A MODEL OF GREEN MANAGEMENT SUCCESS IN IRON AND STEEL ENTERPRISES IN CHINA

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A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Management

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DECLARATION

I, Li WuJun, hereby certify that the work embodied in this dissertation entitled "A Model of Green Management Success in Iron and Steel Enterprises in China" is result of original research and has not been submitted for a higher degree to any other university or institution.

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ABSTRACT

Title : A Model of Green Management Success in Iron and Steel Enterprises in China

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The study aimed to address the following objectives: 1) to identify and explore the primary factors influencing the functioning of green management practices within China's iron and steel enterprises; 2) to assess the connection between green transformational leadership and employees' pro-environmental behavior; 3) to examine whether green self-efficacy and green organizational culture acted as mediators within that relationship. A mixed-methods approach was used to guide the investigation. On the quantitative side, 600 structured questionnaires were distributed to employees across the sector. The qualitative portion consisted of interviews of twelve individuals, eight from companies (including senior leaders, managers, and production staff), two from regulatory bodies or industry associations, and two experts in sustainability. Data were examined using descriptive statistical tools, including frequency, mean, and standard deviation, as well as confirmatory factor analysis and structural equation modeling, to assess the relationships and test for mediation.

The findings revealed a strong correlation between green transformational leadership and employees' environmentally conscious behavior. Leaders who modeled green values appeared to shape both individual confidence in environmental actions and

the broader organizational culture. These two elements, self-efficacy and culture, also played a mediating role, helping to explain how leadership translated into greener behavior across teams. Altogether, the results highlight how leadership influences sustainable outcomes and why organizations in the sector may benefit from strategies that integrate both cultural and individual drivers of change.

Keyword: green management success, green transformational leadership, green self-efficacy, green organizational culture, employee green behavior

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1.1 Background of the Problem

Since China's economic reform and opening-up in 1978, the nation has experienced rapid economic expansion, with an average annual growth rate of approximately 10% (Investerest, 2020; Wan, 1998; Song & Woo, 2008). However, this economic boom has resulted in significant environmental consequences, including resource depletion and escalating pollution levels (Sun et al., 2021). Environmental protection has thus become a critical global concern (Ones & Dilchert, 2012; Imbrogiano & Nichols, 2021).

The iron and steel industry serves as a cornerstone of China's industrial economy. In 2011, the industry produced 683.27 million tons of steel, increasing to 1.033 billion tons by 2021—marking a 15.45-fold growth (China Iron and Steel News, 2021). However, this rapid development has contributed substantially to environmental pollution (Shuping & Hanshi, 2019). In 2021, China's carbon dioxide emissions surpassed 11.9 billion tonnes, representing 33% of global emissions (Smith, 2022). This has led to severe environmental repercussions, including rising global temperatures, extreme weather conditions, ocean acidification, biodiversity loss, and threats to food security (Qu & Wu, 2020). Consequently, transitioning from high-speed growth to high-quality, sustainable development has become imperative for the iron and steel industry.

In response to these challenges, the State Council of the People's Republic of China has emphasized the adoption of sustainable development practices, including carbon peaking and carbon neutrality (State Council of the People's Republic of China, 2021). Additionally, the Ministry of Industry and Information Technology, the Development and Reform Commission, and the Ministry of Ecology and Environment (2022) have issued guidelines for promoting sustainable practices within the steel industry, setting a carbon peaking target for 2030. To achieve these goals, steel enterprises must integrate green management strategies, such as accurate carbon accounting, carbon trading, green technology innovation, energy efficiency measures, and specialized carbon neutrality training programs.

Under the concept of green management, Green management emphasizes ecological sustainability by integrating circular economy principles to ensure environmental protection, ecological balance, and sustainable production processes. Through the implementation of green management practices, steel enterprises can minimize emissions, reduce environmental pressures, and enhance sustainability (Zhou, 2023). Furthermore, green management fosters innovation, competitiveness, and long-term industrial sustainability (Dong, 2024; Zhou, 2022). It enhances resource efficiency, lowers energy consumption, and mitigates pollution (Li & Wu, 2023).

Green management involves strategic organizational practices aimed at promoting environmental protection and sustainability. The key elements of green management include leadership, corporate culture, employee self-efficacy, and environmental behaviors (Hu et al., 2022). Leadership plays a pivotal role in driving green initiatives by setting environmental goals and inspiring employees to adopt sustainable practices (Zacher et al., 2024). Moreover, an organization's environmental culture significantly influences its employees' engagement in green behaviors (Liu & Lin, 2020). Green self-efficacy—employees' confidence in their ability to participate in environmental protection efforts—directly affects their willingness to engage in green behaviors (Chen et al., 2014). Employee behaviors, such as energy conservation and resource recycling, are shaped by green leadership, corporate culture, and self-efficacy (Aggarwal & Agarwala, 2022).

Green transformational leadership is a key driver of environmental sustainability, as it instills environmental values and fosters employees' green self-efficacy (Peng et al., 2019; Peng et al., 2020). A strong green organizational culture, as reflected in leadership practices, encourages employees to adopt environmentally friendly behaviors (Xiao, 2023; Yu et al., 2021). Employees with high green self-efficacy are more likely to participate in sustainability efforts, thereby supporting green management objectives (Zhu et al., 2022; Peng et al., 2020; Zhu & Zhang, 2022).

1.2 Significance of the Problem

In the context of escalating global environmental challenges, the iron and steel industry, characterized by high energy consumption and emissions, faces a critical imperative for green transformation to achieve sustainable development. However, existing research has paid limited attention to the role of leadership in fostering employees' green behaviors, particularly regarding how green transformational leadership influences such behaviors through organizational culture and employees' self-efficacy.

This study aims to explore the impact of green transformational leadership on employees' green behaviors within Chinese iron and steel enterprises, focusing on the mediating roles of green organizational culture and green self-efficacy. By thoroughly examining these relationships, the following research gaps will be addressed.

Firstly, it is aimed to enhance the Understanding of Green Transformational Leadership, while prior studies suggest that green transformational leadership can stimulate employees' green behaviors, the specific pathways and mechanisms remain underexplored. This research introduces green organizational culture and green self-efficacy to elucidate how leadership fosters green behaviors by shaping the organizational environment and boosting employees' confidence.

Secondly, expanding perspectives on green organizational culture, organizational culture significantly influences employee behavior; however limited research has investigated how green organizational culture mediates the relationship between leadership

and employees' green behaviors. This study examines the mediating effect of green organizational culture, contributing to the theoretical discourse in this domain.

Thirdly, it highlights the role of green self-efficacy. Employees' self-efficacy is a crucial determinant of their behaviors. This research assesses the mediating role of green self-efficacy between green transformational leadership and employees' green behaviors, offering new insights into promoting such behaviors.

Through this study, the research aim to deepen the comprehension of the interplay among leadership, organizational culture, and employee behaviors, providing empirical support for green management practices in iron and steel enterprises and aiding their pursuit of sustainable development in a competitive market.

In order to clarify the research context, theoretical foundations, and the identified gaps, the following schematic map (Research Gap Map) has been developed as shown in Table1.1.

Table 1.1

Research Gap Map

Context	Theories Chosen	Key Variables	Identified Gaps
China's Iron and Steel Industry facing dual-carbon policy pressure	Transformational Leadership Theory (Bass, 1985); Green Transformational Leadership (Chen & Chang, 2013)	Green Transformational Leadership (GTL)	Insufficient understanding of how leadership styles specifically foster sustainable behaviors at employee level in heavy industries
High energy consumption and environmental burden of steel manufacturing	Social Cognitive Theory (Bandura, 1986)	Green Self-Efficacy (GSE)	Limited empirical exploration of employees' perceived capability to influence environmental outcomes in resource-intensive sectors
Organizational cultural inertia in traditional manufacturing enterprises	Organizational Culture Theory (Schein, 1985)	Green Organizational Culture (GOC)	Lack of studies on how green leadership transforms organizational norms and behaviors sustainably

Source: Researcher (2024).

Transformational Leadership Theory (Bass, 1985) was selected as a core foundation because it emphasizes the ability of leaders to inspire vision-driven change, encourage innovation, and align individual motivations with collective goals. Within the energy-intensive and hierarchical context of Chinese iron and steel enterprises, leadership behavior plays a disproportionately strong role in shaping organizational actions (Ren et al., 2021). The adaptation into Green Transformational Leadership (GTL) (Chen & Chang, 2013) fits specifically as it incorporates environmental vision into leadership behaviors, directly aligning with the industry's urgent need for sustainable transformation.

Social Cognitive Theory (SCT) (Bandura, 1986) was chosen to complement leadership perspectives by focusing on internal psychological mechanisms, particularly Green Self-Efficacy (GSE). In the steel industry, where operational tasks are often rigid and highly structured, employees' belief in their capacity to contribute to environmental initiatives critically influences the success of top-down policies (Zhao et al., 2021). SCT highlights how self-efficacy beliefs mediate between external influences (leadership and culture) and individual behaviors, making it essential to understand green behavior change in this sector. Integrating these theories allows this research to explore not only direct leadership effects but also the mediating psychological and cultural mechanisms that are pivotal in industries characterized by deep-rooted operational habits and resistance to change.

1.3 Research Question

How is a model of green management success in iron and steel enterprises developed in China?

1.4 Research Objectives

1) To investigate what factors comprise green management success model in the context of iron and steel enterprises in China.

This objective seeks to explore the organizational and behavioral variables that impact the success of green management in high-emission sectors like iron and steel. The

complexity of implementing sustainability in such industries requires attention to leadership style, employee awareness, resource allocation, and industrial constraints (Chen & Li, 2019; Wang, 2019). Understanding these factors is essential for building targeted and practical green strategies.

2) To identify the relationship between Green Transformational Leadership and Employee Green Behavior.

This objective addresses how leaders who emphasize environmental values and vision can influence employees to act in environmentally responsible ways. Prior studies have demonstrated that transformational leadership styles are positively associated with sustainable behaviors among employees (Chen & Tang, 2019; Robertson & Barling, 2013). In the context of China's hierarchical industrial culture, leadership plays a pivotal role in shaping organizational direction and employee behavior.

3) To investigate the mediating effect of Green Organizational Culture and Green Self-efficacy on Employee Green Behavior, through Green Transformational Leadership.

While leadership sets the tone, its influence is often mediated by shared values and psychological empowerment. Green organizational culture helps institutionalize sustainability (Harris & Crane, 2002; Zhang & Dong, 2022), while green self-efficacy strengthens employees' confidence in their ability to perform pro-environmental behaviors (Bandura, 1997; Aggarwal & Agarwala, 2021). Clarifying these mechanisms deepens understanding of how green leadership translates into behavior.

4) To develop a green management success model for iron and steel enterprises in China.

This final objective aims to synthesize the findings into a coherent conceptual model that reflects the interrelationships between green leadership, culture, self-efficacy, and employee behavior. The goal is to produce a framework that not only advances theoretical understanding but also offers practical implications for organizational transformation (Yusliza et al., 2020; Chandra et al., 2021).

1.5 Scope of the Study

In this study, the scope was classified as follows:

- Scope of Area

The analysis concentrated specifically on the iron and steel manufacturing sector in mainland China, with a distinct focus on enterprises that are registered under the auspices of the China Iron and Steel Association.

- Scope of Population

For the quantitative sampling, the research targeted a population of 1,359,300 industry professionals (CISA, 2023) and used 600 structured questionnaires.

For the qualitative interviews, this study conducted interviews with twelve individuals closely related to green management, including eight employees from iron and steel companies, two officials from the Ministry of Industry and Information Technology, and two experts from the green industry.

- Scope of Content

The research topic under consideration pertains to the influence of green transformational leadership on employee pro-environmental behavior in the context of Chinese iron and steel enterprises, with a specific focus on green organizational culture and green self-efficacy serving as mediating variables. This investigation is fundamentally grounded in several theoretical frameworks, including transformational leadership theory, social cognitive theory, planned behavior theory, and sustainable development theory.

- Scope of Time

The research commenced in March 2024 and lasted for completion by March 2025.

1.6 Expected Results

1) This research proposes a new concept of green management success.

2) The model of green management success is expected to provide a framework for Chinese iron and steel enterprises to reduce their carbon dioxide emissions and environmental impact in line with national and global sustainable development goals, thereby contributing to the broader goals of sustainable development.

3) The government can use the findings of the study to improve the sustainable development of Chinese iron and steel enterprises.

1.7 Key Definitions

Green management success refers to a comprehensive outcome in which an organization implements environmental sustainability strategies, guides employees' green behavior, and enhances environmental performance through the development of internal culture and individual capabilities.

Green transformational leadership refers to those leaders who effectively inspire the dedication and enthusiasm of employees towards the preservation of the environment, thereby directing the organization toward sustainable development objectives.

Employee green behavior encompasses the individual actions undertaken by employees within the workplace that contribute to the attainment of environmental sustainability objectives.

Green self-efficacy denotes an individual's conviction regarding their capability to organize and execute the requisite actions to achieve environmental objectives.

Green organizational culture signifies the collective environmental management values, beliefs, norms, symbols, and practices prevalent within an organization that direct employees in the pursuit of sustainability objectives.

CHAPTER 2
LITERATURE REVIEW

The literature related to the research titled "A Model of Green Management Success in Iron and Steel Enterprises in China" is explored in this chapter, which is structured as follows:

2.1 Introduction to Green Iron and Steel Industry in China

As global environmental challenges intensify, and pursuant to the strategic framework delineated by China's carbon peak and carbon neutrality objectives, the manufacturing sector—most notably the iron and steel industry—experiences escalating pressures for ecological transformation and sustainable advancement. Given its considerable energy consumption and substantial environmental repercussions, the iron and steel sector is a principal focus of ecological regulatory measures. Within this framework, employee green behavior has emerged as a pivotal element influencing organizational environmental performance (Hu & Yu, 2019; Zhang & Dong, 2022). Employee green behavior encompasses task-oriented activities such as waste reduction and energy conservation, along with extra-role behaviors including the initiation of green innovations and the advocacy for environmental values (Lamm et al., 2013; Ones & Dilchert, 2012).

Among the myriad determinants of employee green behavior, green transformational leadership has attracted considerable scholarly interest for its potential to foster employees' pro-environmental consciousness and actions. Green transformational leadership derives from conventional transformational leadership theory (Bass, 1985) and assimilates environmental objectives into its four dimensions: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration (Robertson & Barling, 2013; Ren et al., 2021). A plethora of empirical investigations has substantiated that green transformational leadership enhances green creativity (Chen & Chang, 2013), promotes green organizational citizenship behavior (Ahmad et al., 2021), and bolsters overall environmental performance (Singh et al., 2020). In the context of China, Li Rui et al. (2020) established that green transformational leadership significantly advances workplace green behavior by augmenting employees' green self-efficacy.

Nonetheless, the relationship between leadership and employee green behavior is neither linear nor simplistic. Researchers have increasingly devoted attention to the mediating mechanisms that underlie this relationship. Green organizational culture, characterized as a system of shared environmental values and norms, plays a fundamental role in shaping employee conduct (Harris & Crane, 2002; Yusliza et al., 2020). Within the Chinese iron and steel sector, Tian Yu and Tian Wei (2020) emphasized that green organizational culture mediates the association between leadership and green behaviors. An additional critical factor is green self-efficacy, which pertains to an employee's confidence in their capacity to contribute to environmental sustainability. Green self-efficacy has been recognized as a vital psychological conduit linking green transformational leadership to employee green behavior (Mousa & Othman, 2020; Zhao et al., 2021). Recent investigations by Chinese scholars such as Peng Bo (2023) and Huang Yan (2022) have further reaffirmed that enhancing green self-efficacy facilitates employee alignment with organizational environmental objectives and enhances behavioral consistency.

Consequently, this research endeavor seeks to elucidate how green transformational leadership affects employee green behavior within China's iron and steel industry, with a particular emphasis on the mediating roles of green organizational culture and green self-efficacy. By integrating a literature review with empirical analysis, this study aspires to bridge theoretical gaps and furnish practical insights. The outcomes are anticipated to assist steel enterprises in attaining their environmental management objectives and to contribute to the broader academic discourse surrounding sustainable leadership and green employee behavior. The theoretical foundation of this study is constructed from four major theories. However, emphasis is placed on two core theories: Transformational Leadership Theory and Social Cognitive Theory which are directly aligned with the central research objectives. Theory of Planned Behavior and Sustainable Development Theory are included as supporting frameworks to strengthen the conceptual development.

2.2 Core and Supporting Theories and Concepts

2.2.1 Transformational Leadership Theory (Core Theory)

Transformational Leadership Theory, pioneered by Burns (1978) and extended by Bass (1985), posits that leaders can inspire followers beyond transactional exchanges by cultivating a shared vision, motivating higher performance, and fostering personal development. Bass introduced four key dimensions: Idealized Influence, Inspirational Motivation, Intellectual Stimulation, and Individualized Consideration.

In the context of green management, this theory has evolved into Green Transformational Leadership (GTL), wherein leaders integrate environmental priorities into leadership practices (Chen & Chang, 2013). GTL inspires employees to adopt sustainable behaviors through role modeling, vision articulation, and empowering innovation.

Particularly in China's iron and steel industry—a traditionally hierarchical and production-focused sector—transformational leadership is pivotal for steering deep cultural and operational changes towards sustainability (Ren, Tang, & Eisingerich, 2021).

2.2.2 Social Cognitive Theory (Core Theory)

Social Cognitive Theory (Bandura, 1986) emphasizes the reciprocal interaction between personal factors, environmental influences, and behaviors. Central to this theory is the construct of self-efficacy—an individual's belief in their capability to perform specific tasks successfully.

Green self-efficacy (GSE) adapts this concept to environmental actions, referring to employees' confidence in contributing to sustainability initiatives (Li et al., 2020). High GSE correlates with proactive green behaviors such as energy conservation, waste management, and advocacy for environmental practices.

In the rigid, heavily regulated environment of steel manufacturing, fostering GSE is crucial to achieving bottom-up behavioral changes that align with organizational sustainability goals (Zhao et al., 2021).

The integration of Transformational Leadership Theory and Social Cognitive Theory provides a robust explanatory framework: leadership behaviors influence environmental culture and self-efficacy, which in turn drive green employee behavior.

2.2.3 Theory of Planned Behavior (Supporting Theory)

Theory of Planned Behavior, conceptualized by Ajzen (1991), asserts that human behavior is predominantly influenced by behavioral intentions, which are subsequently molded by Attitudes, Subjective Norms, and Perceived Behavioral Control. Theory of Planned Behavior has emerged as one of the most extensively utilized frameworks for forecasting pro-environmental behaviors, encompassing green consumption, energy conservation, and recycling practices (Ones & Dilchert, 2012).

Within the organizational milieu, the environmentally conscious behaviors of employees are significantly affected by their attitudes towards environmental issues, the perceived expectations of supervisors and colleagues, and their confidence in their capac ity to perform these behaviors (Lamm et al., 2013). A green organizational culture has the

potential to shape subjective norms, whereas green self-efficacy is intricately linked to perceived behavioral control.

In the context of the Chinese manufacturing industry, Yong et al. (2020) ascertained that all three dimensions of the Theory of Planned Behavior substantially predict green behavior, with perceived behavioral control exerting the most pronounced effect on behavioral intentions. Wu & Zhang (2021) further elucidated that in industries characterized by high environmental pressures, such as steel production, the Theory of Planned Behavior becomes increasingly predictive of green behavior due to external expectations and compliance mandates.

Zhang Hongwei et al. (2021) employed Theory of Planned Behavior in their examination of green performance management, proposing that the enhancement of cultural and behavioral norms can bolster employees' intentions and execution of environmentally friendly actions. Correspondingly, Li Xiaonan (2023) illustrated that the Theory of Planned Behavior serves as a robust framework for scrutinizing employee behavioral modifications in response to China's "carbon peak and neutrality" policy.

Crucially, Theory of Planned Behavior and social cognitive theory can serve as complementary frameworks: while the Theory of Planned Behavior emphasizes the development of behavioral intentions, social cognitive theory focuses on individuals' beliefs regarding their behavioral capabilities. The synthesis of these two theoretical models facilitates a more holistic comprehension of how green leadership translates into tangible green behaviors.

2.2.4 Sustainable Development Theory (Supporting Theory)

Sustainable Development Theory arose in response to the increasing acknowledgment that economic advancement should not occur at the detriment of environmental integrity or social equity. The seminal definition, articulated in the Brundtland Report by the World Commission on Environment and Development (1987), characterizes sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Over the years, this theory has matured into a multidisciplinary paradigm that amalgamates three fundamental pillars: economic viability, environmental stewardship, and social equity (Drexhage & Murphy, 2010; Sachs, 2015). These dimensions not only inform policy-making but also significantly influence corporate and individual behavioral dynamics.

Application in Organizational and Leadership Contexts

In contemporary scholarly discourse, researchers have increasingly commenced the application of Sustainable Development Theory within the sphere of organizational leadership, with a specific emphasis on the capacity of leadership to direct corporations towards enduring environmental accountability and ethical decision-making (Bansal & DesJardine, 2014).

Leaders with a sustainability-oriented vision play a crucial role in driving organizations to integrate environmental and social goals into their strategic plans in order to build long-term competitive advantage. This transformation involves not only strategic adjustments but also fundamental changes in leadership behavior, organizational culture, and internal processes. It reflects the need for leaders to shift from traditional business practices to embracing a deeper responsibility toward society and the environment at all organizational levels (Epstein & Buhovac, 2014; Dyllick & Muff, 2016; Klettner et al., 2014).

Within the framework of employee behavior, the principles of sustainable development advocate for the importance of individual-level environmental behaviors—such as energy conservation, recycling, and waste minimization—as vital components for the realization of broader sustainability objectives (Lozano, 2012; Gadenne et al., 2011). Leaders, particularly those exhibiting a transformational orientation, are instrumental in this endeavor by shaping employees' attitudes and norms concerning sustainability.

Integration with Green Transformational Leadership

Green transformational leadership exhibits a significant congruence with Sustainable Development Theory. Leaders who prioritize visionary green objectives, long-

term ecological considerations, and inclusive stakeholder engagement encapsulate the essence of sustainability (Robertson & Barling, 2013). Their capacity to associate organizational vision with sustainable practices facilitates the cultivation of pro-environmental behaviors among employees, thereby translating the conceptual tenets of sustainable development into practical corporate actions.

Sustainability-oriented leadership has been shown to positively influence both individual and organizational outcomes related to environmental responsibility. Such leadership not only encourages employees to engage in green behaviors and initiatives, but also fosters creativity aimed at solving environmental challenges and enhancing long-term sustainability. When supported by green human resource practices, these leadership styles further reinforce pro-environmental behaviors, such as organizational citizenship behavior for the environment (OCBE). At the organizational level, this form of leadership contributes to improved environmental performance, particularly within sectors such as manufacturing where sustainability is becoming increasingly vital (Mittal & Dhar, 2016; Chen et al., 2014; Ren et al., 2021).

Chinese Context and Industrial Application

In China, the pursuit of sustainable development has been established as a national strategic imperative (Liu & Zhang, 2020). The steel sector, identified as a significant contributor to pollution, faces escalating demands to conform to the nation's "dual-carbon" objectives—achieving carbon peak by 2030 and carbon neutrality by 2060.

In resource-intensive industries such as the steel sector, sustainability-oriented leadership plays a pivotal role in cultivating consistent green behavior among employees. Effective green leadership has been found to significantly influence employees' environmental engagement, particularly when sustainability principles are embedded into organizational culture. Moreover, leadership acts as a key mediator that translates sustainable development policies into actionable practices within organizations, thereby ensuring their practical effectiveness. These findings highlight the importance of aligning

leadership, culture, and policy to drive environmental responsibility in traditional industrial settings (Tian & Tian, 2020; Zhao & Guo, 2022; Zhang et al., 2023).

In conclusion, Sustainable Development Theory offers a robust theoretical framework for elucidating the manner in which green transformational leadership impacts employee green behavior. By advocating for long-term ecological aims, ethical accountability, and systemic analysis, the theory endorses the incorporation of environmental values into the organizational vision and culture. This alignment is instrumental in fostering significant behavioral transformation among employees, especially when facilitated by a green organizational culture and enhanced green self-efficacy.

