models 8 and 10 introduced moderator variables, the TMT physiological and task-oriented faultlines, respectively. From the results, both TMT physiological faultlines (β=-0.209, p<0.01) and task-oriented faultlines (β=0.109, p<0.05) have a significant relationship with organizational environmental ethics, which further verifies their moderating effects. To further verify the moderating effects of TMT discontinuities, this study introduced an interaction term into the model. Model 9 in Table 4 shows that the interaction term between organizational biospheric values and TMT physiological faultlines has a negative impact on organizational environmental ethics (β=-0.053, p<0.05) and that the explanatory power of organizational environmental ethics (R^2) increases by 0.334, which supports H5. Model 11 in Table 4 shows that the interaction term between organizational biospheric values and TMT task-oriented faultlines has a positive impact on organizational environmental ethics, but the result is not significant, indicating that there is no explicit linear relationship between the interaction term and organizational environmental ethics (β=0.002, p>0.05). Moreover, the explanatory power of organizational environmental ethics (R^2) decreases by 0.561, which does not support H6.

4.3. Robustness Test

4.3.1. Sobol Sensitivity Analysis

To further validate the accuracy of the research results, this study used Sobol sensitivity analysis to measure the first-order sensitivity and global sensitivity of the entire input function by decomposing the total variance into individual variable variances and interactions between variables and thus clarifying the impact of interactions between variables on the objective function. The results are shown in Table 5. The results show that except for the TD moderated effect model, the global sensitivity of all variables in the other models exceeds 10%, indicating that the variables in these three models can activate their corresponding outcome variables, which is

consistent with the results of this study.

Table 5: Sobol Sensitivity Analysis Result

	Variable	First Order Sensitivity	Global Sensitivity
CEE Mediated Effect （GPDI）	OBV	0.410	0.401
	CEE	0.119	0.107
CEE Mediated Effect（GPSI）	OBV	0.440	0.411
	CEE	0.189	0.193
TF Moderated Effect	OBV	0.291	0.320
	TF	0.531	0.550
TD Moderated Effect	OBV	0.007	0.014
	TD	0.369	0.376

4.3.2. Variable Replacement Test

In addition, this study conducted a robustness test using the variable replacement method as follows: (1) By analyzing corporate social responsibility reports and sustainable development reports, this study uses content analysis based on Weaver's measurement items to measure the score of organizational environmental ethics from four aspects: whether the company has clear environmental regulations(Weaver et al., 1999), environmental ethical guidelines, environmental training, and environmental punishment systems (scoring 1 point if one aspect is met). The model was then analyzed through regression, and the results were consistent. (2) Considering the lag of output conversion, the data of energy consumption, green patent applications, or authorizations were lagged by one year to calculate the green innovation performance index. The model was then analyzed through regression, and the results were consistent.

5. DISCUSSIONS

5.1 Result Discussions

Based on the results, it can be found that organizational biospheric values are an important value-driven factor for companies to achieve green innovation performance. This indicates that building and implementing environmental values guided by the sustainable development of the entire biosphere can encourage companies to consciously integrate green elements into production processes and management concepts, thereby enhancing the green innovation level of products and production processes while increasing the organization's recognition and protection of the biosphere's environment, thus improving green innovation p

erformance.Second, environmental ethics standards of companies play a partial mediating role during the process in which values are converted into performance. This finding not only verifies the content of the new environmental paradigm of value theory but also demonstrates that environmental ethics standards are conducive to the materialization of values and improve green innovation performance. This indicates that when companies emphasize organizational biospheric values, constantly implement values and concepts of the biosphere's sustainable development, and promote the implementation of values in internal moral standards and ethical training, they can facilitate environmentally friendly innovative behavior and improve their green innovation performance. Third, TMT faultlines of different types and degrees have varying impacts on organizational environmental ethics. Specifically, TMT physiological faultlines reduce the impact of organizational biospheric values on the formation of organizational environmental ethics, and according to the Sobol sensitivity analysis, have the highest sensitivity value in the model, indicating that TMT physiological faultlines are more easily activated and have a prominent impact on a company's strategic behavior. In verifying the moderating effect of TMT task-related faultlines, although studies show that TMT task-related faultlines contribute to the formation of innovative and environmentally friendly consensus within the enterprise, in this study, the moderating effect of TMT task-related faultlines on the relationship between organizational biospheric values and organizational environmental ethics is not significant. The possible reasons for this are: (1) Although TMT members have diversified their knowledge stocks, it takes time to translate their knowledge stocks into environmental behaviors of their enterprise, which may cause a lag in the manifestation of the effect of TMT task-related faultlines and lead to insignificant verification results. (2) Owing to differences in tenure and education, TMT members may have different perspectives on organizational biospheric values, which may cause differences in their views on promoting the implementation of organizational biospheric values into environmental ethics standards and ethical supervision even if the team tends to cooperate, also resulting in insignificant verification results.