2.3 Theories and Concepts Related to Green Transformational Leadership

2.3.1 Meaning of Green Transformational Leadership

The interpretation of green transformational leadership exhibits variability among academics, influenced by their distinct theoretical frameworks, sociocultural environments, and research objectives. Analogous to conventional leadership theories, green transformational leadership embodies a multifaceted construct whose precise interpretation is contingent upon the theoretical perspective employed. Chen and Chang (2013) were pioneers in delineating green transformational leadership as a leadership paradigm that amalgamates environmental considerations into transformational actions, thereby motivating employees to engage in environmentally conscientious behaviors through vision, values, and conduct.

Robertson and Barling (2013) posited that green transformational leadership entails the inculcation of pro-environmental values within employees, achieved through exemplary behavior and the promotion of environmentally friendly initiatives within the organizational context. Drawing upon the principles of transformational leadership theory, they underscored the psychological mechanisms by which green leaders galvanize pro-

environmental behavior—particularly through the facilitation of green identity, motivation, and modeling.

Numerous scholars have endeavored to deconstruct green transformational leadership into distinct dimensions. Afsar et al. (2016, 2018) proposed a four-dimensional framework: green idealized influence, green inspirational motivation, green intellectual stimulation, and green individualized consideration, accentuating how green transformational leadership fosters employee pro-environmental behavior through cognitive, emotional, and behavioral pathways. Similarly, Sun et al. (2022) developed a dimensional model grounded in the traditional transformational leadership framework, albeit with green modifications: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration.

Chen, Chang, and Lin (2014) introduced an innovative perspective by incorporating green innovation support as an essential element of green transformational leadership, contending that effective green leaders cultivate a conducive environment that promotes creativity and enhances green performance. This notion is corroborated by the findings of Ren et al. (2023), who refined the dimensions of green transformational leadership to include: green role modeling, green innovation encouragement, green vision articulation, and green goal setting, thereby reflecting a strategic and future-oriented leadership approach.

Further expanding the conceptual framework, Zhao et al. (2022) identified dimensions of green transformational leadership that encompass green empowerment, green motivation, green care, and green learning, underscoring the significance of developmental support and employee autonomy in fostering sustainable behavioral practices. Jiang and Zhao (2023) proposed an augmented model that integrates green idealized influence, green inspirational motivation, green intellectual stimulation, green individualized care, and green environmental goals, thereby offering a more performance-oriented comprehension of green transformational leadership.

Recent studies have expanded the conceptual foundation of green transformational leadership by introducing diverse dimensions that reflect both strategic and ethical commitments. Within the Chinese cultural context, the notion of green humane care has emerged as a unique dimension that highlights leaders' empathy and moral responsibility in fostering employees' environmental engagement. Complementary perspectives emphasize strategic components, such as green vision, communication, and support, which serve to align leadership intent with organizational resources. Additionally, green leadership has been positioned as a core element of broader green human resource management frameworks, incorporating practices like behavioral modeling, encouragement, training, and moral leadership. These multi-dimensional approaches underscore the integrated role of leadership in cultivating long-term learning, ethical guidance, and a deeply embedded green organizational culture (Zhang & Dong, 2023; Wang & Li, 2022; Liu et al., 2021; Ma et al., 2022).

In a localized framework, Wang Yaojuan (2021) accentuated the role of green transformational leadership in promoting a sustainable organizational culture within Chinese manufacturing sectors, acting as a conduit between leadership practices and corporate environmental accountability. Al-Ghazali et al. (2022), while operating within a Middle Eastern context, underscored the mediating influence of green human resource management on the relationship between green transformational leadership and green employee performance, thereby affirming its applicability across diverse cultural settings.

In conclusion, Green Transformational Leadership should not be perceived as a static or monolithic construct; rather, it represents a dynamic leadership paradigm that is tailored to specific environmental contexts. Although it is anchored in the traditional transformational leadership theory (Bass & Avolio, 1994), it distinguishes itself by integrating ecological considerations, employee development, and strategic foresight. Green transformational leadership typically encompasses dimensions such as green role modeling, green vision articulation, green innovation encouragement, green empowerment, green humane care, and green goal setting, which may vary according to the specific research focus. For the purposes of this investigation, green transformational leadership is

operationally defined as a fluid, multidimensional leadership framework through which leaders exert influence on employees' environmental behaviors by articulating green values, exemplifying sustainable practices, fostering innovation, empowering staff, and embedding environmental objectives within the organizational mission. The principal dimensions of green transformational leadership are detailed in Table 2.1.

Table 2.1

Crosscutting of Green Transformational Leadership

Types of GTL / Authors (year)	Environmental Idealized Influence	Environmental Inspirational Motivation	Environmental Intellectual Stimulation	Environmental Individualized Consideration	Green Vision Articulation	Sustainable Role Modeling	Green Innovation Support	Green Goal Setting	Green Humane Care
Chen & Chang (2013)	✓	✓	✓	✓					
Robertson &Barling (2013)	✓	✓	✓	✓					
Mittal & Dhar (2016)	✓	✓	✓	✓					
Graves et al. (2013)	✓	✓	✓						
Afsar et al. (2016)	✓	✓	✓	✓					
Sun et al. (2022)	✓	✓	✓	✓					
Chen, Chang, & Lin (2014)	✓	✓	✓	✓					
Afsar et al.(2018)		✓		✓	✓	✓			
Tian Hong (2022)	✓	✓	✓	✓					
Al-Ghazali et al. (2022)	✓	✓	✓	✓					
Wang Yaojuan (2021)	✓	✓	✓	✓					
Ren et al. (2023)		✓	✓			✓			✓
Zhang & Dong (2023)	✓	✓	✓						✓
Asif et al. (2021)	✓	✓	✓	✓					
Wang et al.（2020)		✓				✓	✓	✓	
Total	12	15	13	11	1	2	1	1	2

Source: Researcher (2024).

Four Dimensions of green transformational leadership

Environmental inspirational motivation represents a critical element of green transformational leadership, wherein leaders inspire employees by articulating a compelling environmental vision and shared goals. This form of motivation not only appeals to employees' emotions and values but also strengthens their sense of responsibility and commitment to environmental objectives. Effective leaders are able to translate abstract sustainability ideals into practical guidance and action plans, using motivational communication and a positive attitude to energize pro-environmental behavior. Such inspiration often takes shape through symbolic initiatives like green campaigns, vision statements, and participatory meetings, which collectively reinforce a culture of environmental optimism and resilience within the organization (Chen & Chang, 2013; Mittal & Dhar, 2016; Sun et al., 2022).

In summary, environmental inspirational motivation pertains to the capacity of green leaders to inspire employees towards the attainment of environmental objectives through the articulation of compelling visions and the communication of pertinent values, thereby enhancing employees' commitment to environmental stewardship and facilitating the effective execution of green strategies.

Environmental intellectual stimulation, as a core dimension of green transformational leadership, involves leaders encouraging employees to critically assess conventional practices, embrace divergent thinking, and generate innovative solutions to environmental challenges. This leadership approach fosters cognitive engagement and empowers employees to think independently, thereby promoting sustainable innovation. Beyond simply supporting new ideas, leaders cultivate an organizational climate that values openness, inclusivity, and continuous learning. Through provocative questioning and the encouragement of eco-conscious alternatives in areas such as energy use, design, and operations, leaders drive improved environmental outcomes and reinforce a culture of environmental mindfulness (Mittal & Dhar, 2016; Chen & Chang, 2013).

According to Sun et al. (2022), green leaders operating within this dimension frequently advocate for employee engagement in environmental initiatives, process reengineering, and interdepartmental collaboration. They emphasize the necessity of integrating environmental innovation with organizational growth, thereby facilitating the translation of green concepts into tangible outcomes.

In conclusion, environmental intellectual stimulation delineates the manner in which green leaders inspire employees to engage in creative thinking and problem-solving through sustainable methodologies, serving as a pivotal influence for the advancement of the organization's environmental strategy.

Environmental individualized consideration is a key element of green transformational leadership, reflecting leaders' efforts to provide personalized support that empowers employees on their path toward environmental growth. By recognizing individual values, skills, and development needs, green leaders can offer tailored guidance that enhances employees' environmental competencies and self-confidence. This includes targeted training, career development opportunities, and resource provision aimed at aligning personal growth with broader sustainability goals. Furthermore, by actively listening to employees' perspectives and challenges related to green practices, leaders build trust, foster engagement, and strengthen intrinsic motivation for environmental action across the organization (Chen & Chang, 2013; Mittal & Dhar, 2016; Sun et al., 2022).

In summary, environmental individualized consideration encapsulates the personalized guidance, emotional support, and empowerment provided by green leaders, which enables employees to advance their engagement in green practices and align more closely with the organization's environmental objectives.

2.3.2 Concepts and Theories Related to Green Transformational Leadership

2.3.2.1 Conceptual Model of Green Transformational Leadership

Green transformational leadership denotes the process through which leaders effectively inspire and motivate employees to engage in environmentally sustainable behaviors by integrating ecological values into the organizational vision, strategic framework, and cultural ethos (Chen & Chang, 2013; Robertson & Barling, 2013). Drawing upon the theoretical framework of transformational leadership (Bass, 1985), green transformational leadership encompasses four fundamental dimensions that have been tailored to address environmental contexts: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration (Mittal & Dhar, 2016; Ren et al., 2021). These dimensions illustrate the capacity of leaders to serve as environmental role models, articulate a compelling green vision, stimulate critical thinking regarding environmental challenges, and provide personalized support to promote ecological development.

The conceptual framework of green transformational leadership delineates various antecedents, including environmental ethical leadership (Zhang et al., 2022), the personal green values held by leaders (Graves et al., 2013), and the implementation of green human resource management practices (Yong et al., 2020). These antecedents significantly influence the emergence and efficacy of green transformational leadership within organizational settings. In terms of resultant outcomes, green transformational leadership exhibits a strong correlation with employee engagement in green behaviors (Tariq et al., 2021), the cultivation of green creativity (Chen & Chang, 2013), the promotion of green organizational citizenship behaviors (OCBE) (Ahmad et al., 2021), and even the overall environmental performance at the firm level (Singh et al., 2020).

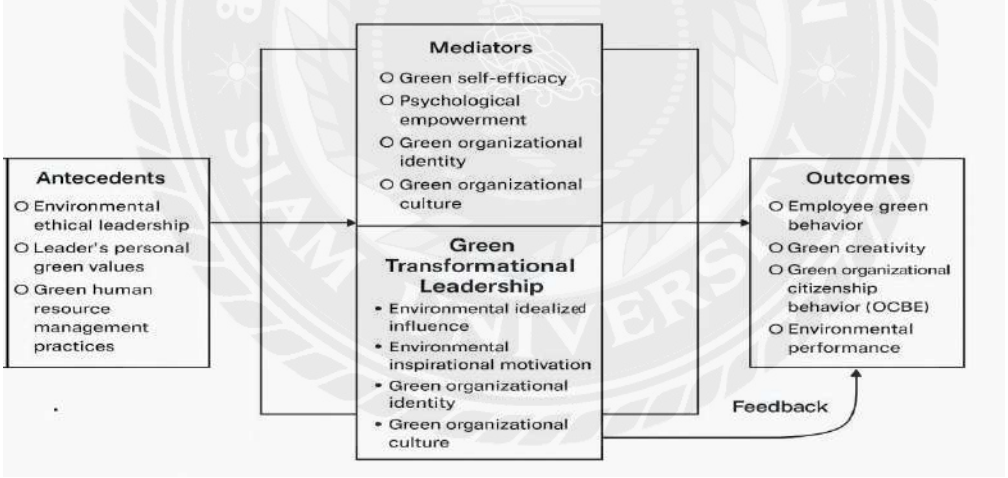
Furthermore, a plethora of studies have elucidated the mediating mechanisms that clarify how green transformational leadership impacts various outcomes. Prominent mediators encompass green self-efficacy (Li et al., 2020), psychological empowerment (Zhao et al., 2021), green organizational identity (Chen et al., 2022), and green

organizational culture (Zhang & Dong, 2022). These variables encapsulate the manner in which green transformational leadership bolsters employees' confidence in their environmental competencies, fosters a sense of purpose, and cultivates a collective ecological identity within the organization.

This model also elucidates a feedback loop, wherein employee engagement in green behaviors and enhanced environmental performance further solidify leaders' commitment to ecological values, thereby engendering a resource gain spiral akin to that described in the Job Demands-Resources (JD-R) model (Bakker & Demerouti, 2007). Over time, green transformational leadership engenders a self-reinforcing system that promotes sustainability-driven innovation and secures long-term competitive advantages. The aspects of this model are illustrated in Figure 2.1.

Figure 2.1

Conceptual Model of Green Transformational Leadership



Source: Researcher (2024).

2.3.2.2 Influence role of Green Transformational Leadership on Employee Green Behavior

Green transformational leadership exerts a significant influence on employee engagement in green behaviors, and the principal perspectives can be summarized as follows:

A multitude of studies has corroborated that green transformational leadership exerts a positive influence on employee engagement in green behaviors (Robertson & Barling, 2013; Chen & Chang, 2013; Mittal & Dhar, 2016). Leaders who exemplify green transformational characteristics—such as articulating an inspiring environmental vision, fostering innovative eco-friendly solutions, and personally exemplifying sustainable behaviors—are more likely to inspire employees to undertake green actions within the workplace (Tariq et al., 2021; Singh et al., 2020).

Chen and Chang (2013) demonstrated that green transformational leadership significantly augments employees' green creativity and voluntary engagement in green behaviors. Robertson and Barling (2017) further contended that green transformational leadership not only facilitates task-related green behaviors but also extends its influence to non-task-related green organizational citizenship behaviors.

Scholars have conducted in-depth analyses regarding the function of green transformational leadership through its fundamental dimensions: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration (Ren et al., 2021). These dimensions significantly influence the capacity of leaders to act as green role models, to evoke emotional engagement in employees through ecological values, to promote critical discourse surrounding sustainability challenges, and to offer tailored support for green initiatives.

Research has delved into a variety of mediators that connect green transformational leadership to employee green behavior. For example, green self-efficacy is recognized as a pivotal psychological mechanism that facilitates the translation of green leadership into

actionable behavior (Li et al., 2020; Mousa & Othman, 2020). Employees who possess a belief in their capability to effectuate a green impact are more predisposed to respond positively to initiatives stemming from green transformational leadership. Likewise, psychological empowerment and green organizational identity function as mediators (Zhao et al., 2021; Chen et al., 2022), thereby augmenting employees' sense of purpose and alignment with environmental objectives.

Furthermore, the influence of green transformational leadership is manifested not solely in individual outcomes but also in behaviors at the organizational level. Green transformational leadership has been correlated with the establishment of a green organizational culture (Zhang & Dong, 2022), thereby cultivating an environment conducive to pro-environmental behaviors among employees. According to Graves et al. (2013), the personal green values held by leaders play a crucial role in nurturing employee green behavior through the alignment of values.

Zaw and Takahashi (2022) identified that green transformational leadership exerts a mediating effect through work engagement, which further reinforces employee green behavior. In a similar vein, Aldoghan (2021) indicated that green transformational leadership exerts an indirect influence on green performance through human resource management practices and employee engagement.

A multitude of measurement methodologies is employed to evaluate employee green behavior. Ones and Dilchert (2012) classified employee green behavior into task-related behaviors (e.g., energy conservation, waste reduction) and voluntary behaviors (e.g., encouraging peers to adopt green practices). Lamm et al. (2013) provided behavioral scales that assess both the frequency and intention of green behaviors exhibited at the workplace.

In conclusion, green transformational leadership serves a pivotal function in advancing employee green behavior. This is achieved through the inspiration, intellectual stimulation, and personalized support provided to employees in their green endeavors, while simultaneously fostering an organizational culture that aligns with sustainability

principles. This leadership paradigm is indispensable for accomplishing enduring environmental performance and cultivating a green-oriented workforce.

2.4.2.3 Influence role of Green Transformational Leadership on Green Organizational Culture

Green transformational leadership is integral to the development and reinforcement of green organizational culture. The salient perspectives derived from previous research are as follows:

Green transformational leaders shape the evolution of organizational culture by integrating environmental values into the foundational vision, strategy, and operational practices of the organization (Chen & Chang, 2013; Ren et al., 2021). They exemplify sustainable practices through both their verbal commitments and actions, thereby nurturing a collective environmental awareness among employees (Robertson & Barling, 2013).

As articulated by Zhang and Dong (2022), green transformational leadership plays a significant role in the cultivation of green organizational culture by motivating employees to internalize green values and norms. Leaders demonstrating environmental idealized influence and inspirational motivation function as role models who advocate for shared ecological objectives and inspire collective commitment to sustainability. Mittal and Dhar (2016) underscored that when leaders intellectually stimulate employees to engage in innovative thinking regarding environmental challenges and provide individualized encouragement for green practices, a green-oriented culture is more likely to materialize.

Green organizational culture is delineated by a collection of shared values, norms, and behaviors that promote environmental sustainability. Green transformational leadership augments these characteristics by bolstering pro-environmental expectations, incorporating sustainability into training and development programs, and acknowledging contributions to green initiatives (Graves et al., 2013; Yong et al., 2020).

Moreover, green transformational leadership cultivates a social learning environment in which pro-environmental behaviors are normalized rather than regarded as anomalies. Through persistent reinforcement and the application of green human resource

management practices, leaders institutionalize environmental values that influence employee attitudes and behaviors in congruence with organizational objectives (Zhang et al., 2022). These practices facilitate the dissemination of green values across various departments and hierarchical levels, thereby further entrenching a green culture.

In addition, numerous studies have posited that green organizational culture may function as a mediating variable between green transformational leadership and diverse green outcomes, including green performance, employee pro-environmental behavior, and green innovation (Chen et al., 2022; Tariq et al., 2021). The existence of a robust green culture amplifies the consistency and sustainability of employee behaviors that align with environmental objectives.

From a strategic vantage point, the green culture induced by transformational leadership presents a competitive advantage, distinguishing the organization within environmentally conscious markets (Singh et al., 2020). This cultural transformation significantly contributes to long-term environmental performance, compliance with regulations, and the cultivation of stakeholder trust.

In conclusion, green transformational leadership assumes a pivotal role in the development of green organizational culture through the modeling of values, the integration of sustainable practices, and the establishment of a collective environmental vision. This leadership paradigm not only promotes immediate pro-environmental behaviors but also engenders a durable cultural shift towards sustainability.

2.4.2.4 Influence role of Green Transformational Leadership on Green Self-Efficacy

Green transformational leadership has been identified as a crucial predictor of green self-efficacy, which pertains to an individual's conviction in their capability to successfully execute pro-environmental tasks (Li et al., 2020). The principal insights derived from prior literature are outlined below:

Green transformational leadership affects employees' psychological states through its four dimensions related to the environment: environmental idealized influence,

inspirational motivation, intellectual stimulation, and individualized consideration (Mittal & Dhar, 2016; Ren et al., 2021). These leadership behaviors empower employees to perceive themselves as competent in making significant environmental contributions, thereby reinforcing their green self-efficacy.

Li et al. (2020) established that when employees regard their leaders as environmentally responsible and supportive, they are more inclined to have confidence in their own abilities to engage in pro-environmental behaviors. This phenomenon is particularly pronounced when leaders articulate a compelling vision for sustainability, serve as green role models, and acknowledge individual contributions to sustainability objectives (Chen & Chang, 2013; Robertson & Barling, 2013).

Green self-efficacy is further nurtured through intellectual stimulation, wherein leaders promote critical thinking and innovative problem-solving in environmental contexts. This approach cultivates employees' confidence in addressing environmental challenges independently (Zhao et al., 2021). Furthermore, individualized consideration provides tailored support and developmental opportunities that bolster employees' confidence in pursuing green initiatives (Graves et al., 2013).

The association between green transformational leadership and green self-efficacy (GSE) has been demonstrated to exert consequential influences on employee green behavior, green innovation, and organizational environmental performance (Ahmad et al., 2021; Tariq et al., 2021). Employees exhibiting elevated levels of GSE demonstrate a heightened propensity to engage in sustainability initiatives, adopt environmentally friendly practices, and maintain resilience in confronting ecological challenges.

Furthermore, green self-efficacy frequently functions as a mediating construct that connects green transformational leadership to an array of environmentally beneficial outcomes. For example, Li and Khattak (2023) illustrated that green self-efficacy mediates the relationship between green leadership and employee pro-environmental behavior. This finding indicates that green transformational leadership not only directly influences

behavior but also cultivates the intrinsic confidence requisite for sustained long-term engagement with environmental issues.

In conclusion, green transformational leadership plays a pivotal role in fostering the development of green self-efficacy by cultivating a supportive, empowering, and environmentally attuned organizational milieu. This psychological empowerment equips employees to act with confidence and proactivity in the pursuit of sustainability objectives.

2.4 Theories and Concepts Related to Green Organizational Culture

2.4.1 Meaning of Green Organizational Culture

Green organizational culture has increasingly emerged as a central theme in the discourse surrounding organizational sustainability research, encapsulating the collective environmental values, norms, and practices that inform employee conduct and shape decision-making processes (Harris & Crane, 2002; Yusliza et al., 2020). Green organizational culture accentuates ecological awareness and weaves sustainability into the very cultural fabric of organizations. It embodies an intrinsic motivational force that bolsters the execution of green strategies and the embracement of environmentally responsible practices (Aggarwal & Agarwala, 2021; Zhang & Dong, 2022).

According to Porter et al. (2016), green organizational culture encompasses environmental missions, norms, and shared symbols that orient employees towards pro-environmental cognition and action. These collectively held understandings cultivate an organizational culture wherein green practices are seamlessly integrated into quotidian operations and long-term strategic frameworks. Anthony et al. (2020) further articulated that a nurturing green culture is instrumental in reinforcing environmental values and stimulating innovation in sustainable initiatives.

Yu and Li (2024) underscored that green organizational culture promotes internal coherence with sustainability objectives by advocating for green values and expectations across the organization. In a similar vein, Al-Shehri and Basweed (2024) observed that

organizations possessing robust green cultures are more predisposed to exhibit consistent environmental behaviors, even amidst external pressures.

Chandra et al. (2021) illuminated that green organizational culture operates as a mechanism of social influence, shaping employees' green behaviors through implicit cultural signals and collective norms. Suyadi et al. (2021) recognized green culture as a fundamental enabler of environmental innovation, fostering a mindset characterized by continuous improvement and engagement with ecological initiatives.

Chen et al. (2019) contended that a mature green culture nurtures organizational competencies in areas such as green human resource management, sustainable supply chains, and responsible leadership practices. Zhang and Dong (2022) noted that within the context of China, green organizational culture aligns with Confucian ideals such as harmony with nature and collective well-being, thereby enhancing the cultural legitimacy of green practices.

Imran and Jingzu (2022) observed that green organizational culture is dynamic, evolving through processes of leadership, learning, and employee socialization. Hadjri et al. (2019) posited that proactive green cultures stimulate innovation and performance, while reactive cultures merely conform to regulatory imperatives.

Wang (2019) articulated that within the manufacturing domain, a green organizational culture serves as a pivotal conduit between environmental accountability and operational efficacy, thereby facilitating the establishment of a sustainable corporate identity.

In summary, a green organizational culture constitutes a dynamic framework of collective environmental values and practices that fosters pro-environmental conduct among personnel. It augments strategic coherence, bolsters green innovation, and fortifies the organization's capacity to attain sustainable performance results (Yusliza et al., 2020; Zhang & Dong, 2022).

Table 2.2

Crosscutting of Green Organizational Culture

Types of GOC / Authors (year)	Degree	Depth	Diffusion	Innovation Green	Green Values	Performance Environmental	System Green Cultural
Harris & Crane (2002)	✓	✓	✓				
Aggarwal & Agarwala (2021)	✓	✓	✓				
Porter et al. (2016)	✓	✓	✓				✓
Anthony et al. (2020)	✓	✓	✓				
Yu & Li (2024)	✓	✓	✓		✓		✓
Al-Shehri & Basweed (2024)	✓	✓	✓				
Chandra et al. (2021)	✓	✓	✓				
Suyadi et al. (2021)	✓	✓	✓				
Chen et al. (2019)	✓	✓	✓		✓		
Zhang & Dong (2022)	✓	✓	✓				
Imran & Jingzu (2022)				✓		✓	
Hadjri et al. (2019)		✓				✓	
Wang (2019)	✓		✓	✓		✓	
Yusliza et al. (2020)					✓	✓	
Yusliza et al. (2020)	✓		✓	✓	✓		✓
Total	12	11	12	3	4	4	3

Source: Researcher (2024).

Three Dimensions of Green Organizational Culture

The degree dimension pertains to the magnitude to which values related to environmental protection are ingrained within the organization's mission, vision, strategic goals, and institutional documents. It signifies the depth of sustainable development's integration into the organization's core value system and acts as the cultural substratum for promoting environmentally friendly behaviors.

Harris and Crane (2002) indicated that only when environmental values ascend to the status of strategic orientation can a genuinely action-oriented green culture be cultivated. Porter et al. (2016) underscored that mere verbal affirmation of green values is inadequate to influence employee conduct. Chen and Chang (2013) proposed that institutionalizing green values aids employees in recognizing and adhering to pertinent environmental practices.

In the context of the steel industry in China, Yu and Li (2024) discovered that the extent of green culture is chiefly manifested through institutional norms, national policy imperatives, and the environmental commitment exhibited by leadership. Organizations that prioritize environmental protection within their developmental objectives are more likely to cultivate employees' sense of environmental accountability.

In essence, the degree dimension signifies the organization's formal dedication to environmental values and constitutes the preliminary phase in the establishment of a green organizational culture.

The diffusion dimension pertains to the efficacy with which green values and behavioral norms are disseminated and shared across various organizational strata and departments. Effective diffusion signifies that environmental values surpass hierarchical boundaries and become ingrained in the cognition and actions of all employees.

Anthony et al. (2020) asserted that the diffusion of green culture is contingent upon systematic internal communication and ongoing training. Aggarwal and Agarwala (2021) highlighted that green values must be incorporated into operational processes, including green procurement and energy-efficient process controls.

Within the steel industry, Zhang and Dong (2022) observed that due to hierarchical and intricate management structures, green values frequently encounter "breakdowns" during dissemination, leading to diminished participation from frontline employees. They advocate for the implementation of green training, interdepartmental communication platforms, and green incentives to facilitate the diffusion of values.

Al-Shehri and Basweed (2024) further observed that effective diffusion hinges not only on top-down leadership initiatives but also on grassroots employee involvement. Suyadi et al. (2021) recommended the establishment of initiatives such as “green ambassadors” and “green project teams” to foster bottom-up advocacy for environmental practices.

Consequently, the diffusion dimension functions as the cultural conduit that translates top-tier environmental ideologies into organization-wide consensus and engagement.

The depth dimension pertains to the degree to which employees have genuinely internalized green values and utilize them as intrinsic motivators for quotidian behavior. This dimension transcends cognitive acceptance to accentuate emotional resonance and behavioral alignment.

Hadjri et al. (2019) posited that when employees perceive environmental protection as integral to their personal mission or professional advancement, the green culture becomes thoroughly integrated within the organizational framework. Yusliza et al. (2020) asserted that the process of internalization necessitates contextual reinforcement, emotional investment, and alignment of values.

In the context of Chinese manufacturing, Wang (2019) identified that the profundity of green culture is contingent upon the extent to which organizations offer educational opportunities and value-oriented guidance. Imran and Jingzu (2022) underscored the significance of leaders’ consistent communication and demonstration of environmentally friendly behaviors as crucial for facilitating internalization among the workforce.

Chandra et al. (2021) proposed the implementation of ritualized practices—such as environmental recognition programs, green storytelling initiatives, and eco-centric events—to cultivate emotional connections between employees and the organization’s environmental objectives, thereby enhancing intrinsic motivation for sustainable behaviors.

The dimension of depth fundamentally determines the capacity of green culture to transcend superficial performative expressions and evolve into a genuine source of behavioral transformation.

2.4.2 Concepts and Theories Related to Green Organizational Culture

2.4.2.1 Conceptual Model of Green Organizational Culture

Green organizational culture encapsulates the collective environmental values, assumptions, and norms that steer employee conduct and organizational practices towards ecological sustainability (Harris & Crane, 2002; Jabbour & Santos, 2008). Grounded in organizational culture theory (Schein, 1985), green organizational culture functions at three distinct levels: artifacts (e.g., recycling receptacles, energy conservation policies), espoused values (e.g., sustainability as a fundamental mission), and underlying assumptions (e.g., the conviction in environmental stewardship). These strata interactively influence employees' perceptions of green expectations and their alignment with environmental objectives (Zhang & Dong, 2022).

The conceptual framework of green organizational culture encompasses various antecedents that affect its development. Prominent drivers include green transformational leadership (Zhao et al., 2022), which instills green values through visionary and behavioral practices; green human resource management (GHRM) practices (Yong et al., 2020), which institutionalize green norms via recruitment, training, and performance evaluation; and corporate environmental ethics and strategy (Aggarwal & Agarwala, 2021), which shape the cultural narrative and indicate a long-term commitment to ecological sustainability.

Regarding outcomes, a robust green organizational culture significantly contributes to a diverse array of pro-environmental results. These encompass employee green behaviors (Tariq et al., 2021), green innovation (Jabbour et al., 2010), environmental performance (Daily et al., 2009), and organizational sustainability (Al-Shehri & Basweed, 2024). Furthermore, green organizational culture serves a mediating function in connecting

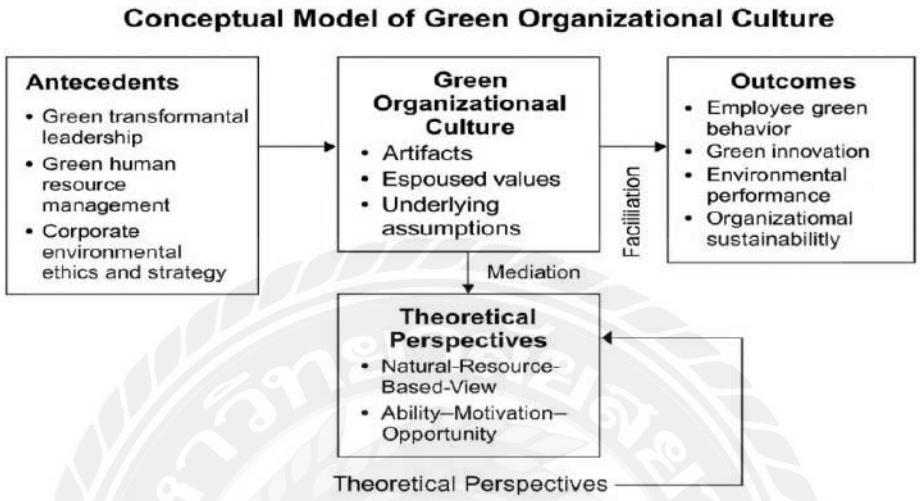
leadership and HRM practices with green outcomes by establishing a shared framework that aligns individual and organizational environmental objectives (Chen et al., 2022; Zhang & Dong, 2022). The model also integrates feedback mechanisms. Favorable green outcomes—such as enhanced environmental performance or innovations in green technology—can reinforce and augment the organization's cultural commitment to sustainability. Over time, this fosters a virtuous cycle in which culture and outcomes mutually enhance one another, cultivating a long-term ecological identity and capability within the organization (Porter et al., 2016; Wang, 2019).

From a theoretical perspective, the proposed model incorporates the Natural-Resource-Based View (NRBV) (Hart, 1995), which conceptualizes green organizational culture as a strategic intangible asset, alongside the Ability–Motivation–Opportunity (AMO) theory (Appelbaum et al., 2000), which posits that the effective establishment of green organizational culture is contingent upon employees' capabilities and motivation to engage in environmentally friendly practices, bolstered by supportive organizational frameworks. Within the Chinese milieu, Confucian principles such as harmony with nature and collective well-being further influence the evolution of green culture (Liu & Dong, 2021).

In summary, green organizational culture operates simultaneously as a behavioral framework and a strategic asset. It originates from leadership and human resource systems, progresses through interactions with established practices and outcomes, and perpetuates organizational momentum towards green innovation and enduring sustainability. These components of the model are illustrated in Figure 2.2.

Figure 2.2

Conceptual Model of Green Organizational Culture



Source: Researcher (2024).

2.4.2.2 Influence role of Green Organizational Culture on Employee Green Behavior

Green organizational culture is pivotal in shaping and reinforcing employees' environmentally conscious behaviors within organizations. As a system of collective environmental values, beliefs, and norms, green organizational culture establishes both the groundwork and the context within which pro-environmental actions are promoted and sustained (Harris & Crane, 2002; Jabbour & Santos, 2008; Zhang & Dong, 2022).

A resilient green organizational culture communicates to employees that environmental sustainability constitutes a fundamental organizational priority, thereby directing daily practices and decision-making processes. It fosters a collective environmental identity that aligns individual behaviors with broader ecological objectives (Yusliza et al., 2020). Empirical research indicates that a robust green organizational culture significantly increases the likelihood of employees participating in environmentally friendly behaviors, such as minimizing waste, conserving energy, and endorsing eco-conscious practices (Daily et al., 2009; Jabbour et al., 2010; Tariq et al., 2021).

Investigations suggest that green organizational culture manifests its influence through multiple avenues. Initially, it serves as a normative framework that molds employees' environmental attitudes and behavioral intentions. When green values are deeply embedded within the organizational culture, employees come to regard environmental behavior as a collective expectation and a manifestation of the organizational identity (Chen et al., 2022; Singh et al., 2020).

Furthermore, green organizational culture establishes a conducive environment for green behavior by providing structural support—such as environmentally sustainable policies, training initiatives, and reward systems—that reinforce actions aligned with ecological responsibility (Yong et al., 2020). These cultural artifacts and mechanisms facilitate the internalization of green norms and encourage voluntary green organizational citizenship behavior (OCBE) among employees (Ahmad et al., 2021).

Moreover, green organizational culture augments employee psychological states that are crucial for fostering green behavior. Research has demonstrated that green culture positively influences green self-efficacy (Li et al., 2020) and psychological empowerment (Zhao et al., 2021), both of which serve as essential mediators in the relationship between green organizational culture and employee green behavior. Employees operating within organizations characterized by a supportive green culture are inclined to feel more competent and motivated to engage in environmentally responsible actions.

Additionally, green organizational culture functions as a moderator that enhances the effectiveness of other precursors of employee green behavior, such as green transformational leadership and green human resource management. It strengthens the congruence between organizational aspirations and individual values, generating a synergistic effect that amplifies green behaviors throughout all organizational levels (Zhang & Dong, 2022; Pham et al., 2019).

From a theoretical perspective, the impact of green organizational culture on employees' environmentally friendly behaviors can be elucidated through the frameworks of Social Learning Theory and the Theory of Planned Behavior. Employees tend to observe

and replicate eco-conscious behaviors that are advocated within the organizational culture, while their behavioral intentions are influenced by perceived norms and the extent of organizational support (Ajzen, 1991; Bandura, 1986).

In conclusion, the presence of a green organizational culture plays a crucial role in fostering and sustaining employees' environmentally responsible behaviors. By integrating environmental values into organizational frameworks, promoting psychological readiness, and harmonizing individual and collective objectives, green organizational culture acts as a fundamental facilitator of ecological accountability within the workplace. Organizations aspiring to attain enduring environmental performance must devote resources to the cultivation and maintenance of a robust green culture.

2.5 Theories and Concepts Related to Green Self-Efficacy

2.5.1 Meaning of Green Self-Efficacy

Green self-efficacy pertains to an individual's conviction in their ability to execute tasks and behaviors that advance environmental sustainability (Bandura, 1997; Chen & Chang, 2013). It encapsulates employees' assurance in their capability to initiate, execute, and perpetuate eco-friendly practices within the workplace, such as energy conservation, waste reduction, or advocating for green initiatives (Li et al., 2020; Mousa & Othman, 2020).

Grounded in Bandura's (1986, 1997) social cognitive theory, self-efficacy assumes a pivotal role in influencing behavior via cognitive, motivational, affective, and decision-making processes. Green self-efficacy, as a specific application within this domain, operationalizes this belief system within the environmental context, thereby affecting how employees assess challenges and opportunities pertinent to sustainability (Pham et al., 2019).

Individuals possessing elevated levels of green self-efficacy are more inclined to undertake initiatives in environmental practices, demonstrate persistence in overcoming obstacles, and encourage eco-friendly behaviors amongst their colleagues (Tariq et al.,

2021). Furthermore, green self-efficacy has been recognized as a robust predictor of employees' environmentally friendly behaviors (Zhao et al., 2021), mediating the influences of leadership, organizational culture, and human resource practices on pro-environmental outcomes (Chen et al., 2022; Zhang & Dong, 2022).

Empirical investigations indicate that green self-efficacy is positively affected by variables such as green transformational leadership, green training initiatives, and organizational support for environmental programs (Li et al., 2020; Yong et al., 2020). When organizations cultivate a supportive environment and equip employees with the requisite knowledge and resources, they can significantly enhance employees' green self-efficacy.

In summary, green self-efficacy constitutes a foundational element in promoting sustainable behaviors within organizations. It functions as both a psychological facilitator and a mediating factor, empowering employees to act in concert with environmental objectives and contributing to the overall green performance of the organization.

Table 2.3

Crosscutting of Green Self-Efficacy

Types of GSE / Authors (year)	Individual Green Self-Efficacy	Collective Green Self-Efficacy	Emotional Regulation Ability	Green Goal-Setting Ability	Cognitive Ability	Sense of Behavioral Control	Problem-Solving Confidence	Green Innovation Confidence	Behavioral Control
Bandura, A. (1997)	✓				✓		✓		✓
Chen, Y. S., & Chang, C. H. (2013)	✓	✓					✓	✓	
Paillé, P., Chen, Y., Boiral, O., & Jin, J. (2014)	✓	✓							✓
Norton, T. A., Zacher, H., & Ashkanasy, N. M. (2014)	✓	✓		✓		✓			
Liu, X., Wang, C., Shishime, T., &	✓	✓		✓					

Types of GSE / Authors (year)	Individual Green Self-Efficacy	Collective Green Self-Efficacy	Emotional Regulation Ability	Green Goal-Setting Ability	Cognitive Ability	Sense of Behavioral Control	Problem-Solving Confidence	Green Innovation Confidence	Behavioral Control
Fujitsuka, T. (2012)									
Siahaan, F., Purnomo, M., & Yulianto, E. (2020)	✓	✓	✓					✓	
Zhang, D., Yang, J., & Liu, H. (2019)	✓	✓	✓			✓			
Robertson, J. L., & Barling, J. (2013)	✓	✓			✓				
Chaudhary, R. (2020)	✓	✓		✓					✓
Cheng, C. C. J., & Shiu, E. C. (2012)	✓	✓			✓			✓	
Wang, H. J., & Zhang, S. Y. (2020)	✓	✓	✓						✓
J. H., & Li, Y. F. (2024)	✓	✓	✓						
Ahmed, M., & Narula, S. A. (2021)	✓	✓		✓	✓				
Al-Ghazali, B. M., & Afsar, B. (2021)	✓	✓					✓	✓	
Yusliza, M. Y., et al. (2020)		✓		✓					
Total	14	14	4	5	4	2	3	4	4

Source: Researcher (2024).

Two Dimensions of Green Self-Efficacy

Green Self-Efficacy is predicated on Bandura's (1997) self-efficacy theory, which pertains to an individual's assurance in their ability to execute environmentally sustainable tasks. Bandura posited that self-efficacy influences whether individuals undertake actions, the intensity of effort they exert, and their resilience when confronted with challenges. Within the realm of green management, individual green self-efficacy is critically significant in determining whether one can successfully engage in environmentally sustainable behaviors.

Bandura (1997) underscored that an individual's self-efficacy can be augmented through three principal avenues: mastery experiences, which involve building confidence through the successful completion of tasks; vicarious experiences, whereby observing the accomplishments of others enhances one's own beliefs; and verbal persuasion, which entails receiving emotional support and encouragement that bolster one's confidence.

In the context of green transformation, organizational leaders can augment employees' sense of green self-efficacy by delivering essential support, affirmative feedback, and illustrative success narratives. For example, through the inclusion of employees in triumphant green innovation initiatives, leaders facilitate the accumulation of experiences, thereby bolstering their confidence in environmental responsibilities, which serves as a catalyst for increased engagement in pro-environmental behaviors.

Paillé et al. (2014) posited that green leaders play a pivotal role in fostering employees' confidence in their environmental conduct through the provision of encouragement and support, particularly in relation to practical execution and successful outcomes in environmental initiatives. As employees accrue experience under such supportive leadership, their green self-efficacy is enhanced, which in turn propels them towards more vigorous involvement in green initiatives.

Mittal and Dhar (2016) articulated that green leaders contribute to the enhancement of employees' green self-efficacy through the facilitation of training, skill enhancement, and resource provision. This multifaceted support not only augments employees' competencies but also galvanizes them to take initiative and exhibit creativity in addressing environmental challenges.

Norton, Zacher, & Ashkanasy (2014) underscored the significance of emotional support and encouragement from green leaders as critical factors in empowering employees to surmount difficulties, thereby amplifying their confidence and enthusiasm towards environmentally sustainable behaviors. The care and support extended by leaders are essential for the elevation of employees' green self-efficacy.

Sun et al. (2022) observed that personalized support from leaders is instrumental in aiding employees to transcend uncertainties regarding their capacity to engage in green behaviors, thereby enhancing their confidence in undertaking environmental responsibilities. For instance, through individualized coaching and constructive feedback, leaders can gain deeper insights into the challenges faced by employees in implementing green practices and subsequently provide tailored support, thereby elevating their green self-efficacy.

Collective Green Self-Efficacy pertains to the shared conviction among a team or organization regarding their capability to successfully execute environmental tasks. It encapsulates the manner in which collaboration and collective endeavors among team members bolster their confidence in achieving unified environmental objectives.

Chen and Chang (2013) indicated that green leaders significantly enhance collective green self-efficacy by articulating a shared vision and goals related to environmental sustainability, which serves to motivate team members to embrace collective accountability. By fostering participation in collaborative green initiatives and facilitating goal-setting, leaders cultivate a climate of cooperation and trust among team members.

Robertson and Barling (2013) asserted that the enhancement of collective green self-efficacy is contingent upon the establishment of trust and collaboration among team members. When team members converge in their beliefs and confidence regarding environmental aspirations, their collective green self-efficacy is strengthened, which subsequently contributes to superior team performance in environmental tasks.

Chaudhary (2020) emphasized that the augmentation of collective green self-efficacy is predicated on robust cooperation and reciprocal support among team members. Green leaders can fortify collective green self-efficacy by delivering positive reinforcement, motivational incentives, and facilitating opportunities for inter-departmental collaboration, all of which further bolster teamwork in environmental initiatives.

Wang and Zhang (2020) highlighted that the advancement of collective green self-efficacy necessitates a nurturing organizational culture and effective leadership. Leaders who delineate clear green objectives and a coherent vision for sustainability can inspire team members to strive towards these collective environmental aims. Furthermore, collective green self-efficacy is shaped by mutual learning and knowledge-sharing within the team, wherein collaborative efforts progressively cultivate confidence in executing green tasks.

Yu and Li (2024) further elucidated that the augmentation of collective green self-efficacy is intricately linked to the evolution of an organization's green culture. In organizations characterized by a robust green culture, employees exhibit a greater propensity to trust one another, which subsequently enhances collective green self-efficacy, thereby facilitating the effective execution of green strategies.

Zhang, Yang, and Liu (2019) articulated that interdepartmental collaboration and the exchange of information exert a significant influence on collective green self-efficacy. By fostering collaborative efforts across departments, organizational leaders bolster collective green self-efficacy, which, in turn, promotes teamwork and innovation in green initiatives, thereby augmenting the successful realization of green strategies.

Through the integration of Bandura (1997) and ancillary research, it becomes evident that green leaders ought to concentrate on augmenting both individual and collective green self-efficacy. These two dimensions are mutually reinforcing, collectively propelling the effective implementation of green strategies and the establishment of a green organizational culture.

2.5.2 Concepts and Theories Related to Green Self-Efficacy

2.5.2.1 Conceptual Model of Green Self-Efficacy

The conceptual framework of green self-efficacy delineates how individual, organizational, and leadership variables interact to shape employees' conviction in their capacity to engage in pro-environmental behaviors. Green self-efficacy functions as a

pivotal psychological construct that mediates the association between contextual antecedents and green behavioral outcomes within the workplace.

- **Antecedents of Green Self-Efficacy**

Numerous factors contribute to the cultivation of green self-efficacy, including:

Green transformational leadership: Leaders who articulate a compelling environmental vision, provide tailored support, and exemplify green behaviors positively affect employees' confidence in their environmental capabilities (Tariq et al., 2021; Ren et al., 2021).

Green human resource management (GHRM): Initiatives such as green training, performance evaluations, and reward systems enhance employees' convictions regarding their capacity to engage in sustainable practices (Yong et al., 2020).

Organizational green culture and values: A well-established green culture that reinforces environmental norms and expectations offers psychological safety and support, thereby nurturing employee self-efficacy (Zhang & Dong, 2022).

Individual traits and prior experiences: Personality characteristics such as conscientiousness, openness to experience, and previous successes in environmental endeavors also play a role in shaping self-efficacy (Graves et al., 2013; Mousa & Othman, 2020).

- **Core Components of Green Self-Efficacy**

Green self-efficacy is not merely a general sense of confidence; it is specifically oriented towards environmental actions. It encompasses: Task-specific self-belief: The confidence to perform particular green behaviors (e.g., energy conservation, waste minimization). Challenge-handling: The perceived capacity to maintain green behaviors in the face of challenges. Outcome expectation: The belief that one's green actions will yield significant environmental benefits (Chen et al., 2020).

- **Outcomes of Green Self-Efficacy**

Elevated levels of green self-efficacy are associated with favorable behavioral and psychological outcomes:

Employee green behavior (EGB): This includes both in-role (e.g., waste reduction) and extra-role behaviors (e.g., motivating colleagues) (Ones & Dilchert, 2012; Lamm et al., 2013).

Green organizational citizenship behavior (OCBE): Voluntary behaviors that support sustainability beyond formal job responsibilities (Ahmad et al., 2021).

Green innovation and creativity: Employees exhibiting strong green self-efficacy are more inclined to conceive and implement eco-friendly initiatives (Chen & Chang, 2013).

Sustained engagement with environmental practices: High self-efficacy enhances motivation and long-term commitment to sustainability objectives (Li et al., 2020).

- **Theoretical Perspectives**

The theoretical framework is fundamentally anchored in two predominant paradigms:

Social Cognitive Theory (Bandura, 1986): The construct of self-efficacy constitutes a fundamental element of behavioral regulation via processes of observation, modeling, and reinforcement.

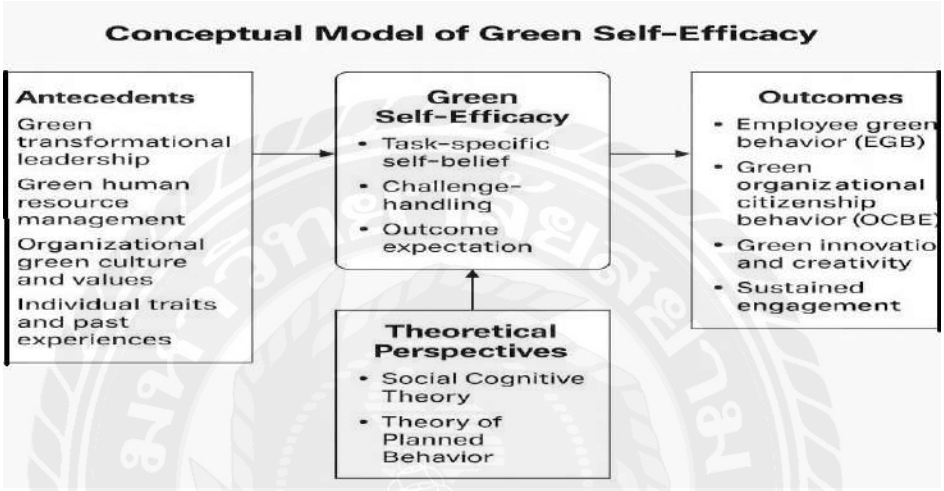
Theory of Planned Behavior (Ajzen, 1991): The concept of green self-efficacy is congruent with perceived behavioral control, which serves as a pivotal predictor of both behavioral intention and execution.

In conclusion, the theoretical framework of green self-efficacy elucidates the intricate interplay among organizational context, leadership style, and individual determinants that collectively foster employees' environmental confidence. This enhanced confidence subsequently catalyzes pro-environmental behaviors and positively impacts

overall environmental performance within organizational settings. The components of this model are illustrated in Figure 2.3.

Figure 2.3

Conceptual Model of Green Self-efficacy



Source: Researcher (2024).

2.5.2.2 Influence role of Green Self-Efficacy on Employee Green Behavior

Green self-efficacy is integral to the development of employee pro-environmental behaviors within organizational contexts. It is delineated as an individual's conviction in their ability to effectively engage in tasks that yield environmental benefits (Chen et al., 2020), thus functioning as a psychological asset that enables employees to initiate and sustain pro-environmental practices within the workplace (Li et al., 2020; Mousa & Othman, 2020).