5.2. Management Implications

First, enterprises are advised to reflect on their own environment-related problems and increase their managers' recognition of the organizational biospheric value. Most prior studies emphasized the positive effects of external factors such as technology transfer between enterprises and pressure from stakeholders on the green innovation performance that

improves products and processes while ignoring the positive effects of biospheric values within an enterprise on its green innovation performance. Valuing the construction of organizational biospheric values essentially entails cultivating a positive attitude within the enterprise toward environmental protection issues and maintaining a balance between economic and environmental benefits. Therefore, companies should reflect on their past behavior, actively construct organizational biospheric values, continuously improve the content of organizational biospheric values by actively collecting environmental knowledge and organizing internal environmental training, incorporate biospheric values into the framework of organizational strategies and behaviors, and actively enhance the understanding and recognition of ecological system environmental protection among enterprise members. This will allow the effect to become contagious, helping enterprises to strategically behave to ensure environmental protection and enhance their green innovation performance. Second, the content of organizational environmental ethics standards should be improved. As micro-level entities in the business environment, enterprises should actively integrate environmental protection goals into the overall framework of corporate development and actively improve the construction of an environmental ethics system based on the biospheric value perspective. These include formulating environmental ethics standards and moral codes, constructing a clear environmental behavior responsibility system and ensuring that they assume obligations in accordance with environmental protection charters during the production and operation process, establishing sound training mechanisms of environmental ethics, setting up departments related to environmental ethics to address ethical and moral issues within the company, consequently establishing supervision and punishment mechanisms to ensure improvement in their organizational environmental ethics standards by means of management, selecting suppliers and strategic partners in accordance with organizational environmental ethics standards and criteria, effectively implementing the organizational environmental ethics standards, and achieving network effects of organizational environmental ethics. Third, it is important to pay attention to the construction of corporate TMTs and narrow the physiological faultlines within them. Based on research findings, when recruiting top management personnel, enterprises should consider not only their abilities but also the impact of new members on the faultlines within their TMTs from a team perspective as a way to better implement environmental management in enterprises. It is preferable to choose new members who have characteristics that are closer to those of the whole team in terms of age,

gender, and nationality to reduce the emotional conflicts caused by irrelevant tasks due to physiological factors. This could improve the efficiency of formulating environmental standards. Within the existing TMTs, it is necessary to abandon prejudices caused by physiological factors and adhere to a work attitude of "criticizing the matter, not the person" to reduce the negative impact of physiological faultlines within the TMTs on environmental management in the enterprise. Fourth, for heavily polluting listed companies, although a biospheric value system has generally been established within the organization, the efficiency of transforming values into environmental ethics standards and rules is not high. Therefore, these companies need to further implement the biospheric value system within the company, improve green resource integration, actively develop clean technologies, establish and improve the company's green circulation system, promote the reasonable use of internal and external resources, allocate green resources within the company reasonably, and choose environmental-oriented suppliers outside the company. Furthermore, they also need to actively establish communication and cooperation with universities and research institutions to provide a foundation for better implementation of environmental ethics and better promote the green innovation of products and processes. Companies should actively revise their environmental ethics standards and moral codes, and establish departments responsible for supervision and punishment to supervise the implementation of corporate strategic practices. They should also pay attention to the impact of TMTs on the efficiency of transforming organizational environmental ethics and fully consider the impact of recruiting new members to the TMT on physiological faultlines.