Elevated levels of green self-efficacy have been empirically linked to an array of employee pro-environmental behaviors, encompassing task-related initiatives (e.g., diminishing energy consumption, recycling) and discretionary actions that extend beyond formal job obligations (e.g., motivating peers to adopt environmentally responsible practices) (Ones & Dilchert, 2012; Lamm et al., 2013). When employees possess a strong belief in their competence to perform environmentally beneficial activities, they are more

inclined to adopt and maintain such behaviors, even when confronted with challenges (Pham et al., 2019).

The influence of green self-efficacy on behavior operates through several mechanisms. Initially, it bolsters motivation and perseverance by fortifying individuals' convictions regarding their environmental impact, thereby prompting them to take proactive steps in the implementation of green practices (Bandura, 1997). Employees exhibiting high levels of green self-efficacy are more predisposed to establish ambitious ecological objectives, engage in problem-solving endeavors, and demonstrate resilience in the face of adversity (Li et al., 2020).

Moreover, green self-efficacy interacts with organizational variables to enhance its effect. For example, within a conducive organizational milieu—exemplified by green transformational leadership or a robust green culture—the green self-efficacy of employees is augmented, thereby further inspiring engagement in sustainable practices (Zhao et al., 2021; Chen et al., 2022). This interaction implies that personal confidence in green abilities is both influenced by and responsive to the encompassing organizational landscape.

Research further underscores that green self-efficacy functions as a vital mediator between leadership dynamics and behavioral outcomes. Empirical studies have illustrated that green transformational leadership elevates green self-efficacy, which, in turn, fosters increased pro-environmental behaviors among employees (Tariq et al., 2021; Ren et al., 2021). Correspondingly, green human resource initiatives, such as training and development programs, enhance employees' self-efficacy related to environmental tasks (Yong et al., 2020), which subsequently translates into proactive environmental engagement.

Additionally, green self-efficacy plays a significant role in the cultivation of green organizational citizenship behavior (OCBE), motivating employees to exceed basic environmental expectations and voluntarily participate in actions that support the organization's environmental objectives (Ahmad et al., 2021).

From a theoretical perspective, the influence of green self-efficacy on employee environmentally conscious behavior is substantiated by Bandura's Social Cognitive Theory, which asserts that beliefs regarding self-efficacy fundamentally shape individual motivation, decision-making, and perseverance (Bandura, 1986). Furthermore, the Theory of Planned Behavior underscores the significance of perceived behavioral control—an element conceptually aligned with self-efficacy—as a significant predictor of both behavioral intention and subsequent actions (Ajzen, 1991).

In summary, green self-efficacy serves as a pivotal catalyst for employee environmentally responsible behavior, equipping individuals with the psychological preparedness and assurance requisite for engaging in sustainable practices. Organizations that aspire to enhance ecological accountability among their workforce should cultivate green self-efficacy through leadership endorsement, targeted training initiatives, recognition of efforts, and the establishment of a supportive work environment that both encourages and rewards environmentally proactive conduct.

2.6 Theories and Concepts Related to Employee Green Behavior

2.6.1 Meaning of Employee Green Behavior

Employee Green Behavior (EGB) denotes the environmentally sustainable actions undertaken by employees within their workplace, encompassing both their formal job obligations and voluntary activities that exceed these requirements (Ones & Dilchert, 2012; Norton et al., 2015). Such behaviors play a significant role in enhancing an organization's environmental performance and achieving its long-term sustainability objectives.

EGB is typically classified into two principal categories:

Task-Related Green Behavior: This category encompasses job-prescribed actions aimed at conserving energy, minimizing waste, adhering to environmental protocols, and optimizing resource utilization (Lamm et al., 2013; Kim et al., 2017). For instance, employees may adhere to recycling policies or diminish paper consumption as part of their established operating procedures.

Voluntary Green Behavior (Green Organizational Citizenship Behavior, OCBE): These behaviors are discretionary in nature and are not formally mandated, including advocating for environmentally sustainable changes, volunteering for green initiatives, and motivating colleagues to participate in sustainable practices (Boiral, 2009; Paillé & Boiral, 2013; Anwar et al., 2020). Such actions reflect a personal dedication to environmental objectives and are frequently driven by intrinsic motivation.

The theoretical frameworks informing EGB encompass Theory of Planned Behavior (Ajzen, 1991), which elucidates the influence of environmental attitudes, subjective norms, and perceived behavioral control on the formation of green intentions. Furthermore, Social Learning Theory (Bandura, 1986) posits that employees acquire green behaviors through the observation of role models, such as supervisors or peers, who prioritize sustainability.

A multitude of empirical investigations have delineated individual and organizational determinants that affect EGB:

- Green Leadership: Green transformational leadership markedly enhances EGB by fostering an environmental vision, motivation, and personalized support (Robertson & Barling, 2013; Mittal & Dhar, 2016; Chen & Chang, 2013).

- Green Self-Efficacy: Employees possessing high levels of confidence in their capacity to engage in green behavior demonstrate a greater propensity for sustainable actions (Tabernero & Hernández, 2011; Li et al., 2020).

- Green HRM Practices: Initiatives such as green recruitment, training, and performance evaluations bolster environmentally responsible behaviors (Renwick et al., 2013; Yong et al., 2020).

- Psychological Empowerment and Moral Obligation: These psychological factors serve to motivate voluntary green actions (Zhao et al., 2021; Ramus & Steger, 2000).

- Environmental Passion and Identity: Employees with a pronounced environmental identity or a deep emotional connection to nature exhibit elevated levels of EGB (Ruepert et al., 2017; Kim et al., 2021).

Recent research additionally underscores the significance of contextual and social influences:

- Organizational Climate and Culture: A green organizational culture cultivates a normative atmosphere that promotes EGB (Jabbour & Santos, 2008; Daily et al., 2009; Pham et al., 2019).

- Colleague and Peer Influence: Social dynamics and peer modeling significantly enhance employee involvement in pro-environmental behaviors (Norton et al., 2014; Boiral & Paillé, 2012).

- Sustainability-Oriented Organizational Identity: When employees align themselves with a sustainability-focused organization, their propensity to engage in green behaviors is amplified (Zhang & Dong, 2022; Chen et al., 2022).

- Work Engagement: Employees who exhibit high levels of engagement in their work are more inclined to undertake green behaviors, as evidenced by Zaw and Takahashi (2022).

In conclusion, employee green behavior represents a complex construct influenced by leadership, motivational factors, organizational systems, and psychological elements. Organizations aspiring to augment their sustainability performance must cultivate enabling environments through effective leadership, supportive cultures, and human resource management systems that empower and incentivize employees to engage in environmentally sustainable practices.

Table 2.4

Crosscutting of Employee Green Behavior

Types of EGB / Authors (year)	Task-related Green Behavior	Voluntary Green Behavior	Green Behavior Motivation	Green Behavior Execution	Green Innovation Behavior	Green Participation Behavior	Green Behavior Performance	Environmental Advocacy Behavior	Green Decision-Making Behavior
Smith et al.（2012）	✓		✓	✓			✓		
Ones & Dilchert（2012）	✓	✓				✓			
Robertson & Barling (2013)	✓	✓						✓	
Graves et al. (2013)	✓	✓			✓				✓
Lamm et al. (2013)	✓	✓	✓					✓	
Temminck et al. (2015)	✓	✓		✓		✓			
Erdogan et al. (2015)	✓	✓							✓
Kim et al. (2017)	✓	✓		✓				✓	
Bissing-Olson et al. (2013)	✓	✓	✓			✓	✓		
Dumont et al. (2017)	✓	✓							
Boiral & Paillé (2012)	✓	✓							✓
Mi et al.(2020)	✓	✓			✓		✓		
Norton et al. (2015)	✓								
Kim et al. (2017)	✓	✓				✓			
Unsworth, Dmitrieva & Adriasola (2013)		✓			✓		✓		
Total	14	13	3	3	3	4	4	3	3

Source: Researcher (2024).

Two Dimensions of Employee Green Behavior

Task-related green behavior denotes distinct, role-specific activities undertaken by employees to align with the environmental objectives and practices of their organizations. Such behaviors are frequently formalized and anticipated actions that are directly associated with the employee's occupational responsibilities, encompassing actions such as diminishing resource utilization, reducing waste generation, and complying with environmental regulations within the workplace.

Smith et al. (2012) underscored that task-related green behavior is typically motivated by an amalgamation of organizational mandates and the employees' intrinsic sense of social accountability. Employees are incentivized to partake in environmentally friendly activities, including energy conservation, waste management, and compliance with sustainability standards in the execution of their daily responsibilities.

Ones & Dilchert (2012) posited that green behavior within the workplace encompasses both intrinsic motivation—characterized by a personal dedication to environmental stewardship—and extrinsic motivation, which includes organizational expectations or incentives. Task-related green behavior may encompass initiatives such as decreasing carbon emissions and conserving energy throughout work activities.

Robertson & Barling (2013) emphasized that task-related green behavior can be significantly shaped by leadership that establishes explicit expectations and incorporates sustainability objectives within employee job descriptions. Employees are more likely to align with these objectives when they perceive a direct correlation to their roles and responsibilities.

Graves et al. (2013) observed that task-related green behaviors constitute elements of formal job obligations, often concentrating on particular environmental actions, such as making environmentally conscious decisions regarding the selection of materials or processes employed in daily operations. These actions aim to ensure adherence to environmental standards while contributing to the broader organizational sustainability objectives.

Lamm et al. (2013) accentuated the critical role of training and organizational support in cultivating task-related green behaviors. When employees are provided with sufficient training and resources related to environmental practices, they are more inclined to engage in actions such as waste reduction or resource optimization as integral components of their work activities.

Temminck et al. (2015) indicated that effective communication and structured leadership can motivate employees to adopt task-related green behaviors, including the integration of green practices into their routine activities and adherence to sustainability goals established by the organization.

Erdogan et al. (2015) highlighted the significance of green human resource management in influencing task-related green behavior. When organizations align their human resource policies with environmental objectives—such as implementing performance evaluations that incorporate environmental criteria—employees are more inclined to integrate sustainable practices into their job functions.

Kim et al. (2017) noted that task-related green behavior is closely associated with the degree to which environmental objectives are embedded within the job description. Employees who perceive sustainability as an integral aspect of their role are more likely to undertake actions that actively support green initiatives, such as adopting energy-saving practices or utilizing eco-friendly technologies in their work.

Bissing-Olson et al. (2013) discovered that when employees are acknowledged and rewarded for engaging in task-related green behaviors, they are more likely to replicate these behaviors. This reinforcement of environmentally responsible actions can play a pivotal role in attaining organizational environmental objectives.

Dumont et al. (2017) posited that task-related green behavior is frequently augmented by green leadership, wherein leaders proactively motivate employees to integrate sustainability within their professional duties. Such integration may encompass actions like minimizing paper consumption or embracing environmentally sustainable practices in workplace environments.

Boiral & Paillé (2012) contended that task-related green behavior coincides with organizational policies, asserting that employees typically engage in these behaviors as mandated by the organization. Such behaviors encompass tangible actions, including waste reduction, energy conservation, or participation in sustainable practices that directly further the organization's ecological objectives.

Mi et al. (2020) asserted that employees who participate in task-related green behavior often do so under the conviction that their actions significantly contribute to the realization of organizational sustainability objectives. Their conduct is congruent with the company's formal green initiatives, such as waste minimization and energy conservation practices.

Norton et al. (2015) determined that employees who receive explicit guidance and training in green practices exhibit a greater likelihood of executing task-related behaviors that directly bolster sustainability initiatives. Such behaviors are frequently codified within job expectations.

Unsworth, Dmitrieva & Adriasola (2013) examined the impact of leadership on task-related green behavior. Their findings indicated that employees who are routinely reminded of the significance of environmental accountability in their roles are more inclined to adopt environmentally sustainable practices.

In conclusion, Task-related Green Behavior encompasses specialized actions undertaken by employees to fulfill the environmental objectives established by the organization. These behaviors are predominantly driven by organizational aspirations, formal policies, and leadership direction, thereby facilitating the incorporation of sustainability into employees' quotidian responsibilities.

Voluntary Green Behavior pertains to discretionary, self-initiated actions that employees engage in beyond their formal job obligations to endorse sustainability and contribute to environmental stewardship. Such behaviors are generally motivated by intrinsic factors and a personal dedication to sustainability, as opposed to external incentives or directives.

Smith et al. (2012) observed that voluntary green behavior is indicative of employees' intrinsic motivation, encompassing their personal values and sense of social responsibility. Employees who partake in voluntary green behavior take the initiative to advocate for organizational environmental reform, such as instigating green projects or promoting sustainable practices among peers.

Ones & Dilchert (2012) underscored that voluntary green behavior is propelled by personal values and a commitment to sustainability, often manifesting as employees transcending their job responsibilities to engage in environmentally beneficial initiatives, such as orchestrating green events or volunteering for ecological causes. Robertson & Barling (2013) noted that voluntary green behavior is closely associated with the organizational culture. Employees who perceive a strong congruence between their personal values and the organization's ecological objectives are more inclined to partake in voluntary actions, such as championing green practices within the workplace or spearheading sustainability initiatives. Graves et al. (2013) indicated that voluntary green behavior encompasses proactive endeavors to influence the organization's environmental practices. Employees may autonomously propose or execute initiatives that advance sustainability, such as devising new environmentally friendly processes or organizing eco-conscious office events.

Lamm et al. (2013) posited that voluntary green behavior frequently emerges from employees' intrinsic motivation to effectuate a favorable environmental impact. This may encompass assuming leadership roles in sustainability initiatives or advocating for green practices among colleagues beyond their formal responsibilities.

Temminck et al. (2015) emphasized that employees are inclined to engage in voluntary green behavior when they perceive a personal affinity towards sustainability objectives. This may entail unprompted actions, such as minimizing waste or launching recycling initiatives, which are not encompassed within their formal job descriptions.

Erdogan et al. (2015) observed that voluntary green behavior is bolstered by green human resource management policies that motivate employees to assume personal agency

in advancing sustainability. Employees are frequently urged to seek out green actions that extend beyond their immediate job functions.

Kim et al. (2017) contended that voluntary green behavior is shaped by organizational leadership that empowers employees to assume responsibility for environmental concerns. When employees perceive support, they are more inclined to engage in endeavors such as orchestrating green initiatives or participating in environmental campaigns.

Bissing-Olson et al. (2013) discovered that employees who possess an emotional connection to sustainability are more predisposed to engage in voluntary green behavior. This may encompass actions such as advocating for policy reforms, partaking in environmental awareness initiatives, or volunteering for eco-conscious projects.

Dumont et al. (2017) proposed that employees' voluntary green behavior is affected by a supportive workplace atmosphere. Organizations that promote innovation and green initiatives enable employees to partake in activities that transcend their job descriptions, such as mitigating their environmental impact in both personal and professional contexts.

Boiral & Paillé (2012) indicated that voluntary green behavior frequently represents an extension of employees' personal commitment to environmental sustainability. These actions are self-initiated and play a significant role in cultivating a more environmentally responsible organizational culture.

Mi et al. (2020) underscored that employees who participate in voluntary green behavior experience a sense of pride and accountability in contributing to environmental sustainability. Their initiatives may include informal endeavors such as curtailing energy consumption or coordinating green team activities.

Norton et al. (2015) concluded that employees' voluntary green behavior is underpinned by organizational culture and leadership, which establish an environment conducive to employees engaging in sustainability pursuits beyond their formal roles.

Unsworth, Dmitrieva & Adriasola (2013) ascertained that voluntary green behavior is frequently propelled by employees' intrinsic motivation and a sense of personal obligation towards environmental issues. Leaders can facilitate such behaviors by nurturing an environment characterized by trust and transparency, wherein employees feel emboldened to propose and execute green practices.

In conclusion, voluntary green behavior involves employees undertaking self-initiated actions to promote environmental sustainability, frequently driven by personal values and intrinsic motivation. These actions contribute to the cultivation of a positive, proactive green culture within the organization, thereby enhancing its overall sustainability endeavors.

2.6.2 Concepts and Theories Related to Employee Green Behavior

Employee green behavior denotes the actions undertaken by employees that significantly advance environmental sustainability within organizational settings, encompassing both role-specific behaviors (for example, resource conservation and waste minimization) and supplementary behaviors (such as motivating colleagues to adopt environmentally friendly practices and advocating for eco-conscious initiatives). In light of the increasing prominence of environmental issues in corporate governance, employee green behavior has emerged as an essential element of sustainable development strategies employed by organizations.

From a theoretical standpoint, Theory of Planned Behavior (TPB) (Ajzen, 1991) remains among the most extensively utilized frameworks for elucidating employee green behavior (EGB). This theory asserts that employees' intentions to engage in environmentally friendly practices are influenced by their attitudes, the subjective norms prevalent within their organizational context, and their perceived control over behavior. Scholars from China, including Liu et al. (2021), have refined this model by integrating factors such as organizational environmental climate and moral obligation, thereby underscoring the influence of collectivist cultural values on normative expectations and behavioral intentions regarding sustainability within Chinese enterprises.

Social Learning Theory (Bandura, 1986) offers a significant theoretical perspective, positing that employees acquire green behaviors through the observation and imitation of role models present within their organizational environment. Recent investigative efforts in China (e.g., Ren & Zhang, 2022) have underscored the importance of green transformational leadership in exemplifying green behaviors, revealing that employees in cultures characterized by high power distance exhibit heightened sensitivity to the environmentally conscious actions of their supervisors.

Furthermore, Ability–Motivation–Opportunity (AMO) Theory (Appelbaum et al., 2000) presents a holistic framework for understanding EGB. This theory posits that employees are more inclined to participate in green behaviors when they possess the requisite skills (ability), the intrinsic desire (motivation), and an enabling environment (opportunity). Researchers in China, such as Wang & Li (2023), have employed this framework to analyze how green human resource management practices—including environmental training, green performance evaluations, and incentive structures—interact synergistically to bolster employee green behavior in manufacturing sectors, particularly within the context of China's green transformation agenda.

An additional emerging perspective is provided by the Conservation of Resources (COR) theory (Hobfoll, 1989), which elucidates that employees are more predisposed to engage in green behaviors when they perceive an adequate availability of personal and organizational resources. Recent empirical investigations conducted in China have identified green psychological climate and green organizational support as resource buffers that mitigate employee burnout while simultaneously promoting green behavior (Zhou et al., 2023).

Moreover, Self-Determination Theory (Deci & Ryan, 1985) has been employed to investigate the intrinsic and extrinsic motivational factors underpinning EGB. Research within the Chinese context (Chen & Lin, 2021) indicates that employees motivated by intrinsic factors—such as a personal commitment to environmental stewardship—demonstrate a greater propensity to engage in sustainable practices, even in the absence of direct incentives.

Finally, contemporary interdisciplinary research undertaken by scholars in China (e.g., Huang et al., 2024) has started to integrate traditional Confucian values into the conceptualization of EGB. Principles such as the harmony between humanity and nature and the self-discipline that fosters social harmony are regarded as cultural antecedents that promote environmental responsibility, moral obligation, and voluntary engagement in green behaviors within the workplace.

In conclusion, the examination of employee green behavior is significantly enhanced by diverse theoretical frameworks and cultural perspectives. Within the context of China, the amalgamation of Western theoretical constructs with local values and leadership paradigms not only augments the comprehension of employee green behavior but also yields actionable strategies for nurturing a sustainable workforce that aligns with the overarching objectives of national ecological civilization.

2.7 Related Research

Tian and Ian (2020) executed a study entitled "A Research on the Motivating Mechanism of Environmentally-Specific Transformational Leadership on Employees' Green Creativity," grounded in transformational leadership theory and similarity-attraction theory. Employing multiple regression analysis, the researchers investigated the mechanisms through which environmentally-specific transformational leadership impacts employees' green creativity, utilizing a data set comprising 315 valid responses. The findings indicated that environmentally-specific transformational leadership exerts a significantly positive influence on employees' green creativity ($\beta = 0.323$, $p < 0.001$), with value congruence serving as a partial mediator within this relationship (indirect effect = 0.080, 95% CI [0.014, 0.153]). Furthermore, creative self-efficacy was found to positively moderate the association between value congruence and green creativity ($\beta = 0.296$, $p < 0.001$). Subsequent analysis revealed that the mediating effect of value congruence is more pronounced among employees possessing higher creative self-efficacy (indirect effect = 0.129 vs. 0.032). These outcomes suggest that environmentally-specific transformational leadership fosters green creativity through the synergistic impacts of value alignment and

cognitive resources, while concurrently underscoring the moderating role of employees' creative self-efficacy within the leadership transmission mechanism.

Wang Yaojuan et al. (2021) conducted an empirical investigation entitled "The Impact Mechanism of Environmentally Transformational Leadership on Employees' Green Behavior: A Moderated Mediation Effect," informed by social identity theory and self-efficacy theory. Through the implementation of questionnaire surveys, the researchers examined the channels through which environmentally transformational leadership affects employees' green behavior, amassing 262 valid samples from enterprises located in the Anhui and Zhejiang provinces. The results demonstrated that environmentally transformational leadership has a markedly positive impact on employees' green behavior ($\beta = 0.56$, $p < 0.01$), with collectivism acting as a partial mediator in this relationship (indirect effect = 0.12, 95% CI [0.06, 0.19]). Additionally, self-efficacy positively moderates the connection between collectivism and green behavior (interaction term $\beta = 0.33$, $p < 0.01$). Further analysis unveiled that the mediating effect of collectivism is amplified when employees exhibit higher self-efficacy (indirect effect = 0.15 vs. 0.07). These findings elucidate that environmentally transformational leadership advances green behavior by cultivating collectivist values, a process that is further bolstered by employees' self-perceived competence. The investigation also emphasizes the significance of the synergistic interplay between "emotional values and rational cognition" within the Chinese context.

Cen (2021) executed an empirical investigation entitled "The Influence Mechanism of Green Transformational Leadership on Employees' Green Behavior from a Role Perspective," which was grounded in role theory. The researcher devised a moderated mediation model to scrutinize the pathways and boundary conditions through which green transformational leadership affects employees' green behavior, amassing a dataset comprising 325 leader-employee dyads. Empirical analysis demonstrated a significant positive correlation between green transformational leadership and employee green behavior, with the definition of green behavior roles serving as a partial mediator. Furthermore, leadership identification was found to positively moderate the relationship

between green transformational leadership and role definition, thereby further influencing the strength of the mediating pathway. These findings elucidate that green transformational leadership fosters green behavior by shaping employees' role cognitions, a process that is modulated by the degree of employees' identification with their leader. The study underscores the necessity of accounting for both leadership modeling and employees' psychological identification within the context of organizational sustainability initiatives.

Li Wenjing et al. (2020) carried out an empirical investigation titled "Effects of Green Transformational Leadership on Employee's Green Creativity" employing survey research methodologies. This study examined the correlation between green transformational leadership and employees' green creativity, gathering 298 valid questionnaires and analyzing the data utilizing SPSS 24.0 and Amos 24.0. The primary effect analysis revealed a substantial positive correlation between green transformational leadership and employees' green creativity ($\beta = 0.585$, $p < 0.001$). Mediation analysis indicated that green intrinsic motivation acted as a partial mediator in this relationship ($\beta = 0.322$, $p < 0.001$). Moderating effect analysis indicated that green extrinsic motivation (comprising both controlling and informational types) negatively moderated the relationship between green intrinsic motivation and green creativity ($\beta = -0.107$, $p < 0.001$). These findings imply that green transformational leadership enhances employees' green creativity by nurturing their green intrinsic motivation; however, extrinsic motivation diminishes this effect. The study emphasizes the significance of harmonizing leadership styles and incentive mechanisms within corporate green innovation strategies.

Tian Meijie (2022) conducted an empirical inquiry titled "The Impact of Green Transformational Leadership on Employees' Green Behavior: A Moderated Mediation Model," which was predicated on social cognitive theory and social information processing theory. Through questionnaire surveys, the study investigated the relationship between green transformational leadership and employees' green behavior, collecting 307 valid responses. Data analysis was conducted utilizing SPSS and AMOS software. The findings confirmed that green transformational leadership exerts a positive influence on employees' green behavior through the mediating role of green self-efficacy, with the green

psychological climate positively moderating this mediation pathway. The main effect analysis revealed significant positive correlations between green transformational leadership and its four dimensions (green influence, green motivational inspiration, green intellectual stimulation, and green individualized consideration) with employees' green behavior. Further analysis indicated that green self-efficacy partially mediated the effect of green transformational leadership on employees' green behavior, while the green psychological climate intensified the relationship between green self-efficacy and green behavior. These findings suggest that green transformational leadership fosters employees' green behavior through both cognitive and situational mechanisms, while also emphasizing the significance of the organizational psychological climate as a boundary condition in green management practices.

Shi Yadan and Diao Fengqin (2021) executed an empirical investigation entitled "The influence mechanism of green transformational leadership on employees' green behavior" grounded in social cognitive theory and the theory of planned behavior. Utilizing questionnaire surveys, the research scrutinized the correlation between green transformational leadership and employees' green behavior, amassing a total of 269 valid responses. Data analysis was conducted employing SPSS and AMOS software. The findings substantiated that green transformational leadership exerts a positive influence on employees' green behavior through the mediating role of environmental passion, with a pro-environmental organizational climate significantly moderating this mediation pathway. The principal effect analysis indicated a notable positive association between green transformational leadership and employees' green behavior ($\beta = 0.22$, $p < 0.001$). Subsequent analysis revealed that environmental passion partially mediated the impact of green transformational leadership on green behavior (indirect effect = 0.19, $p < 0.001$), whereas the pro-environmental organizational climate augmented the relationship between green transformational leadership and environmental passion ($\beta = 0.17$, $p < 0.001$). Bootstrap testing validated that pro-environmental organizational climate positively moderated the mediating effect of environmental passion (moderated mediation effect = 0.03, 95% CI [0.01, 0.08]). These findings elucidate that green transformational leadership

fosters employees' green behavior by invigorating their environmental passion, whilst also underscoring the significance of nurturing a pro-environmental organizational climate to amplify this mechanism.

Sun et al. (2022) performed an empirical analysis entitled "Green Transformational Leadership and Environmental Performance in Small and Medium Enterprises" employing structural equation modeling. Through questionnaire surveys, the investigators explored the association between green transformational leadership (GTL) and environmental performance (EP), evaluating the mediating functions of green human resource management (GHRM) and green innovation (GI), as well as the moderating influence of environmental values (EV). A total of 110 valid questionnaires were obtained. The outcomes divulged that green transformational leadership possesses a significant positive effect on environmental performance, with green human resource management and green innovation acting as constructive mediators within this relationship. Furthermore, environmental values were determined to play a substantial moderating role between green transformational leadership and environmental performance. These results suggest that green transformational leadership indirectly enhances environmental performance by fostering green human resource management and green innovation, while simultaneously emphasizing the pivotal role of environmental values in fortifying this relationship.

Wang (2022) executed an empirical investigation entitled "Research on the Influence Mechanism of Environmentally Friendly Leadership on Employees' Green Behavior," grounded in the frameworks of social learning theory and self-determination theory. The investigator analyzed the correlation between environmentally friendly leadership and employees' green behavior utilizing questionnaire surveys, amassing 375 valid samples. Assessments of reliability and validity demonstrated that the measurement instruments displayed commendable reliability and validity. Comprehensive effect analysis uncovered that environmentally friendly leadership exerted a substantial positive influence on employees' green behavior. Subsequent analysis indicated that green self-efficacy, autonomous motivation, and extrinsic motivation all served as partial mediators between environmentally friendly leadership and employees' green behavior, with

autonomous motivation exhibiting the most pronounced mediating effect (β=0.129). The findings imply that environmentally friendly leadership affects employees' green behavior through dual mechanisms: a cognitive pathway (green self-efficacy) and a motivational pathway (autonomous-extrinsic motivation). Furthermore, the study underscores that organizations ought to foster green behavior by nurturing environmentally friendly leadership, enhancing employees' green self-efficacy, and fortifying motivational mechanisms.

Yu et al. (2021) performed an empirical investigation titled "Research on Environmental Leadership, Organizational Green Culture, and Employee Green Behavior," employing questionnaire survey methodologies. The researchers examined the association between environmental leadership and employee green behavior via questionnaires, gathering 247 valid samples predominantly from enterprises within the petroleum sector. Reliability and validity assessments revealed that the measurement scales demonstrated satisfactory reliability and validity. Main effect analysis indicated that environmental leadership had a significant positive effect on employee green behavior ($\beta=0.443$, $p<0.01$). Additional analysis illustrated that organizational green culture functioned as a partial mediator between environmental leadership and employee green behavior (mediating effect $\beta=0.243$), with both the total effect (0.455) and direct effect (0.204) being statistically significant. The results suggest that environmental leadership positively influences employee green behavior by shaping organizational green culture as a contextual variable, thereby facilitating the alignment of employee and organizational values. The study further emphasizes that organizations should prioritize the cultivation of environmental leadership and the establishment of an organizational green culture to catalyze employee green behavior.

Jia (2022) executed an empirical investigation entitled The Influence of Green Servant Leadership on Employees' Green Behavior, grounded in the principles of social identity theory. Utilizing a questionnaire survey methodology, the research examined the correlation between green servant leadership and employees' green behavior, amassing a total of 256 valid responses. The study formulated a theoretical model wherein green

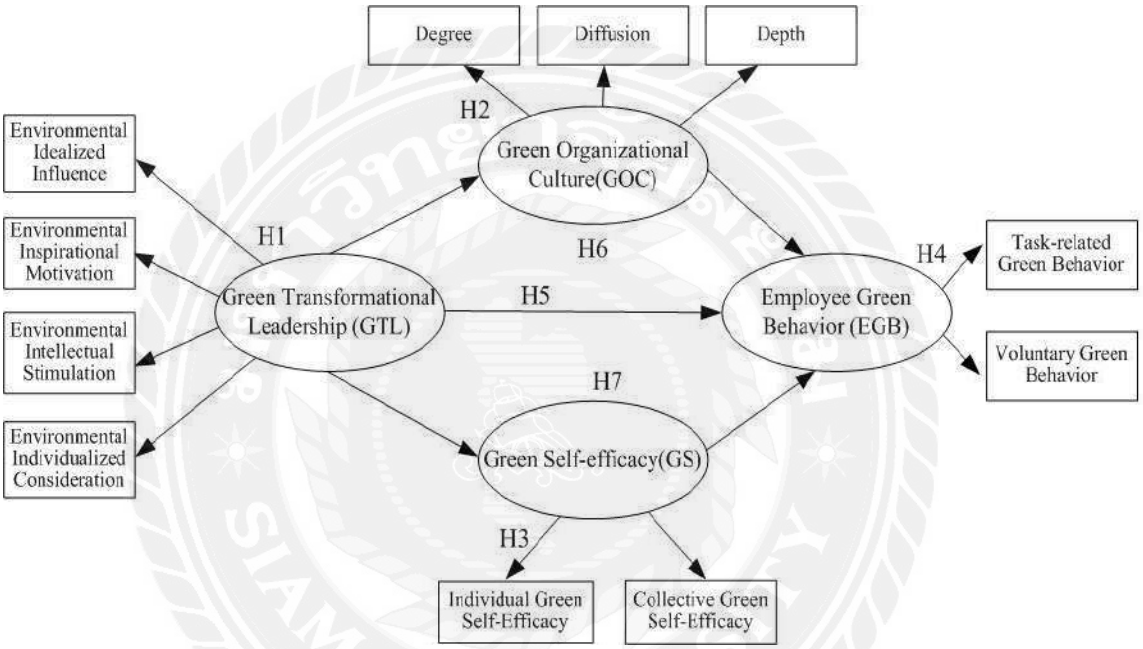
servant leadership was designated as the independent variable, employees' green behavior as the dependent variable, green self-efficacy as the mediating variable, and green organizational identification as the moderating variable. The analysis of the main effects disclosed that green servant leadership exerted a significant positive influence on employees' green behavior ($\beta = 0.468$, $p < 0.001$). Mediation analysis indicated that green self-efficacy served a partial mediating function in the relationship between the two variables (effect size = 0.1393, 95% CI [0.0881, 0.2021]). The examination of moderating effects revealed that green organizational identification positively moderated the relationship between green servant leadership and employees' green behavior ($\beta = 0.158$, $p < 0.05$), as well as the relationship between green servant leadership and green self-efficacy ($\beta = 0.210$, $p < 0.001$). These findings suggest that green servant leadership facilitates employees' green behavior through dual mechanisms, while also indicating that organizations should prioritize the development of leaders' green service attributes and the enhancement of employees' green identification.

2.8 Conceptual Framework, Operational definition, Hypothesis and Explanation of Hypothesis

2.8.1 Conceptual Framework

Figure 2.4

Conceptual Framework



Source: Researcher (2024).

This theoretical framework amalgamates leadership paradigms, employee behavioral studies, and ecological sustainability, thereby offering a holistic model for evaluating the efficacy of green management practices within China's iron and steel sector. The conceptual framework orchestrated for this investigation aims to scrutinize the interrelations among Green Transformational Leadership, Employee Green Behavior, Green Organizational Culture, and Green Self-Efficacy.

- Green Transformational Leadership is posited as the independent variable that exerts influence on both Green Organizational Culture and Green Self-Efficacy.

- Green Organizational Culture and Green Self-Efficacy function as mediators, impacting Employee Green Behavior.

- Employee Green Behavior is designated as the dependent variable, encapsulating the resultant effects of leadership and cultural dynamics within an organization.

2.8.2 Hypothesis

Hypothesis 1: Green Transformational Leadership is constituted by four factors: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration.

Hypothesis 2: Green Organizational Culture is delineated by three factors: degree, diffusion, and depth.

Hypothesis 3: Green Self-Efficacy is characterized by two factors: individual green self-efficacy and collective green self-efficacy.

Hypothesis 4: Employee Green Behavior is comprised of two factors: task-related green behavior and voluntary green behavior.

Hypothesis 5: A positive correlation exists between Green Transformational Leadership and Employee Green Behavior.

Hypothesis 6: Green Organizational Culture mediates the relationship between Green Transformational Leadership and Employee Green Behavior within the organization.

Hypothesis7: Green Self-Efficacy mediates the relationship between Green Transformational Leadership and Employee Green Behavior within the organization.

2.8.3 Operational Definition

- Environmental Idealized Influence pertains to leaders who can serve as exemplary environmental role models, demonstrating a profound commitment to ecological values and policies.

- Environmental Inspirational Motivation pertains to leaders who can inspire and galvanize employees to engage in environmentally sustainable practices and prioritize collective ecological interests.

- Environmental Intellectual Stimulation pertains to leaders who can encourage and motivate employees to innovate and engage in critical thinking regarding environmental protection.

- Environmental Individualized Consideration pertains to leaders who can exhibit personalized care and support for employees, underscoring their contributions and development in relation to environmental performance.

- Task-related Green Behavior pertains to employees' capacity and commitment to competently fulfill their environmental protection responsibilities and duties within their professional roles, as well as their focus on sustainable practices.

- Voluntary Green Behavior pertains to employees' proactive and self-initiated endeavors to advocate for environmental protection that transcends their formal job obligations.

- Degree pertains to managers' integration of environmental considerations into the organization's strategic priorities and objectives.

- Diffusion pertains to the uniform support and incorporation of environmental values and initiatives across various levels, departments, and locations within the organization.

- Depth pertains to the organization's genuine integration and addressing of environmental concerns beyond superficial compliance, particularly in reaction to public scrutiny and internal convictions.

- Individual Green Self-Efficacy refers to the personal assurance in one's capability to successfully execute eco-friendly initiatives, attain environmental objectives,

efficiently perform environmental tasks, surmount ecological challenges, and devise innovative solutions to these predicaments.

- Collective Green Self-Efficacy refers to the shared confidence within a team or organization regarding their collective aptitude to effectively implement and sustain environmental protection measures, realize established environmental objectives, resolve complex ecological issues, and collaboratively formulate innovative solutions.

2.8.4 Explanation of Hypothesis

Hypothesis 1: Green Transformational Leadership is constituted by four factors: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration.

Meaning: Environmental Idealized Influence, Environmental Inspirational Motivation, Environmental Intellectual Stimulation, and Environmental Individualized Consideration—these constructs collectively elucidate the mechanisms through which leaders effectively inspire and direct employees toward sustainability initiatives. This process encompasses the demonstration of pro-environmental behaviors, the motivation derived from a compelling vision of sustainability, the promotion of innovative solutions to ecological challenges, and the provision of tailored support to align employees' professional development with sustainable practices.

Reason: Environmental Idealized Influence, Environmental Inspirational Motivation, Environmental Intellectual Stimulation, and Environmental Individualized Consideration—these dimensions collectively delineate the ways in which leaders proficiently propel sustainability efforts. They function as exemplars, inspire and motivate through a coherent vision, foster innovative problem-solving capabilities, and render personalized support to synchronize employees’ actions with environmental objectives.

Theory or Supporting Research:

Afsar and Umrani (2020) established that transformational leadership exerts a beneficial influence on employees' innovative work behavior and their motivation to learn, with the transformational leadership–innovative work behavior link being mediated by these motivational factors. The study further elucidated that task complexity and the innovation climate serve as moderating variables in the interplay between transformational leadership and employees' innovative work behavior.

Robertson and Barling (2013) demonstrated that leaders' environmental descriptive norms, along with the pro-environmental behaviors they exhibit, play a significant role in facilitating the greening of organizational practices.

Chen, Chang and Lin (2014) identified that green transformational leadership positively affects green mindfulness, green self-efficacy, and green performance. Furthermore, this research illustrates that the affirmative correlation between green transformational leadership and green performance is partially mediated by two key factors: green mindfulness and green self-efficacy. This suggests that green transformational leadership not only exerts a direct positive influence on green performance but also indirectly enhances it through the mechanisms of green mindfulness and green self-efficacy.

Mittal and Dhar (2016) revealed that green transformational leadership cultivates green creativity within organizations. The research delineates how the dimensions of environmental idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration contribute to the enhancement of green creativity among employees in the tourism sector.

Norton et.al. (2015) found that the influence of green transformational leadership on employee green behavior underscores the significance of the four dimensions of green leadership. This provides a robust theoretical framework for comprehending how environmental idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration shape employee engagement in pro-environmental behaviors.

Hypothesis 2: Green Organizational Culture is delineated by three factors: degree, diffusion, and depth.

Meaning: Degree, Diffusion, and Depth—these constructs collectively elucidate the integration and operationalization of sustainability within an organizational framework. Degree pertains to the magnitude and breadth of environmentally sustainable practices, Diffusion evaluates the extent to which these practices are disseminated across various organizational strata, and Depth scrutinizes the profundity with which sustainability principles are ingrained in the organization's cultural and operational paradigms.

Reason: Degree, Diffusion, and Depth—these elements collectively signify the extent and assimilation of sustainability practices within an organizational context. Degree quantifies the breadth of implementation of green practices and their comprehensive scope. Diffusion appraises the reach of these practices across diverse levels and functions, including the engagement of stakeholders. Depth assesses the extent of incorporation of sustainability values within the organizational culture, thereby influencing decision-making processes, operational routines, and overarching commitments.

Theory or Supporting Research:

Harris and Crane (2002) discovered that managerial perceptions indicate that the depth, degree, and diffusion of a green organizational culture are imperative for catalyzing ecological transformation. Depth pertains to the internalization of green values by employees, degree denotes the organization's allegiance to sustainable practices, and diffusion relates to the propagation of green ideologies and behaviors both within and external to the organization. Management posits that effective ecological transformation necessitates the synergistic interplay of these three dimensions.

Bansal (2005) identified that corporate sustainable development represents a dynamic process, wherein the diffusion and depth of a green organizational culture assume pivotal roles. Over time, enterprises have augmented their employees' environmental consciousness and behaviors through the persistent advocacy and deepening of green cultural practices, culminating in the attainment of sustainable development objectives.

The degree of green organizational culture also significantly influences the transition of companies from short-term profitability to long-term sustainability.

Lee and Kim (2018) established that a green organizational culture exerts a significant positive influence on environmental management practices, with green mindfulness serving as a critical mediating variable. Specifically, the degree, diffusion, and depth of green organizational culture amplify the organization's environmental management practices by fostering heightened employee awareness and accountability regarding environmental stewardship.

Dangelico and Pujari (2010) concluded that corporations mainstream green product innovation as a response to market demand, regulatory imperatives, and competitive positioning. The depth and diffusion of a green organizational culture substantially affect the innovation capabilities of firms concerning environmental sustainability. The degree of organizational culture (commitment to green practices) also plays a crucial role in determining investments and outcomes in environmental innovation.

Daily, Bishop, and Steiner (2007) revealed that corporate sustainability strategies can enhance corporate value, with a green organizational culture serving a pivotal function. Specifically, the depth (acknowledgment of green values by organizational constituents) and diffusion (advocacy of green practices) of green organizational culture exhibit positive correlations with financial performance and market outcomes.

Chang and Chen (2013) found that a robust green organizational identity positively impacts green innovation. The degree, diffusion, and depth of green organizational culture exert significant effects on a company's capacity to engage in green innovation. When green practices and values are well-diffused and deeply internalized by employees, the organization is more inclined to develop and implement innovative environmentally sustainable products and practices, thereby augmenting its overall capacity for sustainability.

Hypothesis 3: Green Self-Efficacy is characterized by two factors: individual green self-efficacy and collective green self-efficacy.

Meaning: Green Self-Efficacy encompasses two pivotal components: Individual Green Self-Efficacy, which pertains to an individual's confidence in their capacity to enact and persist in environmentally sustainable behaviors, and Collective Green Self-Efficacy, which refers to the collective conviction within a group or organization regarding their joint competence to attain environmental objectives and tackle challenges. Collectively, these elements encapsulate both individual and collective confidence in fostering environmental sustainability.

Reason: The delineation of Green Self-Efficacy into Individual Green Self-Efficacy and Collective Green Self-Efficacy is essential for comprehensively capturing both personal and group influences on environmental behaviors. Individual Green Self-Efficacy signifies personal assurance in one's ability to adopt and uphold sustainable practices, while Collective Green Self-Efficacy embodies the mutual belief within a group or organization concerning their collaborative potential to realize environmental objectives and confront challenges. This differentiation is vital for elucidating how both personal confidence and group dynamics propel overall environmental performance.

Theory or Supporting Research:

Sanchez and Rodriguez (2021) discovered that individual green self-efficacy significantly impacts personal acceptance of sustainable practices within the hospitality sector, whereas collective green self-efficacy influences team-level practices and the overall customer satisfaction with sustainability initiatives.

Miller and Miller (2022) established that individual green self-efficacy affects personal environmental actions, while collective green self-efficacy plays a critical role in shaping the environmental performance of entire organizations within small and medium-sized enterprises (SMEs) across Europe.

Patel and Gupta (2023) revealed that individual green self-efficacy has a significant effect on personal contributions to corporate sustainability endeavors, and that collective

green self-efficacy influences the comprehensive environmental performance of manufacturing firms in India.

Fischer and Bertram (2021) indicated that both individual and collective green self-efficacy exert an influence on environmental behavior within public sector organizations in Australia, elucidating how personal confidence in green practices alongside collective beliefs impact sustainable actions.

Chen and Zhang (2021) identified that individual green self-efficacy is a determinant of employees' pro-environmental behavior, whereas collective green self-efficacy significantly influences group-level environmental actions and organizational outcomes.

Kim and Kim (2023) demonstrated that individual green self-efficacy positively correlates with personal involvement in green innovation, while collective green self-efficacy enhances the overall environmental performance of the organization.

Li and Li (2022) observed that individual green self-efficacy affects personal environmental behaviors and that collective green self-efficacy significantly influences organizational green practices and cultural dynamics.

Hypothesis 4: Employee Green Behavior is comprised of two factors: task-related green behavior and voluntary green behavior.

Meaning: Employee Green Behavior encompasses two distinct categories: Task-related Green Behavior, which refers to environmentally sustainable actions mandated by job responsibilities and organizational protocols, such as engaging in recycling and minimizing energy consumption, and Voluntary Green Behavior, characterized by discretionary actions undertaken out of a personal commitment to sustainability, including the initiation of green projects and the promotion of environmentally responsible practices.

Reason: Task-related Green Behavior comprises obligatory actions dictated by professional duties and organizational regulations, which contribute directly to achieving environmental objectives and ensuring compliance. Conversely, Voluntary Green

Behavior encompasses discretionary actions motivated by an individual's personal dedication to sustainability, reflecting employees' intrinsic motivation and resulting in additional positive outcomes through proactive initiatives and creative endeavors.

Theory or Supporting Research:

Norton et al. (2015) established a differentiation between task-related and voluntary green behaviors within the context of employee green behavior. Task-related green behavior pertains to actions explicitly linked to job responsibilities, whereas voluntary green behavior encompasses discretionary actions that extend beyond the scope of job requirements.

Ren and Zhang (2020) demonstrated the influence of green transformational leadership on employees' green behavior, which includes both task-related and voluntary behaviors. Their research underscores the mediating effects of green organizational culture and green self-efficacy on these relationships.

Li and Zhang (2023) investigated the effects of green human resource management on employees' green behavior, encompassing both task-related and voluntary actions. This study elaborates on the moderating role of organizational support within this dynamic.

Liu and Zhang (2022) explored the impact of corporate social responsibility on employees' green behavior, emphasizing both task-related and voluntary actions. Their findings highlight the mediating influence of green organizational identity in this context.

Li and Zhang (2021) identified that green transformational leadership affects employees' green behaviors, making a distinction between task-related and voluntary green behaviors. The study further examines the mediating roles of green organizational culture and green self-efficacy within this framework.

Hypothesis 5: A positive correlation exists between Green Transformational Leadership and Employee Green Behavior

Meaning: Leaders who demonstrate green transformational attributes—such as articulating a compelling vision for sustainability, exemplifying environmentally

responsible behaviors, offering support and necessary resources, empowering subordinates, and reinforcing ecological principles—substantially affect employees' propensity to engage in environmentally sustainable practices. This correlation suggests that when leaders adeptly advocate for sustainability and incorporate it into their leadership methodologies, employees are more incentivized, equipped, and predisposed to embrace and maintain eco-friendly actions within their professional responsibilities. In summary, proficient green transformational leadership catalyzes a favorable transformation in employee conduct toward enhanced environmental stewardship.

Reason: Green Transformational Leadership exerts a beneficial influence on Employee Green Behavior by articulating an inspiring vision for sustainability, exemplifying responsible conduct, and furnishing requisite resources and explicit directives. Leaders stimulate employee motivation through encouragement and support, empower them with a degree of autonomy, and cultivate active participation in green initiatives. Furthermore, they reinforce ecological values through consistent acknowledgment and assist in embedding these values into the organizational ethos, thereby establishing a robust alignment between employee actions and sustainability objectives.

Theory or Supporting Research:

Chen and Zheng (2022) established that green transformational leadership exerts a positive influence on employees' environmentally sustainable behavior. The research underscores that environmental knowledge serves as a moderating factor in this relationship, indicating that leaders' impact on green behavior is amplified when employees possess heightened environmental awareness.

Gómez-Suárez and Pérez (2023) demonstrated that green transformational leadership significantly enhances employees' green behavior in Spain. The findings emphasize the pivotal role of leaders in promoting ecological values and practices, culminating in heightened employee engagement in environmentally conscious activities.

Lee and Choi (2021) revealed that green transformational leadership positively influences employees' green behavior in South Korea. The investigation accentuates the critical importance of leaders in nurturing an organizational culture that endorses sustainable practices and inspires employees to partake in eco-friendly conduct.

Khan and Niazi (2021) identified that green transformational leadership positively affects employees' green behavior in Pakistan. The study elucidates how leaders' dedication to environmental sustainability propels employees to adopt environmentally friendly practices in their routine tasks.

Nguyen and Nguyen (2020) found that green transformational leadership significantly impacts employees' green behavior in Vietnam. The research highlights the essential role of leadership in propelling environmental initiatives and augmenting employees' commitment to sustainable practices.

Hypothesis 6: Green Organizational Culture mediates the relationship between Green Transformational Leadership and Employee Green Behavior within the organization

Meaning: The concept of green organizational culture serves as a mediating variable in the association between green transformational leadership and employee green behavior, functioning as an intermediary mechanism. This indicates that the beneficial influence of green transformational leadership on employee green behavior is facilitated through the establishment of a robust green organizational culture. The initiatives undertaken by leaders to advocate for sustainability cultivate an environment that encourages and nurtures employees' green initiatives.