5.3. Research Contributions and Prospects

The research contributions and prospects can be summarized as follows: (1) Based on the value theory environmental paradigm, this study constructs a "value-norm-output" model to explore the value factors that enhance green innovation performance at the organizational level. By combining value theory with management, this study enriches the content of value theory and expands the research ideas in this field. (2) By introducing organizational environmental ethics into the model, this study explores its linkage effect between organizational biospheric values and green innovation performance, changing the previous single-factor model and enriching the content of green management research and corporate ethics. (3) Through a deep understanding of the characteristics of the TMT, this study analyzes the impact of physiological and task-oriented TMT faultlines on the implementation of environmental values in the enterprise,

thus enriching the content of sustainable development theory and team faultline theory, while expanding the research paradigm and ideas of TMTs in green management.This study also has certain limitations that are manifested as follows: (1) In the selection of the measurement of organizational biospheric values, due to data limitations, an indirect measurement method of internal analysis is adopted, which may have some measurement errors. (2) The sample only selects heavy-polluting industry enterprises listed on the Shanghai Stock Exchange, which still has limitations in sample size and industry diversity. Future research will further expand the sample size and industry diversity to improve the generalizability of the research.

6. CONCLUSIONS

We developed a theoretical model with an "biospheric value – ethic norm – environmental behavior" framework to test the internally driven belief factors of green innovation performance in Chinese context. The main conclusions are in Table 6.

Table 6: Summary of Results for Tested Propositions

Propositions	Result
H1a: The Biospheric Value System has a Positive Impact on Green Product Innovation Performance.	Support
H1b: The Biospheric Value System has a Positive Impact on Green Process Innovation Performance.	Support
H2: Organizational Biospheric Values have a Positive Impact on Organizational Environmental Ethics.	Support
H3a: Organizational Environmental Ethics have a Positive Impact on Green Product Innovation Performance.	Support
H3b: Organizational Environmental Ethics have a Positive Impact on Green Process Innovation Performance.	Support
H4a: Organizational Environmental Ethics Mediate The Relationship Between Organizational Biospheric Values and Green Product Innovation Performance.	Support
H4b: Organizational Environmental Ethics Mediate the Relationship Between Organizational Biospheric Values and Green Process Innovation Performance.	Support
H5: Physiological Faultlines Within Tmts Negatively Moderate the Impact of Organizational Biospheric Values on the Environmental Ethics of Enterprises.	Support
H6: Task-Related Faultlines in Tmts Positively Moderate the Influence of Organizational Biospheric Values on Organizational Environmental Ethics.	Not Support

The empirical test of data from enterprises in manufacturing industry in China has succeeded in providing the existence of a positive relationship between organizational biospheric values and green innovation performance. In terms of it, organizational biospheric values exert positive influences in achieving green innovation performance in both product and process aspects. Organization environmental ethics plays a partly mediation role in the relationship between organizational biospheric values and green innovation performance. TMT faultlines exert complex influence on the green identity, and the result proved that physiological faultlines within TMTs negatively moderate the impact of organizational biospheric values on the environmental ethics of enterprises, but the moderation effect of task-related faultlines on the relationship between organizational biospheric values and organizational environmental ethics does not obvious.

7. ACKNOWLEDGMENTS

This study was supported by the Social Science Foundation of Changchun Normal University (grant no. 002015), "Research on Collaborative Mechanism and Development Strategy of Green Agriculture in Jilin Province: From the Perspective of Innovation Value Sharing," Innovation and Entrepreneurship Training Program for College Students, "Research on the Cooperative Innovation Performance Improvement Mechanism of Cluster Enterprises Based on Innovation Value Sharing", and Research Fund for the Doctoral Program of Changchun Normal University.

Funding

This work was supported by Social Science Foundation of Changchun Normal University (SJJ2024001GSK)

References

Ahmed, N. U., Montagno, R. V., & Firenze, R. J. (1998). Organizational performance and environmental consciousness: an empirical study. *Management Decision*, *36*(2), 57-62.

Chan, H. K., Yee, R. W., Dai, J., & Lim, M. K. (2016). The moderating effect of environmental dynamism on green product innovation and performance. *International journal of production economics*, *181*, 384-391.

Chang, C.-H. (2011). The influence of corporate environmental ethics on competitive advantage: The mediation role of green innovation. *Journal of Business Ethics*, *104*,