Reason: Green Organizational Culture acts as a mediator in the nexus between Green Transformational Leadership and Employee Green Behavior by embedding the sustainability visions articulated by leaders into everyday practices and established norms. It establishes a conducive atmosphere replete with explicit norms and resources, thereby assisting employees in the adoption of green behaviors. This cultural framework amplifies motivation and engagement through ongoing reinforcement and encouragement, aids in the

assimilation of green behaviors into habitual activities, and secures the enduring sustainability of green initiatives beyond the individual leadership tenures.

Theory or Supporting Research:

Chou and Chen (2020) demonstrated that green organizational culture mediates the association between green transformational leadership and employees' green behavior within the context of Taiwan. Moreover, green self-efficacy moderates this relationship, augmenting the influence of green organizational culture on green behavior.

Kassinis and Soteriou (2021) illustrated that green organizational culture mediates the affirmative relationship between green transformational leadership and employees' environmental performance in Greece. The research also investigates how green innovation moderates this mediated relationship.

Afsar and Badir (2022) revealed that green organizational culture mediates the influence of green transformational leadership on employees' green behavior in Turkey. Additionally, environmental awareness plays a crucial role in fortifying this mediated relationship.

Gomez and Rodriguez (2023) found that green organizational culture mediates the relationship between green transformational leadership and employees' green behavior within small and medium-sized enterprises (SMEs) in Spain. The study underscores the significance of leadership in cultivating a green culture that propels employee engagement in sustainable practices.

Tariq and Mahmood (2022) established that green organizational culture mediates the positive influence of green transformational leadership on employees' green behavior in Pakistan. The research accentuates how leaders' dedication to environmental sustainability enriches organizational culture and subsequently enhances employee green behavior.

Hypothesis 7: Green Self-Efficacy mediates the relationship between Green Transformational Leadership and Employee Green Behavior within the organization.

Meaning: Green self-efficacy serves as a mediating variable that facilitates the connection between green transformational leadership and employee green behavior by functioning as an intermediary construct. This implies that the influence of green transformational leadership on employees' green behavior occurs indirectly, mediated through its impact on their self-efficacy. Leaders bolster employees' conviction in their capacity to engage in sustainable practices, which subsequently fosters heightened participation in environmentally friendly behaviors.

Reason: The significance of green self-efficacy in mediating the interplay between green transformational leadership and employee green behavior is underscored by its representation of employees' confidence in their own capabilities to execute environmentally sustainable actions. Individuals possessing elevated levels of self-efficacy exhibit greater motivation and perseverance, proactively undertaking sustainable initiatives even when confronted with obstacles. This assurance manifests in observable green behaviors, as individuals who perceive themselves as capable of effecting change are more inclined to actively engage in both obligatory and discretionary environmental actions.

Theory or Supporting Research:

Choi and Moon (2022) established that green self-efficacy mediates the association between green transformational leadership and employees' green behavior within the context of South Korea. Furthermore, the study identifies green organizational culture as a moderating variable that amplifies the impact of green self-efficacy on green behavior.

Afsar and Badir (2021) determined that green self-efficacy acts as a mediator in the relationship between green transformational leadership and employees' green behavior in Turkey. The research identifies green training as a moderating factor that enhances the influence of green self-efficacy on green behavior.

Naderpour and Mahdavi(2023) discovered that green self-efficacy mediates the relationship between green transformational leadership and employees' green behavior in Iran. The study further elucidates how green organizational support moderates this mediated relationship, thereby augmenting the efficacy of green self-efficacy.

Gómez-Suárez and Pérez (2021) found that green self-efficacy mediates the affirmative influence of green transformational leadership on employees' green behavior in Spain. Additionally, green motivation is identified as a crucial component that supplements the effects of green self-efficacy.

Zhou and Liu (2023) identified that green self-efficacy plays a pivotal mediating role in the relationship between green transformational leadership and employees' green behavior in China. The research emphasizes that green transformational leadership enhances employees' green self-efficacy, which in turn positively affects their involvement in green practices within the manufacturing sector.

CHAPTER 3
RESEARCH METHODOLOGY

The research methodology in this chapter is separated into 6 parts as follows:

3.1 Research Design

3.2 Population and Sample

3.3 Research Tools

3.4 Data Collection Strategy and Procedure

3.5 Data Analysis

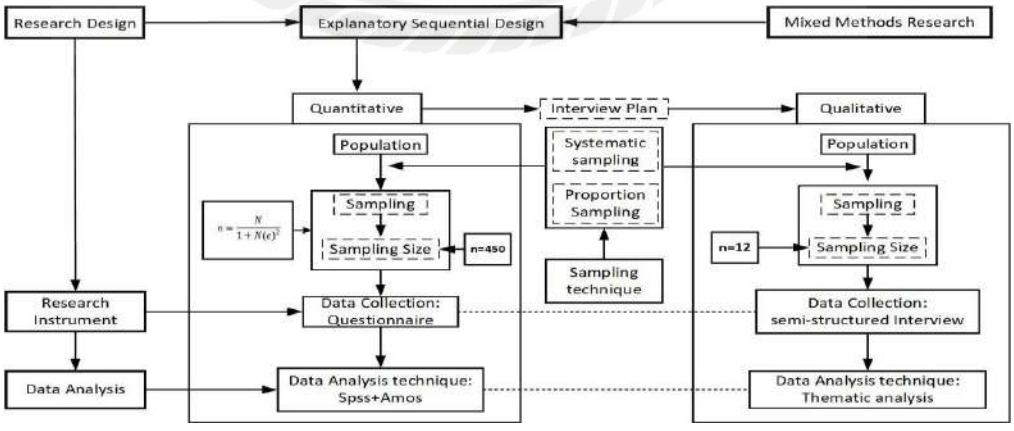
3.6 Research Ethics

3.1 Research Design

This research employed a quantitative research method as a major methodology and used qualitative research method to support the quantitative method data. The combination of quantitative and qualitative methods was chosen to enable both the generalization of the findings across a large population and the in-depth exploration of contextual factors influencing green behavior in iron and steel enterprises. The research steps are shown in Figure 3.1.

Figure 3.1

Research Design



Source: Researcher (2024).

3.1.1 Documentary Analysis

The documentary research phase entailed the systematic gathering of data from a diverse array of sources, encompassing textbooks, scholarly journals, articles, dissertations, theses, online databases, and official reports. The analysis and synthesis of these documents were conducted in conjunction with pre-existing theories, concepts, and extant research to formulate the conceptual framework and derive hypotheses.

3.1.2 Questionnaire Survey

A questionnaire was developed and distributed to the selected samples. The collected responses were analyzed using SPSS statistical software to assess reliability, validity, descriptive statistics, and correlation among variables. The proposed model's hypotheses were tested by evaluating path coefficients and significance levels of relationships between observed and latent variables.

3.1.3 Interview

Qualitative research incorporates a range of data collection methodologies, including in-depth interviews, face-to-face interviews, document analysis, and direct observation (Khan, 2014). This investigation employed semi-structured interviews as a means of data collection, guided by predetermined themes and a uniform set of primary questions (Morgan, 2016; George, 2022).

This study conducted interviews with twelve individuals closely related to green management, including eight employees from iron and steel enterprises, two officials from the Ministry of Industry and Information Technology, and two experts from the green industry.

3.2 Population and Sample

3.2.1 Population

This study centered on employees (Senior Management: General Managers, Vice General Managers, and Department Directors; Middle Management: Department Managers, Project Managers, and Team Leaders; Staff: Workers directly engaged in production and operational activities) within Chinese iron and steel enterprises. As of 2022, the sector comprised 565 companies employing a total of 1,359,300 individuals (China Iron and Steel Association, 2023). The enumeration of companies across China's 28 provinces is organized in descending order from the largest to the smallest, as illustrated in Table 3.1.

Table 3.1

Number of Iron and Steel Companies in China

Ranking	Provinces	Number of companies	Percentage
1	HeBei	108	19.1
2	JiangSu	50	8.8
3	SiChuan	45	8.0
4	LiaoNing	43	7.6
5	ZheJiang	34	6.0
6	XinJiang	31	5.5
7	NeiMengGu	28	5.0
8	ShanXi	27	4.8
9	GuangDong	27	4.8
10	ShanDong	22	3.9
11	Fu Jijan	20	3.5
12	HuBei	19	3.4
13	GuangXi	18	3.2
14	HeNan	14	2.5
15	JiangXi	13	2.3

Ranking	Provinces	Number of companies	Percentage
16	AnHui	12	2.1
17	YunNan	12	2.1
18	ChongQing	10	1.8
19	TianJing	9	1.6
20	ShannXi	4	0.7
21	Hu Nan	4	0.7
22	HeiLongJiang	4	0.7
23	JiLin	3	0.5
24	GanSu	3	0.5
25	NingXia	2	0.4
26	ShangHai	1	0.2
27	QingHai	1	0.2
28	GuiZhou	1	0.2
Total		**565**	100

Source: China Iron and Steel Association（2023）

3.2.2 Sample for Quantitative and Qualitative Research Methods

3.2.2.1 Quantitative Research Methods

The total population for this study was 1,359,300. The sample size was calculated from Yamane's formula (1967) as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where n = Sample Size

N = Population Size = 1,359,300

e = Level of Precision = 0.05

therefore n will be

$$n = \frac{1{,}359{,}300}{1 + 1{,}359{,}300\ (0.05)^2}$$

$$n = 399.88 = 400$$

By applying the formula, the calculated sample size is 400 respondents.

According to the formula proposed by Yamane (1967), the minimum requisite sample size was determined to be 400. Nevertheless, in the context of structural equation modeling (SEM), a sample size surpassing 500 is typically regarded as more robust. To guarantee the successful acquisition of a minimum of 500 valid responses, a total of 600 questionnaires were disseminated in the present study.

This research utilized a multi-stage sampling methodology to attain representative findings as delineated below:

The first stage: A stratified random sampling approach was implemented to guarantee that Table 3.2 reflects the distribution of companies across each province, which are derived from the top 10 Chinese iron and steel enterprises by province, encompassing 73.5% of the entire population: Hubei, Jiangsu, Sichuan, Liaoning, Zhejiang, Xinjiang, Inner Mongolia, Shanxi, Guangdong, and Shandong were incorporated.

Table 3.2

Number and Percentage of Companies in the Top 10 Provinces

Ranking	Provinces	Number of companies	Percentage
1	HeBei	108	19.1
2	JiangSu	50	8.8
3	SiChuan	45	8.0
4	LiaoNing	43	7.6
5	ZheJiang	34	6.0
6	XinJiang	31	5.5
7	NeiMengGu	28	5.0
8	ShanXi	27	4.8
9	GuangDong	27	4.8
10	ShanDong	22	3.9
Total		415	**73.5%**

Source: Researcher (2024).

The second stage: Proportionate sampling guarantees that the quantity of participants from each province corresponds with the true distribution of enterprises. The allocation of the sample was ascertained by computing the percentage of enterprises within each province and disseminating questionnaires in accordance with that distribution. Table 3.3 illustrates that a total of 600 questionnaires were disseminated.

Table 3.3

Number of Questionnaires of the Top 10 Provinces

Ranking	Provinces	Number of companies	Percentage	Number of questionnaires
1	HeBei	108	26.0	156
2	JiangSu	50	12.0	72
3	SiChuan	45	10.8	65
4	LiaoNing	43	10.4	63
5	ZheJing	34	8.2	48
6	XinJiang	31	7.5	45
7	NeiMengGu	28	6.7	41
8	ShanXi	27	6.5	39
9	GuangDong	27	6.5	39
10	ShanDong	22	5.3	32
Total		415	100	**600**

Source: Researcher (2024).

The third stage employed a purposive sampling method to determine the final sample. The questionnaires were distributed to individuals directly involved in production and operational tasks within the selected Chinese iron and steel enterprises.

3.2.2.2 Qualitative Research Method

The quantity of interviews was established based on the principle of data saturation, as corroborated by Brinkmann and Tanggaard (2020), Guest et al. (2006), and Francis et al. (2010), who posit that twelve interviews are generally adequate for extracting significant insights. These interviews centered on participants' perspectives regarding

green transformational leadership, green behavior, environmental consciousness, and their comprehension of green organizational culture and green self-efficacy. The objective is to investigate how these elements influence their green behavior and contribute to the enhancement of green management mechanisms, the organizational green culture, and employee green self-efficacy.

The research utilized a semi-structured, in-depth interview methodology, incorporating a meticulously crafted informed consent document for the purpose of interviewing the subsequent key informants:, 8 employees from iron and steel enterprises, 2 officials from the Ministry of Industry and Information Technology, and 2 experts from the green industry.

3.3 Research Tools

3.3.1 Quantitative Research Method

- **Content Validity (IOC)**

To ensure the content validity of the questionnaire, the Item-Objective Congruence (IOC) method was adopted. This approach is a widely accepted technique in instrument development used to determine how well each item aligns with the intended research objectives and theoretical constructs. A panel of five experts with substantial backgrounds in green management, environmental science, and organizational behavior, was invited to assess the relevance of each questionnaire item. The list of experts is as follows:

1. Prof. Dr. Lu Zhiping (School of Management, Guangxi University of Science and Technology, China)

2. Prof. Dr. Zhu Xiaoqin (School of Management, Guangxi University of Science and Technology, China)

3. Assoc. Prof. Dr. Liang Feiwen (School of Management, Guangxi University of Science and Technology, China)

4. Dr. Qin Jiayin (School of Management, Guangxi University of Science and Technology, China)

5. Assoc. Prof. Dr. Li Li (School of Management, Guangxi University of Science and Technology, China)

Five experts were instructed to rate each item according to the following scale:

- +1 = clearly relevant
- 0 = uncertain or unclear relevance
- − 1 = clearly irrelevant

The IOC score for each item was calculated using the formula:

$$\text{IOC} = \frac{\text{Sum of expert ratings}}{\text{Number of experts (5)}}$$

All questionnaire items achieved an IOC score of 0.50 or higher, indicating that they met the minimum criterion for acceptable content validity. As a result, no items were deleted or revised following the IOC assessment. This outcome confirmed the congruence between the questionnaire items and the study's conceptual framework, thereby reinforcing the content validity of the instrument. The questionnaire items were adapted from validated scales in previous studies, including green transformational scale (Chen & Chang, 2013), green self-efficacy scale (Li et al., 2020), green organizational culture (Harris & Crane, 2002)) and employee green behavior scale (Ones & Dilchert, 2012). Minor modifications were made to fit the context of China's iron and steel industry.

In this study five experts checked 55 items. The IOC value is 0.865, the result shows that the questionnaire has a good content validity.

- **Reliability**

To assess the reliability of the questionnaire, this study employed the Cronbach's Alpha coefficient. Internal consistency reliability refers to the degree of correlation between items in the questionnaire and their collective ability to measure the same construct. It is commonly used to determine whether a measurement tool can consistently and reliably assess the same variable.

First, the questionnaire data were collected from the study participants. Then, the Cronbach's Alpha coefficient for all relevant items in the questionnaire was calculated

using statistical software (SPSS data analysis tools). The Cronbach's Alpha coefficient ranges from 0 to 1, and it is generally interpreted as follows:

- $\alpha \geq 0.70$: Indicates good internal consistency, and the reliability is acceptable.
- $0.60 \leq \alpha < 0.70$: Indicates borderline reliability, and the questionnaire may require improvement.
- $\alpha < 0.60$: Indicates poor internal consistency, and the reliability is low, suggesting that the questionnaire may need revision or optimization.

In this study, a reliability threshold of 0.70 was set, meaning that a Cronbach's Alpha score of 0.70 or above was considered acceptable. If the result met or exceeded this standard, it indicated that the questionnaire has high consistency in measuring the same construct and can reliably reflect the research variables.

According to Table 3.4, a pre-test of the questionnaire was conducted with 30 samples (from Fujian, Hubei, and Guangxi). All Cronbach's alpha values exceeded 0.7, thereby indicating that the questionnaire demonstrates commendable reliability and is appropriate for formal data collection.

Table 3.4

Reliability Statistics of Variable

NO.	Variable	Cronbach's Alpha	N of Items
1	Environmental Idealized Influence	0.841	5
2	Environmental Inspirational Motivation	0.896	5
3	Environmental Intellectual Stimulation	0.884	5
4	Environmental Individualized Consideration	0.828	5
5	Task-related Green Behavior	0.921	5
6	Voluntary Green Behavior	0.929	5

NO.	Variable	Cronbach's Alpha	N of Items
7	Degree	0.840	5
8	Diffusion	0.889	5
9	Depth	0.885	5
10	Individual Green Self-Efficacy	0.901	5
11	Collective Green Self-Efficacy	0.939	5

Source: Researcher (2024).

3.3.2 Qualitative Research Method

The research utilized a semi-structured, in-depth interview methodology, incorporating a meticulously crafted informed consent document for the purpose of interviewing the subsequent key informants:, 8 employees from iron and steel enterprises, 2 officials from the Ministry of Industry and Information Technology, and 2 experts from the green industry.

3.4 Data Collection Strategy and Procedure

This study adopted a mixed-methods data collection strategy, combining quantitative and qualitative data to enhance the comprehensiveness and reliability of the research. The specific strategies are as follows:

Quantitative data: Collected through structured questionnaires to measure relationships between variables and conduct statistical analysis.

Qualitative data: Obtained via semi-structured interviews to gain in-depth understanding of the underlying mechanisms and influencing factors of the research phenomenon.

3.4.1 Quantitative Data Collection Steps

The quantitative data collection process followed a systematic approach to ensure the collection of reliable and valid data for analysis. The steps undertaken in the data collection process were as follows:

- **Questionnaire Design**

A structured questionnaire was developed to measure the key variables of the study, including green transformational leadership, green organizational culture, green self-efficacy, and employee green behavior. The questionnaire was designed to align with the operational definitions of these variables and was reviewed for clarity and relevance to the research objectives. Experts in the fields of green management and organizational behavior reviewed the questionnaire for content validity using the Item-Objective Congruence (IOC) method.

- **Pre-test**

The pre-test of the questionnaire was composed of 30 questionnaires from Fujian, Hubei and Guangxi provinces (10 randomly selected from each province) to assess the clarity, understandability and overall function of the questionnaire. The feedback obtained from the pilot test was used to improve the questionnaire to ensure that all items were understandable.

- **Sampling Strategy**

This study employed a multi-stage sampling methodology. In the first stage, stratified random sampling was used; in the second stage, proportionate sampling was applied; and in the third stage, proportionate sampling was also utilized.

- **Data Collection**

The questionnaire was distributed to the selected participants either through online surveys(https://www.wjx.cn/), depending on participant availability and preference.

Participants were provided with clear instructions on how to complete the questionnaire, and consent was obtained prior to participation. The data collection process was conducted over a period of six months, ensuring a comprehensive datasets were gathered.

- **Data Storage and Management**

The collected data were securely stored and organized in a database for subsequent analysis. Data cleaning procedures were performed to remove incomplete or inconsistent responses, ensuring that only valid responses were included in the final datasets.

- **Ethical Considerations**

Ethical guidelines were strictly followed during the data collection process. All participants were informed about the purpose of the study, and their anonymity and confidentiality were guaranteed. Informed consent was obtained, and participants were given the option to withdraw from the study at any time.

3.4.2 Qualitative Data Collection Steps

3.4.2.1 Design Interview Form

A semi-structured interview form was created containing open-ended questions.

3.4.2.2 Select Participants

This study conducted interviews with twelve individuals closely related to green management, including eight employees from iron and steel enterprises, two officials from the Ministry of Industry and Information Technology, and two experts from the green industry.

3.4.2.3 Conduct Interviews

Interviews were scheduled at times and locations that were convenient for the participants, or conducted through online platforms. At the commencement of each interview, the research purpose was introduced and elucidated. The interview form served as a conversational guide, while maintaining the flexibility to explore emergent topics or insights during the interview process.

3.4.2.4 Recording and Documentation

Consent was obtained for audio recording in order to ensure the precision of data collection. Detailed notes was compiled during the interview.

Through the aforementioned procedures, the researcher comprehensively gathered and analyzed both quantitative and qualitative data, thereby providing robust data support for the research study.

3.5 Data Analysis

3.5.1 Quantitative Data Analysis

Quantitative data analysis endeavored to elucidate the patterns, correlations, and associations that such analysis can unveil between variables, as well as to evaluate the hypotheses posited in the research. The subsequent step involved the application of the following methodology:

3.5.1.1 Analysis of General Information of Interviewees

This phase encompassed the employment of frequency and percentage statistical techniques to scrutinize the fundamental characteristics of the interview participants. This analysis included, yet was not confined to, demographic factors including age, gender, years of professional experience, educational qualifications, and job titles. These statistical findings present a comprehensive overview of the study sample, facilitating an understanding of the sample's representativeness and heterogeneity.

3.5.1.2 Analysis of Characteristics of Variables

This study employed the mean and standard deviation (SD) to evaluate specific variables. Such variables may encapsulate the interviewees' attitudes, perceptions, or other quantitative indicators in relation to particular questions. The mean signifies the average magnitude of the variable, while the standard deviation elucidates the extent of dispersion or variability of the data points surrounding the mean.

3.5.1.3 Descriptive Statistical Analysis of Variables

The objective is to execute a descriptive statistical analysis of four key variables: green transformational leadership, green organizational culture, green self-efficacy, and employee green behavior. By computing the arithmetic mean and standard deviation for these variables, an initial comprehension of their central tendency and variability was acquired. The mean indicates the overall level of each variable, whereas the standard deviation delineates the span of data points in relation to the mean.

3.5.1.4 Pearson's Correlation Coefficient (r)

This study utilized Pearson's correlation coefficient (r) to quantify the strength and direction of the linear relationships existing between green transformational leadership and employee green behavior, green transformational leadership and green organizational culture, green transformational leadership and green self-efficacy, green organizational culture and employee green behavior, as well as green self-efficacy and employee green behavior.

3.5.1.5 Confirmatory Factor Analysis (CFA)

AMOS 24.0 was employed to conduct Confirmatory Factor Analysis (CFA) in order to ascertain whether the measurement models of the latent constructs—namely, green transformational leadership, green organizational culture, green self-efficacy, and employee green behavior—conform to theoretical expectations. CFA assessed whether the items in the questionnaire effectively represent their corresponding latent constructs through factor loading values.

3.5.1.6 Structural Equation Modeling (SEM) Analysis

Utilizing AMOS 24.0 software for Structural Equation Modeling (SEM) analysis facilitates a thorough investigation of the influence of green transformational leadership, green organizational culture, and green self-efficacy on employee green behavior. In this framework, green transformational leadership is designated as the independent variable, employee green behavior as the dependent variable, while green organizational culture and

green self-efficacy function as mediating variables. Path analysis was performed using the maximum likelihood estimation method to evaluate both direct and indirect effects among these variables.

3.5.1.7 Mediation Effect Testing

The Bootstrap method was implemented to scrutinize whether the mediating roles of green organizational culture and green self-efficacy in the relationship between green transformational leadership and employee green behavior are statistically significant.

In summary, by amalgamating descriptive statistical analysis with SEM, the interrelations among green transformational leadership, green organizational culture, green self-efficacy, and employee green behavior was thoroughly examined, yielding valuable insights for Chinese iron and steel enterprises.

3.5.2 Qualitative Data Analysis

3.5.2.1 Content Analysis

Content analysis served as a methodological approach for processing data acquired from interviews. This process entails the systematic encoding of interview transcripts, as well as the identification of overarching themes, patterns, and categorical distinctions. Through rigorous examination of the data, salient themes and concepts emerge, including determinants of efficiency, challenges in management, and prevailing trends within the industry.

3.5.2.2 Triangulation and Depth of Analysis

Triangulation was implemented through the integration of quantitative findings to augment the credibility and profundity of the research. In the analysis of qualitative data, the viewpoints of various interviewees were taken into account, allowing for the identification of areas of agreement and conflict, as well as an examination of how these viewpoints corroborate or contradict the conclusions drawn from the quantitative data.

3.5.2.3 Integration of Results and Application

The findings from qualitative analysis were synthesized with those of quantitative analysis in order to furnish a more holistic understanding. The nuanced insights derived from qualitative data were employed to elucidate and enrich the outcomes of quantitative analysis, thereby providing targeted recommendations aimed at fostering environmentally responsible behavior among employees within Chinese iron and steel enterprises.

3.6 Research Ethics

The researcher procured formal consent from all individuals participating in the study. This process included ensuring that each participant was thoroughly apprised of the research's objectives, the nature of their participation, and their rights, including the prerogative to withdraw from the study at any point without facing any adverse repercussions. The consent procedure also encompassed assurances of confidentiality and anonymity for all participants, thereby safeguarding their personal and sensitive data. Furthermore, the researcher pledged to utilize the data solely for the purposes delineated in the research and for no other objectives.

The researcher obtained a certificate in research ethics, Certification Number: 2991155, from Protecting Human Research Participants Online Training Inc. Prior to the execution of the research, the questionnaire and interview framework were presently under review for approval by the research ethics committee PIM-REC 024/2568.

CHAPTER 4
RESEARCH RESULTS

This chapter primarily investigates the model of success pertaining to green management practices within Chinese steel enterprises. It is organized into three principal sections. The initial section emphasizes quantitative analysis, utilizing a questionnaire survey methodology to develop a structural equation model. The subsequent section encompasses qualitative research, which entails conducting comprehensive interviews with officials from the Ministry of Industry and Information Technology of China, specialists in the green industry sector, and personnel from Chinese steel enterprises. Ultimately, the chapter synthesizes qualitative and quantitative research approaches to articulate the impact model of green transformational leadership on employees' green behavior. The results are organized into two main sections; 1. Quantitative Data Analysis: This section includes descriptive statistics, normality tests, reliability and validity analysis, confirmatory factor analysis (CFA), correlation analysis, structural equation modeling (SEM), and mediation effect testing. 2. Qualitative Data Analysis: This section presents the thematic analysis of in-depth interviews, providing insights that complement and deepen the quantitative findings. The structure of this chapter is delineated as follows:

4.4.2 In-depth Interview Data Analysis on Green Organizational Culture

4.4.3 In-depth Interview Data Analysis on Green Self-efficacy

4.4.4 In-depth Interview Data Analysis on Employee Green Behavior

4.4.5 In-depth Interview Data Analysis on the Mediating Effect of Green Organizational Culture

4.4.6 In-depth Interview Data Analysis on the Mediating Effect of Green Self-efficacy

4.5 Combination of Quantitative Research and Qualitative Research

4.1 Symbols Representing Variables

This study examines the impact of Green Transformational Leadership (GTL), Green Organizational Culture (GOC), and Green Self-Efficacy (GSE) on Employee Green Behavior (EGB) in iron and steel enterprises in China. The symbols representing variables and number of items for questionnaire are as shown in Table 4.1.

Table 4.1

Symbols Representing Variables

Latent Variables	Observed Variables	Number of Items
Green Transformational Leadership (GTL)	Environmental Idealized Influence	5 (GTL1-GTL5)
	Environmental Inspirational Motivation	5 (GTL6-GTL10)
	Environmental Intellectual Stimulation	5 (GTL11-GTL15)
	Environmental Individualized Consideration	5 (GTL16-GTL20)
Green Organizational Culture (GOC)	Degree	5 (GOC1- GOC5)
	Diffusion	5 (GOC6- GOC10)
	Depth	5 (GOC11- GOC15)
Green Self-efficacy (GSE)	Individual Green Self-Efficacy	5 (GSE1- GSE5)
	Collective Green Self-Efficacy	5 (GSE6- GSE10)
Employee Green Behavior (EGB)	Task-related Green Behavior	5 (EGB1- EGB5)
	Voluntary Green Behavior	5 (EGB6- EGB10)

Source: Researcher (2024).

4.2 The Model Fit Indices and Their Acceptable Thresholds

To evaluate the quality of the structural model and the degree to which the hypothesized model fits the observed data, several model fit indices were employed in this study. These indices are commonly used in structural equation modeling (SEM) and reflect different aspects of model fit. The acceptable threshold values for each index are summarized in Table 4.2.

Table 4.2

Model Fit Indices and Their Acceptable Thresholds

Goodness of Fit Index(Statistic Abbreviation)	Goodness of Fit Index	Objective	Level of Acceptance	Interpretation
CMIN/DF (χ^2/df)	Relative Chi-square	To verify that the model is consistent with the empirical data	<5	Pass
GFI	Goodness of Fit Index	To measure the level of harmony in comparison with a value between 0-1.00	>0.90	Pass
AGFI	Adjusted Goodness-of-Fit Index	To assess the overall model fit while penalizing model complexity through degrees-of-freedom adjustment, thereby avoiding artificially inflated goodness-of-fit due to over-parameterization.	>0.90	Pass
RMSEA	Root Mean Square Error of Approximation	To indicate the error value of the model, in form of the root of mean square's error by approximating the value between 0-1.00	<0.08	Pass
IFI	Incremental Fit Index	Adjusts the Normed Fit Index (NFI) for sample size and degrees of freedom	>0.90	Pass
NFI	Normed fit index	Defined as 1 minus the Chi² value of the proposed model divided by the Chi² values of the null model	>0.90	Pass
TLI (NNFI)	Tucker-Lewis Index (Non-Normed Fit Index)	To evaluate the improvement in fit of the theoretical model compared to the null model, while penalizing model complexity.	>0.90	Pass

Goodness of Fit Index(Statistic Abbreviation)	Goodness of Fit Index	Objective	Level of Acceptance	Interpretation
CFI	Comparative Fit Index	Examine the discrepancy between the data and the hypothesized model, while adjusting for the issues of sample size inherent in the chi-squared test of model fit, and the normed fit index	>0.90	Pass
SRMR	Standardized Root Mean Square Residual	quantifies the overall discrepancy between the observed covariance matrix and the model-implied covariance matrix.	<0.05	Pass

Source: Researcher (2024).

4.3 Quantitative Data Analysis

This segment elucidates the examination of the gathered data. The central aim of this investigation is to analyze the interrelations among green transformational leadership, green organizational culture, green self-efficacy, and employee green behavior. The analytical procedures were executed utilizing SPSS 24.0 for the computation of descriptive statistics, while AMOS 24.0 was employed to formulate a structural equation model.

The segment commences with a descriptive statistical evaluation aimed at probing the demographic attributes of the sample and determining the adherence of the data to a normal distribution. Subsequently, assessments of reliability and validity were carried out on the administered questionnaire. In the validity evaluation, principal component analysis (PCA) was initially conducted, succeeded by confirmatory factor analysis (CFA) to authenticate and further scrutinize the proposed structural framework.

4.3.1 Sample Characteristic Description

The analytical exploration of sample characteristics seeks to scrutinize the fundamental attributes of the sample. Within the framework of descriptive statistical analysis, demographic variables including gender, age, educational attainment, and occupational status were utilized. A cumulative total of 532 valid questionnaires were

acquired and subsequently analyzed in the context of this research, with the descriptive data delineated in Table 4.3.

The statistical analysis reveals that within the cohort of 532 respondents, 351 were identified as male, representing 65.98%, whereas 181 were categorized as female, constituting 34.02%. In terms of the demographic distribution by age, 125 respondents fell within the 21-30 age bracket, 219 were aged 31-40, 154 belonged to the 41-50 age range, and 34 were aged 51 and older, corresponding to 23.50%, 41.16%, 28.947%, and 6.40%, respectively. Notably, the age group of 31-40 exhibited the highest representation. Concerning educational attainment, the predominant proportion of respondents possessed a bachelor's degree, with a total of 290 individuals, translating to 54.51%, while 119 individuals held a master's degree or a higher qualification, accounting for 22.37%. In terms of professional experience, 56 respondents reported having less than 3 years of experience, 262 reported 4-6 years, 174 reported 7-9 years, and 40 reported 10 years or more of experience, which correspond to 10.53%, 49.25%, 32.71%, and 7.52%, respectively. An analysis of positional distribution indicates that the category of ordinary employees was the most populous, comprising 311 individuals, which accounts for 58.46%, a figure exceeding half of the total respondents. This group was succeeded by middle managers, numbering 141 individuals and representing 26.50%. Senior managers constituted 54 individuals, amounting to 10.15%, while other roles encompassed 26 individuals, or 4.89%.

Table 4.3

Sample Feature Description

Variable	Option	Frequency	Percent
Gender	Male	351	65.98
	Female	181	34.02
Age	21-30 years	125	23.50
	31-40 years	219	41.17
	41-50 years	154	28.95
	Above 51 years	34	6.39

Variable	Option	Frequency	Percent
Education level	Under Bachelor Degree	123	23.12
	Bachelor Degree	290	54.51
	Master's degree or higher	119	22.37
Working years	1-3 years	56	10.53
	4-6 years	262	49.25
	7-9 years	174	32.71
	Above 10 years	40	7.52
Position	Staff	311	58.46
	Middle manager	141	26.50
	Senior manager	54	10.15
	Others	26	4.89
Total		532	100.0

Source: Researcher (2024).

In summary, the empirical sample data procured in this investigation fulfills the research criteria from the perspective of the interviewees' essential demographic statistics.

4.3.2 Data Normal Distribution Test

This study performed descriptive statistical analyses on all items within the scale, principally encompassing mean, standard deviation, with the objective of evaluating the fundamental level and distribution characteristics of the scale items. The calculated means are uniformly proximate to 4, suggesting that the majority of responses align with the "agree" category. The data amassed from the administered questionnaire is readily applicable for subsequent statistical evaluations, including reliability and validity assessments.

Table 4.4

Results of items description analysis

Items	N	$\overline{X}$	SD.	Level	Rank No
GTL1	532	3.923	0.914	Agree	5
GTL2	532	3.947	0.929	Agree	3
GTL3	532	3.934	0.920	Agree	4
GTL4	532	3.919	0.830	Agree	2
GTL5	532	3.979	0.899	Agree	1
Environmental Idealized Influence	532	3.941	0.749	Agree	
GTL6	532	4.222	1.012	Agree	1
GTL7	532	3.981	0.850	Agree	4
GTL8	532	4.212	0.960	Agree	2
GTL9	532	3.987	0.860	Agree	3
GTL10	532	3.716	0.990	Agree	5
Environmental Inspirational Motivation	532	4.024	0.750	Agree	
GTL11	532	3.996	0.940	Agree	3
GTL12	532	3.983	0.990	Agree	4
GTL13	532	3.904	0.992	Agree	5
GTL14	532	4.006	0.920	Agree	2
GTL15	532	4.030	0.878	Agree	1
Environmental Intellectual Stimulation	532	3.984	0.770	Agree	
GTL16	532	3.992	0.970	Agree	4
GTL17	532	4.041	0.876	Agree	2
GTL18	532	4.094	0.897	Agree	1
GTL19	532	3.976	1.017	Agree	5
GTL20	532	4.009	1.015	Agree	3
Environmental Individualized Consideration	532	4.023	0.786	Agree	
Green Transformational Leadership (GTL)	532	3.993	0.619	Agree	
GOC1	532	3.801	0.897	Agree	5
GOC2	532	3.867	0.897	Agree	4
GOC3	532	3.945	0.944	Agree	3
GOC4	532	4.056	0.873	Agree	1
GOC5	532	3.976	0.947	Agree	2
Degree	532	3.929	0.759	Agree	
GOC6	532	4.111	0.965	Agree	1
GOC7	532	3.989	0.896	Agree	2
GOC8	532	3.904	0.949	Agree	3
GOC9	532	3.731	0.998	Agree	5
GOC10	532	3.763	0.995	Agree	4
Diffusion	532	3.900	0.798	Agree	

GOC11	532	3.883	0.988	Agree	2
GOC12	532	3.842	0.936	Agree	5
GOC13	532	3.855	0.925	Agree	4
GOC14	532	3.870	0.974	Agree	3
GOC15	532	3.923	0.912	Agree	1
Depth	532	3.875	0.778	Agree	
Green Organizational Culture (GOC)	532	3.901	0.650	Agree	
GSE1	532	4.039	0.824	Agree	5
GSE2	532	4.098	0.856	Agree	3
GSE3	532	4.148	0.832	Agree	1
GSE4	532	4.092	0.844	Agree	4
GSE5	532	4.133	0.832	Agree	2
Individual Green Self-Efficacy	532	4.102	0.719	Agree	
GSE6	532	4.056	0.846	Agree	1
GSE7	532	4.126	0.801	Agree	2
GSE8	532	3.927	0.939	Agree	3
GSE9	532	3.883	0.946	Agree	5
GSE10	532	3.889	0.907	Agree	4
Collective Green Self-Efficacy	532	3.976	0.694	Agree	
Green Self-efficacy (GSE)	532	4.039	0.618	Agree	
EGB1	532	3.944	0.820	Agree	1
EGB2	532	3.912	0.851	Agree	4
EGB3	532	3.932	0.830	Agree	3
EGB4	532	3.934	0.882	Agree	2
EGB5	532	3.889	0.853	Agree	5
Task-related Green Behavior	532	3.922	0.712	Agree	
EGB6	532	4.053	0.770	Agree	1
EGB7	532	4.045	0.808	Agree	2
EGB8	532	3.996	0.819	Agree	4
EGB9	532	3.962	0.852	Agree	5
EGB10	532	4.002	0.913	Agree	3
Voluntary Green Behavior	532	4.012	0.679	Agree	
Employee Green Behavior (EGB)	532	3.967	0.613	Agree	

Source: Researcher (2024).

4.3.3 Reliability, Validity, and Confirmatory Factor Analysis

This investigation employed SPSS version 24.0 and AMOS version 24.0 to perform assessments of reliability and validity, in addition to executing confirmatory factor analysis on a datasets comprising 532 valid questionnaires. Initially, the data derived from the

questionnaire underwent rigorous testing for reliability and validity, subsequently followed by structural equation modeling predicated upon the data that satisfied the established reliability and validity criteria.

4.3.3.1 Reliability Analysis

The analysis of reliability is carried out to ascertain the soundness of model fit evaluation as well as hypothesis testing. This research utilized the Cronbach's Alpha reliability coefficient to evaluate the consistency of the research variables across diverse measurement items within the questionnaire. As per the assertions of Hair, Anderson, Tatham, and Black (2009) and Devellis (1991), a variable is deemed to exhibit satisfactory reliability if the Cronbach's Alpha coefficient surpasses the threshold of 0.7.

In the context of this study, reliability testing was executed on the amassed data. The software SPSS version 24.0 was employed to conduct a reliability analysis across all scales, utilizing the Cronbach's Alpha technique. The findings indicate a high overall reliability for the questionnaire. The variables encompassed within the questionnaire consist of 55 items, yielding a Cronbach's Alpha value of 0.955, thereby illustrating robust reliability and adherence to the requisite standards. The specific findings are delineated in Table 4.5.

Table 4.5

Reliability Testing

Cronbach's Alpha	N of Items
0.955	55

Source: Researcher (2024).

As delineated in Table 4.6, the values of Cronbach's Alpha and the Corrected Item-Total Correlation (CITC) for all items conform to the established standards for internal consistency and reliability. The Cronbach's Alpha values exceed 0.7, while the Corrected Item-Total Correlation (CITC) surpasses 0.5. The analysis reveals that the Cronbach's Alpha for the Green Transformational Leadership scale stands at 0.916, for the Employee Green Behavior scale at 0.927, for the Green Organizational Culture scale at 0.901, and for

the Green Self-efficacy scale at 0.928, all exceeding the threshold of 0.9, thereby demonstrating that the questionnaire possesses exceptional reliability.

Table 4.6

Results of Scale Reliability Analysis

Dimension	Items	Corrected Item-TOTAL Correlation (CITC)	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	
Environmental Idealized Influence	GTL1	0.774	0.782	0.841	0.916
	GTL2	0.684	0.797		
	GTL3	0.589	0.836		
	GTL4	0.617	0.819		
	GTL5	0.641	0.810		
Environmental Inspirational Motivation	GTL6	0.775	0.866	0.896	
	GTL7	0.780	0.866		
	GTL8	0.850	0.849		
	GTL9	0.705	0.882		
	GTL10	0.630	0.897		
Environmental Intellectual Stimulation	GTL11	0.680	0.869	0.884	
	GTL12	0.718	0.865		
	GTL13	0.674	0.869		
	GTL14	0.709	0.861		
	GTL15	0.852	0.827		
Environmental Individualized Consideration	GTL16	0.641	0.790	0.828	
	GTL17	0.586	0.806		
	GTL18	0.716	0.766		
	GTL19	0.681	0.781		
	GTL20	0.515	0.823		
Individual Green Self-Efficacy	GSE1	0.763	0.878	0.901	0.928
	GSE2	0.777	0.874		
	GSE3	0.781	0.874		
	GSE4	0.742	0.886		
	GSE5	0.732	0.885		
Collective Green Self-Efficacy	GSE6	0.919	0.911	0.939	
	GSE7	0.862	0.928		
	GSE8	0.771	0.937		
	GSE9	0.880	0.917		
	GSE10	0.809	0.930		
Degree	GOC1	0.704	0.793	0.840	0.901
	GOC2	0.596	0.820		
	GOC3	0.568	0.827		
	GOC4	0.689	0.794		

Dimension	Items	Corrected Item-TOTAL Correlation (CITC)	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	
	GOC5	0.672	0.800		
Diffusion	GOC6	0.798	0.851	0.889	
	GOC7	0.668	0.879		
	GOC8	0.788	0.854		
	GOC9	0.644	0.885		
	GOC10	0.773	0.856		
Depth	GOC11	0.757	0.853	0.885	
	GOC12	0.793	0.855		
	GOC13	0.831	0.848		
	GOC14	0.610	0.884		
	GOC15	0.788	0.862		
Task-related Green Behavior	EGB1	0.814	0.905	0.921	0.927
	EGB2	0.898	0.911		
	EGB3	0.783	0.907		
	EGB4	0.863	0.891		
	EGB5	0.829	0.902		
Voluntary Green Behavior	EGB6	0.885	0.902	0.929	
	EGB7	0.836	0.909		
	EGB8	0.795	0.916		
	EGB9	0.803	0.920		
	EGB10	0.787	0.918		

Source: Researcher (2024).

4.3.3.2 Validity Analysis

Prior to the execution of Confirmatory Factor Analysis (CFA), the Kaiser-Meyer-Olkin (KMO) test alongside Bartlett's test of sphericity was employed to ascertain the appropriateness of the datasets for factor analysis.

Kaiser (1970) introduced the KMO test (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) to evaluate the appropriateness of data for factor analysis. A KMO value within the range of 0.90 to 1.00 signifies that the data is highly suitable for factor analysis (Excellent), while a KMO within the range of 0.80 to less than 0.90 indicates that the data is suitable for factor analysis (Good). A KMO ranging from 0.70 to less than 0.80 suggests that the data is moderately suitable for factor analysis (Fair), a KMO from 0.60 to less than 0.70 implies that the data is marginally suitable for factor analysis (Mediocre), and a KMO of less than 0.60 denotes that the data is unsuitable for factor analysis (Unacceptable),

thereby necessitating a redesign of the questionnaire or an adjustment of the variables. Concurrently, Bartlett (1950) developed Bartlett's Test of Sphericity to investigate the correlations among variables and assess the appropriateness of data for factor analysis. A p-value of less than 0.05 indicates significant correlations among variables, thereby rendering the data suitable for factor analysis; conversely, a p-value of greater than or equal to 0.05 suggests the absence of significant correlations among variables, thereby deeming the data unsuitable for factor analysis. Consequently, the KMO test and Bartlett's Test of Sphericity are frequently employed in conjunction to holistically evaluate the appropriateness of data for factor analysis.

As delineated in Table 4.7, the outcomes of the KMO and Bartlett's tests reveal that the KMO statistic is 0.936, while the p-value derived from Bartlett's test is 0.000, thereby indicating that the datasets is markedly conducive for factor analysis.

Table 4.7
KMO and Bartlett test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.936
Bartlett's Test	Approx. Chi-Square	18274.667
	df	1485
	P-value	0.000

Source: Researcher (2024).

4.3.3.3 Principal Component Analysis (PCA)

Factors are derived utilizing principal component analysis (PCA) or alternative methodologies. The determination of the number of factors is predicated on criteria such as eigenvalues exceeding 1 or other pertinent benchmarks. The identified factors are subsequently subjected to rotation (employing techniques such as Varimax or Oblimin rotation) to elucidate the factor structure. The absolute magnitude of factor loadings (generally exceeding 0.5) is utilized to ascertain the association of variables with specific factors. Each factor is designated a name, and its underlying significance is interpreted. Communality is assessed to confirm that each variable is adequately accounted for by the

factors (typically exceeding 0.5). The cumulative variance explanation rate is analyzed to evaluate the capacity of the factors to elucidate the overall variation.

As per the data presented in Table 4.8, the KMO statistic is recorded at 0.930, surpassing the threshold of 0.7, thereby fulfilling the requisite criteria for factor analysis. This observation signifies that the datasets is amenable to factor analysis investigations. Furthermore, the datasets successfully passed Bartlett's test of sphericity ($p < 0.05$), thereby substantiating the appropriateness of the research data for factor analysis.

Table 4.8

Results of the KMO and Bartlett's Test for the GTL Scale

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.930
Bartlett's Test of Sphericity	Approx. Chi-Square	6112.595
	df	190
	p	0.000

Source: Researcher (2024).

Through the application of Principal Component Analysis, a total of four factors were extracted, each exhibiting an eigenvalue exceeding 1. The variance explanation rates for these four factors following rotation are 17.172%, 17.161%, 17.076%, and 16.436%, respectively. The cumulative variance explanation rate subsequent to rotation is 67.845%. These findings are depicted in Table 4.9.

Table 4.9

Result of Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.788	43.939	43.939	8.788	43.939	43.939	3.434	17.172	17.172
2	1.833	9.166	53.105	1.833	9.166	53.105	3.432	17.161	34.333
3	1.514	7.572	60.677	1.514	7.572	60.677	3.415	17.076	51.409
4	1.434	7.168	67.845	1.434	7.168	67.845	3.287	16.436	67.845
5	0.587	2.934	70.779						
6	0.527	2.637	73.416						

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
7	0.504	2.519	75.935						
8	0.478	2.388	78.323						
9	0.465	2.325	80.647						
10	0.446	2.228	82.875						
11	0.437	2.183	85.058						
12	0.414	2.069	87.127						
13	0.386	1.929	89.057						
14	0.382	1.908	90.964						
15	0.372	1.859	92.823						
16	0.348	1.741	94.564						
17	0.339	1.695	96.259						
18	0.320	1.598	97.857						
19	0.275	1.376	99.234						
20	0.153	0.766	100.000						

Source: Researcher (2024).

In the present investigation, the varimax rotation method was employed to rotate the factors to discern the relationship between the factors and the research items. The aforementioned table illustrates the factor extraction information concerning the research items and the correlation between the factors and these items.

As evidenced in Table 4.10, all research items exhibit communality values exceeding 0.5, signifying a robust association between the research items and the factors, thus affirming that the factors can effectively extract pertinent information. Following the validation that the factors can extract the majority of the information from the research items, the relationship between the factors and the research items was further analyzed (a factor loading coefficient with an absolute value greater than 0.5 indicates a correspondence between the item and the factor).

Table 4.10

Result of Varimax Rotation

	Component				Communalities
	1	2	3	4	
GTL1	0.189	0.767	0.248	0.219	0.734
GTL2	0.237	0.695	0.203	0.246	0.641
GTL3	0.223	0.696	0.252	0.185	0.632
GTL4	0.190	0.763	0.194	0.170	0.686
GTL5	0.135	0.842	0.220	0.133	0.793
GTL6	0.194	0.139	0.118	0.757	0.644
GTL7	0.186	0.239	0.183	0.720	0.644
GTL8	0.258	0.163	0.214	0.718	0.654
GTL9	0.233	0.110	0.236	0.760	0.699
GTL10	0.143	0.265	0.183	0.731	0.659
GTL11	0.766	0.228	0.174	0.135	0.688
GTL12	0.786	0.161	0.139	0.232	0.717
GTL13	0.753	0.178	0.194	0.200	0.676
GTL14	0.744	0.171	0.187	0.179	0.651
GTL15	0.744	0.170	0.146	0.252	0.668
GTL16	0.171	0.192	0.753	0.184	0.667
GTL17	0.171	0.235	0.742	0.184	0.669
GTL18	0.180	0.190	0.752	0.148	0.657
GTL19	0.149	0.250	0.731	0.224	0.669
GTL20	0.176	0.201	0.786	0.181	0.722

Source: Researcher (2024).

The validation assessment of the four-dimensional construct of green transformational leadership elucidated that factor analysis revealed four distinct factors, with a cumulative variance explanation rate of 67.845% (exceeding the threshold of 60%). Subsequent to the application of varimax rotation, all items were distinctly associated with the four factors, with factor loadings surpassing the threshold of 0.7. The quantitative findings substantiate Hypothesis 1: green transformational leadership is constituted by four dimensions as delineated below.

Table 4.11

Hypothesis Test Result

NO	Hypothesis	Result
H1	Green Transformational Leadership is constituted by four factors: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration.	**Accepted**

Source: Researcher (2024).