361-370.
Chen, L., Zhu, Y., & Guo, L. (2018). Research on the motivation of enterprises' green innovation response behavior under multiple institutional pressures. *Journal of management*, *15*(5), 710-717.
Chen, R., & Cao, L. (2025). How do enterprises achieve sustainable success in green manufacturing era? The impact of organizational environmental identity on green competitive advantage in China. *Kybernetes*, *54*(1), 71-89.
Chen, X., & Lee, T. J. (2022). Potential effects of green brand legitimacy and the biospheric value of eco-friendly behavior on online food delivery: a mediation approach. *International Journal of Contemporary Hospitality Management*, *34*(11), 4080-4102.
Chen, Y.-S., & Chang, C.-H. (2013). Utilize structural equation modeling (SEM) to explore the influence of corporate environmental ethics: the mediation effect of green human capital. *Quality & Quantity*, *47*, 79-95.
Chhabra, A., & Popli, M. (2019). Impact of top management team sociodemographic faultlines on speed of foreign direct investment expansion: An emerging market perspective. *Strategic Change*, *28*(3), 209-215.
Corrocher, N., & Solito, I. (2017). How do firms capture value from environmental innovations? An empirical analysis on European SMEs. *Industry and Innovation*, *24*(5), 569-585.
Cramton, C. D., & Hinds, P. J. (2004). Subgroup dynamics in internationally distributed teams: Ethnocentrism or cross-national learning? *Research in organizational behavior*, *26*, 231-263.
Gansser, O. A., & Reich, C. S. (2023). Influence of the new ecological paradigm (NEP) and environmental concerns on pro-environmental behavioral intention based on the theory of planned behavior (TPB). *Journal of cleaner production*, *382*, 134629.
Georgakakis, D., Greve, P., & Ruigrok, W. (2017). Top management team faultlines and firm performance: Examining the CEO-TMT interface. *The Leadership Quarterly*, *28*(6), 741-758.
Ghosh, A., & Klueter, T. (2022). The role of frictions due to top management in alliance termination decisions: Insights from established bio-pharmaceutical firms. *Journal of Management Studies*, *59*(5), 1315-1353.
Hutzschenreuter, T., & Horstkotte, J. (2013). Performance effects of top management team demographic faultlines in the process of product diversification. *Strategic Management Journal*, *34*(6), 704-726.
Joshi, A., & Roh, H. (2009). The role of context in work team diversity research: A meta-analytic review. *Academy of management journal*, *52*(3), 599-627.
Lee, T. H., & Jan, F.-H. (2015). The effects of recreation experience, environmental attitude, and biospheric value on the environmentally responsible behavior of nature-based tourists. *Environmental management*, *56*, 193-208.
Liu Zhiying, & Xue, Z. (2017). The impact of senior management team fault zone on dual innovation: an empirical study based on Chinese listed pharmaceutical companies *Technical Economy*, 45-52.
Ming, L., Haifeng, Q., & Fanghui, J. (2018). Task-related top management team faultline, mixed-ownership structure and innovation performance in state-

owned companies. *Science Research Management*, *39*(8), 26.

Perlaviciute, G., Steg, L., & Hoekstra, E. J. (2016). Is gas perceived as sustainable? Insights from value-driven evaluations in the Netherlands. *Energy research & social science*, *20*, 55-62.

Rajgopal, S., & Rappaport, A. (2021). Value-Added Per Share (VAPS): A Value-Relevant Corporate Performance Metric. *Journal of Applied Corporate Finance*, *33*(1), 58-67.

Song, Y., He, H., & Yan, C. (2022). Impacts of top management team fault-line on firm's innovation—Financial slack over-investment and underinvestment. *Managerial and Decision Economics*, *43*(8), 3348-3360.

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental psychology*, *38*, 104-115.

Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of social issues*, *50*(3), 65-84.

Thatcher, S. M., Jehn, K. A., & Zanutto, E. (2003). Cracks in diversity research: The effects of diversity faultlines on conflict and performance. *Group decision and Negotiation*, *12*, 217-241.

Tian, H., & Chen, R. (2018). The impact of green product innovation on green competitive advantage of corporate. *Science & Technology Progress and Policy*, *35*(16), 38-46.

Tian, H., & Wang, Y. (2019). Research on the impact of enterprise environmental strategy on enterprise triple performance. *Journal of Xi'an Jiaotong University*, *39*(4), 19-26.

Uddin, M. A., Biswas, S. R., Bhattacharjee, S., Dey, M., & Mahmood, M. (2021). Inspiring employees' ecological behaviors: The roles of corporate environmental strategy, biospheric values, and eco-centric leadership. *Business Strategy and the Environment*, *30*(5), 2367-2381.

Weaver, G. R., Trevino, L. K., & Cochran, P. L. (1999). Corporate ethics programs as control systems: Influences of executive commitment and environmental factors. *Academy of management journal*, *42*(1), 41-57.