As indicated in Table 4.12, the KMO statistic is 0.903, which exceeds the minimum benchmark of 0.7, thereby satisfying the conditions requisite for factor analysis. This finding suggests that the datasets is appropriate for conducting factor analysis research. Furthermore, the data successfully met the criteria of Bartlett's test of sphericity ($p < 0.05$), thereby affirming the suitability of the research data for factor analysis.

Table 4.12

Results of the KMO and Bartlett's Test for the GOC Scale

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.919
Bartlett's Test of Sphericity	Approx. Chi-Square	4755.458
	df	105
	p	0.000

Source: Researcher (2024).

Utilizing Principal Component Analysis, a total of three distinct factors were extracted, each exhibiting an eigenvalue exceeding the threshold of 1. The variance explanation rates associated with these three factors subsequent to the rotation are recorded as 48.066%, 11.826%, and 9.259%, respectively. The cumulative variance explanation rate following rotation amounts to 69.150%. The pertinent findings are delineated in Table 4.13.

Table 4.13

Result of Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.210	48.066	48.066	7.210	48.066	48.066	3.462	23.080	23.080
2	1.774	11.826	59.891	1.774	11.826	59.891	3.459	23.063	46.142
3	1.389	9.259	69.150	1.389	9.259	69.150	3.451	23.007	69.150
4	0.556	3.705	72.855						
5	0.522	3.478	76.333						
6	0.456	3.041	79.375						
7	0.450	2.998	82.372						
8	0.427	2.847	85.220						
9	0.407	2.710	87.930						
10	0.385	2.568	90.498						
11	0.361	2.404	92.902						
12	0.341	2.275	95.177						
13	0.276	1.837	97.015						
14	0.261	1.742	98.757						
15	0.186	1.243	100.000						

Source: Researcher (2024).

In the present investigation, the varimax rotation technique was employed to systematically rotate the factors with the aim of discerning the relationships between the factors and the research items. The aforementioned table delineates the extraction of information pertaining to the factors associated with the research items, as well as the relationships between these factors and the research items. As illustrated in Table 4.14, all research items present communality values exceeding 0.5, which signifies a robust correlation between the research items and the factors, thereby indicating that the factors are adept at effectively extracting relevant information. Following the validation that the factors are capable of extracting the majority of the pertinent information from the research

items, an analysis of the relationships between the factors and the research items was conducted (a factor loading coefficient possessing an absolute value greater than 0.5 signifies a relationship between the item and the factor).

Table 4.14

Result of Varimax Rotation

	Component			Communalities
	1	2	3	
GOC1	0.816	0.216	0.269	0.784
GOC2	0.753	0.213	0.238	0.669
GOC3	0.759	0.258	0.234	0.698
GOC4	0.732	0.172	0.248	0.627
GOC5	0.787	0.156	0.231	0.696
GOC6	0.196	0.803	0.270	0.756
GOC7	0.152	0.765	0.291	0.694
GOC8	0.215	0.744	0.272	0.674
GOC9	0.239	0.737	0.211	0.644
GOC10	0.185	0.851	-0.012	0.758
GOC11	0.265	0.235	0.725	0.651
GOC12	0.217	0.232	0.765	0.685
GOC13	0.248	0.133	0.781	0.689
GOC14	0.264	0.178	0.745	0.656
GOC15	0.227	0.196	0.776	0.692

Source: Researcher (2024).

The validation analysis concerning the three-factor structure of green organizational culture elucidated that factor analysis successfully identified three factors, culminating in a cumulative variance explanation rate of 69.150%, which surpasses the 60% benchmark. Post-varimax rotation, all items were distinctly correlated with the three factors (as indicated by factor loadings exceeding 0.7). The quantitative findings substantiate Hypothesis 2: green organizational culture is constituted by three factors as follows.

Table 4.15

Hypothesis Test Result

NO	Hypothesis	Result
H2	Green Organizational Culture is delineated by three factors: degree, diffusion, and depth.	**A**ccepted

Source: Researcher (2024).

As presented in Table 4.16, the KMO value is recorded at 0.892, which exceeds the 0.7 threshold, thereby satisfying the prerequisites for conducting factor analysis. This finding suggests that the data is conducive to research involving factor analysis. Furthermore, the data successfully passed Bartlett's Test of Sphericity ($p < 0.05$), thereby affirming the appropriateness of the research data for factor analysis.

Table 4.16

Results of the KMO and Bartlett's Test for the GSE Scale

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.892
Bartlett's Test of Sphericity	Approx. Chi-Square	2957.515
	df	45
	p	0.000

Source: Researcher (2024).

Employing Principal Component Analysis, a total of two factors were extracted, each possessing an eigenvalue greater than 1. The variance explanation rates of these two factors after rotation are 51.751% and 15.806%, respectively. The cumulative variance explanation rate subsequent to rotation is 67.557%. The results are illustrated in Table 4.17.

Table 4.17

Result of Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.175	51.751	51.751	5.175	51.751	51.751	3.636	36.362	36.362
2	1.581	15.806	67.557	1.581	15.806	67.557	3.119	31.195	67.557
3	0.653	6.525	74.082						
4	0.550	5.500	79.583						
5	0.461	4.607	84.189						
6	0.407	4.069	88.258						
7	0.391	3.910	92.168						
8	0.312	3.123	95.291						
9	0.269	2.694	97.985						
10	0.201	2.015	100.000						

Source: Researcher (2024).

In this inquiry, the varimax rotation methodology was employed to adjust the factors, thereby facilitating the identification of the relationship between the factors and the research items. The aforementioned table conveys the information extraction pertaining to the factors for the research items and the corresponding relationships therein. As evidenced by Table 4.18, all research items exhibit communality values exceeding 0.5, signifying a robust association between the research items and the factors, thus affirming the factors' efficacy in extracting pertinent information. Following the verification that the factors can successfully extract the majority of the information from the research items, an analysis of the correspondence between the factors and the research items was conducted (a factor loading coefficient with an absolute value greater than 0.5 denotes a correlation between the item and the factor).

Table 4.18

Result of Varimax Rotation

	Component		Communalities
	1	2	
GSE1	0.825	0.280	0.759
GSE2	0.767	0.276	0.665
GSE3	0.831	0.264	0.760
GSE4	0.835	0.229	0.749
GSE5	0.862	0.150	0.766
GSE6	0.198	0.790	0.663
GSE7	0.250	0.605	0.429
GSE8	0.235	0.743	0.607
GSE9	0.164	0.811	0.685
GSE10	0.230	0.788	0.673

Source: Researcher (2024).

The validation analysis of the two-factor structure of green self-efficacy indicated that factor analysis successfully extracted two factors, which together account for a cumulative variance of 67.557% (exceeding 60%). Through the application of varimax rotation, all measurement items were distinctly loaded onto their respective factors (with factor loadings exceeding 0.6). The quantitative results affirm Hypothesis 3: Green Self-efficacy is comprised of two distinct factors as outlined.

Table 4.19

Hypothesis Test Result

NO	Hypothesis	Result
H3	Green Self-Efficacy is characterized by two factors: individual green self-efficacy and collective green self-efficacy.	Accepted

Source: Researcher (2024).

According to Table 4.20, the Kaiser-Meyer-Olkin (KMO) value is 0.903, which exceeds the threshold of 0.7, thereby fulfilling the essential criterion for conducting factor

analysis. This finding suggests that the dataset is conducive to factor analysis inquiries. Furthermore, the datasets successfully passed Bartlett's Test of Sphericity ($p < 0.05$), substantiating the appropriateness of the research data for factor analysis.

Table 4.20

Results of the KMO and Bartlett's Test for the EGB Scale

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.903
Bartlett's Test of Sphericity	Approx. Chi-Square	2997.277
	df	45
	p	0.000

Source: Researcher (2024).

Utilizing Principal Component Analysis, a total of two factors were extracted, each exhibiting an eigenvalue exceeding 1. The explained variance rates for these two factors post-rotation are 53.254% and 15.362%, respectively. The cumulative explained variance rate after rotation amounts to 68.616%. The results are documented in Table 4.21.

Table 4.21

Result of Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.325	53.254	53.254	5.325	53.254	53.254	3.515	35.150	35.150
2	1.536	15.362	68.616	1.536	15.362	68.616	3.347	33.466	68.616
3	0.517	5.168	73.784						
4	0.486	4.856	78.640						
5	0.458	4.581	83.221						
6	0.449	4.491	87.712						
7	0.389	3.887	91.599						
8	0.354	3.541	95.139						
9	0.273	2.727	97.866						

10	0.213	2.134	100.000						

Source: Researcher (2024).

In the context of this investigation, the varimax rotation technique was employed to facilitate the rotation of factors, thereby elucidating the relationship between the factors and the research items. The aforementioned table delineates the extraction of information regarding the factors related to the research items and their corresponding relationships. As indicated in Table 4.22, all research items exhibit communality values exceeding 0.5, denoting a robust association between the research items and the factors, thereby affirming the factors' efficacy in information extraction. Subsequent to confirming that the factors could extract the majority of the information from the research items, an analysis of the correspondence between the factors and the research items was conducted (where a factor loading coefficient with an absolute value greater than 0.5 signifies a correspondence between the item and the factor).

Table 4.22

Result of Varimax Rotation

	Component		Communalities
	1	2	
EGB1	0.844	0.255	0.777
EGB2	0.768	0.223	0.640
EGB3	0.791	0.227	0.677
EGB4	0.776	0.273	0.677
EGB5	0.835	0.229	0.750
EGB6	0.234	0.768	0.644
EGB7	0.253	0.823	0.741
EGB8	0.173	0.807	0.682
EGB9	0.275	0.728	0.605
EGB10	0.251	0.778	0.668

Source: Researcher (2024).

The confirmatory factor analysis of employee green behavior, characterized by a two-dimensional structure, yielded results indicating that factor analysis extracted two factors with a cumulative variance explanation rate of 68.616% (surpassing the 60%

benchmark). Following the implementation of varimax rotation, all measurement items exhibited clear factor loadings (>0.7) corresponding to their respective dimensions. The quantitative findings substantiate Hypothesis 4: employee green behavior comprises two distinct factors as outlined.

Table 4.23

Hypothesis Test Result

NO	Hypothesis	Result
H4	Employee Green Behavior is comprised of two factors: task-related green behavior and voluntary green behavior.	**Accepted**

Source: Researcher (2024).

As presented in Table 4.24, the factor analysis identified a total of 11 factors, each possessing an eigenvalue greater than 1. The variance explanation rates for these 11 factors subsequent to rotation are 6.933%, 6.658%, 6.553%, 6.491%, 6.460%, 6.360%, 6.345%, 6.152%, 5.920%, 5.769%, and 5.306%, respectively. The cumulative variance explanation rate following rotation is 68.947%.

Table 4.24

Result of Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**16.291**	29.620	29.620	16.291	29.620	29.620	3.813	6.933	6.933
2	**4.703**	8.550	38.170	4.703	8.550	38.170	3.662	6.658	13.591
3	**3.459**	6.289	44.459	3.459	6.289	44.459	3.604	6.553	20.144
4	**2.545**	4.626	49.086	2.545	4.626	49.086	3.570	6.491	26.635
5	**1.984**	3.607	52.692	1.984	3.607	52.692	3.553	6.460	33.095
6	**1.848**	3.359	56.051	1.848	3.359	56.051	3.498	6.360	39.455
7	**1.675**	3.046	59.098	1.675	3.046	59.098	3.490	6.345	45.801
8	**1.575**	2.864	61.961	1.575	2.864	61.961	3.383	6.152	51.952

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
9	1.399	2.544	64.506	1.399	2.544	64.506	3.256	5.920	57.872
10	1.310	2.382	66.887	1.310	2.382	66.887	3.173	5.769	63.641
11	1.133	2.059	68.947	1.133	2.059	68.947	2.918	5.306	68.947
12	0.731	1.328	70.275						
13	0.686	1.247	71.522						
14	0.658	1.196	72.718						
15	0.626	1.138	73.857						
16	0.611	1.111	74.967						
17	0.577	1.049	76.016						
18	0.558	1.015	77.031						
19	0.535	0.973	78.004						
20	0.531	0.965	78.969						
21	0.508	0.924	79.893						
22	0.498	0.905	80.798						
23	0.491	0.893	81.691						
24	0.475	0.863	82.554						
25	0.472	0.858	83.412						
26	0.458	0.833	84.245						
27	0.447	0.813	85.058						
28	0.433	0.788	85.845						
29	0.415	0.754	86.599						
30	0.411	0.747	87.346						
31	0.402	0.732	88.078						
32	0.386	0.701	88.778						

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
33	0.377	0.685	89.463						
34	0.363	0.661	90.124						
35	0.352	0.639	90.764						
36	0.344	0.625	91.389						
37	0.334	0.608	91.997						
38	0.324	0.589	92.587						
39	0.319	0.580	93.167						
40	0.308	0.560	93.727						
41	0.301	0.548	94.275						
42	0.295	0.536	94.811						
43	0.282	0.514	95.325						
44	0.280	0.510	95.834						
45	0.261	0.474	96.309						
46	0.255	0.464	96.773						
47	0.253	0.460	97.233						
48	0.248	0.452	97.684						
49	0.224	0.407	98.091						
50	0.214	0.389	98.480						
51	0.194	0.353	98.833						
52	0.188	0.341	99.174						
53	0.178	0.324	99.498						
54	0.148	0.269	99.766						
55	0.128	0.234	100.000						

Source: Researcher (2024).

In this investigation, the varimax rotation method was employed to facilitate the rotation of factors, allowing for the identification of the relationship between the factors and the research items. The table above illustrates the extraction of information concerning the factors related to the research items and their corresponding relationships. As evidenced in Table 4.25, all research items possess communality values exceeding 0.5, indicating a strong association between the research items and the factors, thus affirming the capacity of the factors to effectively extract information. Following the confirmation that the factors can extract a substantial portion of the information from the research items, an analysis of the correspondence between the factors and the research items was undertaken (where a factor loading coefficient with an absolute value greater than 0.5 indicates a correspondence between the item and the factor).

Table 4.25

Result of Rotated Component Matrixa

	Component											Communalities
	1	2	3	4	5	6	7	8	9	10	11	
GTL1	0.173	0.260	0.147	0.106	0.185	0.089	0.127	0.140	0.146	0.179	0.682	**0.726**
GTL2	0.120	0.202	0.216	0.140	0.213	0.165	0.132	0.072	0.120	0.217	0.613	**0.654**
GTL3	0.202	0.264	0.147	0.082	0.210	0.084	0.180	0.152	0.099	0.134	0.602	**0.636**
GTL4	0.187	0.201	0.120	0.137	0.173	0.183	0.146	0.107	0.170	0.109	0.668	**0.692**
GTL5	0.161	0.237	0.147	0.131	0.124	0.039	0.114	0.134	0.196	0.095	0.770	**0.809**
GTL6	0.113	0.115	0.132	0.139	0.165	0.077	0.144	0.136	0.123	0.707	0.040	**0.652**
GTL7	0.094	0.186	0.032	0.039	0.177	0.107	0.129	0.188	0.152	0.675	0.184	**0.653**
GTL8	0.158	0.219	0.108	0.072	0.251	0.120	0.109	0.100	0.104	0.665	0.077	**0.648**
GTL9	0.130	0.232	0.036	0.049	0.242	0.123	0.045	0.066	0.135	0.729	0.066	**0.708**
GTL10	0.086	0.186	0.086	0.111	0.130	0.102	0.083	0.082	0.119	0.714	0.223	**0.676**
GTL11	0.022	0.176	0.080	0.135	0.747	0.076	0.109	0.051	0.050	0.114	0.191	**0.687**
GTL12	0.032	0.131	0.130	0.166	0.759	0.153	0.108	0.028	0.039	0.199	0.097	**0.726**
GTL13	0.043	0.188	0.090	0.033	0.753	0.101	0.050	0.111	0.050	0.176	0.143	**0.692**

	Component											Communalities
	1	2	3	4	5	6	7	8	9	10	11	
GTL14	0.060	0.195	0.025	0.113	0.728	0.032	0.162	0.086	0.094	0.145	0.110	**0.661**
GTL15	0.096	0.138	0.149	0.149	0.719	0.055	0.055	0.150	0.044	0.217	0.091	**0.675**
GTL16	0.075	0.744	0.077	0.041	0.155	0.031	0.124	0.141	-0.049	0.175	0.147	**0.681**
GTL17	0.090	0.740	0.119	0.062	0.163	0.121	0.089	0.078	0.043	0.141	0.152	**0.674**
GTL18	0.047	0.745	0.104	0.057	0.172	0.123	0.008	0.035	0.036	0.130	0.150	**0.658**
GTL19	0.045	0.732	0.059	0.148	0.131	0.066	0.051	0.107	0.071	0.196	0.188	**0.678**
GTL20	0.035	0.787	0.063	0.060	0.168	0.135	0.049	0.070	0.093	0.148	0.136	**0.731**
EGB1	0.078	0.068	0.795	0.086	0.111	0.087	0.158	0.208	0.136	0.069	0.130	**0.778**
EGB2	0.077	0.082	0.731	0.068	0.056	0.082	0.167	0.189	0.090	0.080	0.081	**0.647**
EGB3	0.107	0.085	0.737	0.088	0.153	0.110	0.147	0.171	0.121	0.043	0.089	**0.680**
EGB4	0.104	0.104	0.742	0.109	0.052	0.101	0.045	0.231	0.100	0.057	0.168	**0.695**
EGB5	0.101	0.107	0.775	0.105	0.098	0.116	0.151	0.171	0.120	0.114	0.092	**0.745**
EGB6	0.035	0.106	0.202	0.067	0.031	0.085	0.116	0.736	0.160	0.073	0.093	**0.661**
EGB7	0.148	0.189	0.196	0.119	0.083	0.099	0.125	0.758	0.062	0.107	0.131	**0.750**
EGB8	0.089	0.038	0.151	0.090	0.060	0.104	0.051	0.772	0.114	0.103	0.090	**0.685**
EGB9	0.168	0.079	0.218	0.101	0.155	0.165	0.134	0.671	0.046	0.083	0.051	**0.623**
EGB10	0.108	0.054	0.217	0.099	0.114	0.092	0.053	0.725	0.153	0.149	0.084	**0.674**
GOC1	0.028	0.069	0.174	0.248	0.099	0.185	0.777	0.117	0.039	0.069	0.156	**0.789**
GOC2	-0.024	0.069	0.119	0.231	0.101	0.189	0.723	0.085	0.079	0.085	0.099	**0.672**
GOC3	0.063	0.102	0.125	0.224	0.017	0.230	0.733	0.142	0.015	0.095	0.096	**0.710**
GOC4	0.023	0.027	0.125	0.229	0.172	0.146	0.689	0.090	0.045	0.124	0.087	**0.627**
GOC5	0.022	0.082	0.160	0.214	0.116	0.128	0.748	0.058	0.062	0.106	0.092	**0.696**
GOC6	0.023	0.110	0.102	0.259	0.104	0.771	0.161	0.107	0.014	0.119	0.077	**0.753**
GOC7	0.050	0.108	0.091	0.276	0.028	0.727	0.126	0.081	0.017	0.182	0.112	**0.697**
GOC8	0.011	0.114	0.125	0.261	0.073	0.713	0.185	0.099	0.053	0.108	0.070	**0.673**

	Component											Communalities
	1	2	3	4	5	6	7	8	9	10	11	
GOC9	0.025	0.124	0.115	0.195	0.074	0.708	0.203	0.173	0.053	0.016	0.103	**0.659**
GOC10	0.067	0.063	0.080	-0.035	0.137	0.834	0.169	0.092	-0.016	0.074	0.052	**0.776**
GOC11	0.056	0.110	0.108	0.696	0.121	0.203	0.226	0.094	0.054	0.094	0.093	**0.647**
GOC12	0.118	0.079	0.031	0.731	0.187	0.209	0.203	0.081	-0.001	0.092	0.044	**0.692**
GOC13	0.002	0.030	0.144	0.785	0.057	0.118	0.220	0.062	-0.001	0.057	0.057	**0.714**
GOC14	0.079	0.047	0.071	0.712	0.136	0.138	0.229	0.141	0.013	0.090	0.144	**0.659**
GOC15	-0.012	0.111	0.084	0.759	0.099	0.174	0.194	0.091	0.059	0.045	0.101	**0.697**
GSE1	0.794	0.071	0.106	0.032	0.024	0.060	0.012	0.118	0.250	0.101	0.142	**0.758**
GSE2	0.738	0.079	0.085	0.067	0.041	0.019	0.067	0.114	0.243	0.084	0.135	**0.667**
GSE3	0.812	0.086	0.088	0.088	0.031	-0.017	0.016	0.094	0.246	0.117	0.041	**0.769**
GSE4	0.813	0.004	0.092	0.031	0.080	0.035	0.000	0.094	0.207	0.075	0.129	**0.751**
GSE5	0.842	0.060	0.064	-0.003	0.065	0.068	0.006	0.070	0.125	0.106	0.115	**0.771**
GSE6	0.188	0.032	0.094	0.002	0.072	-0.003	0.025	0.048	0.774	0.098	0.085	**0.670**
GSE7	0.239	0.012	0.069	0.070	0.021	0.051	0.028	0.092	0.599	0.069	0.045	**0.445**
GSE8	0.210	0.103	0.089	0.011	0.046	0.043	0.074	0.121	0.695	0.158	0.092	**0.603**
GSE9	0.137	-0.003	0.120	0.009	0.051	0.012	-0.017	0.094	0.778	0.144	0.140	**0.690**
GSE10	0.215	0.048	0.120	0.009	0.060	-0.005	0.102	0.120	0.760	0.029	0.110	**0.682**

Source: Researcher (2024).

4.3.3.4 Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is utilized to evaluate the convergent validity of the internal components associated with each variable, with the primary objective of examining the alignment between the observed measurement data and the established theoretical framework. As posited by Huang (2005), the validity assessment of a measurement scale encompasses several requisite conditions: a measurement model is regarded as possessing convergent validity (Hair, Black, Babin, Anderson, 2010; Fornell

& Larcker, 1981) if it satisfies the subsequent criteria. The factor loadings, which assess the statistical significance of each loading, must exceed the threshold of 0.7. Composite reliability (CR), reflecting the internal consistency among the items within a construct, should surpass 0.7; elevated reliability indicates enhanced consistency among the items. The average variance extracted (AVE), which quantifies the explanatory capacity of each measured item concerning the variance of the latent variable, is ideally expected to exceed 0.5, as a higher AVE value signifies increased reliability and convergent validity of the items.

Model overall fit indices. In the context of executing validity assessments through confirmatory factor analysis, it is imperative to scrutinize the model fit and refine the measurement model to enhance its congruence. In accordance with the benchmarks established by Hu and Bentler (1998), a model fit deemed satisfactory should fulfill the following stipulations: the chi-square ratio (χ^2/df) must be less than 3, the goodness-of-fit index (GFI) should surpass 0.9, the root mean square error of approximation (RMSEA) ought to remain beneath 0.08, and the comparative fit index (CFI), normed fit index (NFI), and non-normed fit index (NNFI) must all exceed 0.9.

- **Green Transformational Leadership Validity Analysis**

As delineated in Table 4.26, the CMIN/DF (χ^2/df) is determined to be 2.222, and the GFI, AGFI, NFI, TLI, IFI, and CFI collectively adhere to the criterion of exceeding 0.9. The RMSEA registers at 0.048, which is below the threshold of 0.08. All fit indices conform to the standards established for structural equation modeling (SEM) research, substantiating that this model exhibits a commendable fit.

Table 4.26

Model Fit Indices of Confirmatory Factor Analysis (CFA) for GTL Scale

Fit Index	The standard or critical value	Results
CMIN		368.831
DF		166
CMIN/DF（χ^2/df）	<3	2.222
GFI	>0.9	0.941

AGFI	>0.9	0.925
RMSEA	<0.08	0.048
IFI	>0.9	0.966
NFI	>0.9	0.941
TLI(NNFI)	>0.9	0.961
CFI	>0.9	0.966
SRMR	<0.05	0.033

Source: Researcher (2024).

In reference to Table 4.27, the standardized factor load (Standard Factor Loadings) for each item surpasses 0.5. The residual error is both positive and statistically significant, with no violations of estimation. The composite reliability (CR) was found to be greater than 0.7. The average variance extracted (AVE) exceeded 0.5. These metrics all met the criteria for convergence and validity, and the corresponding fit was within an acceptable range, thereby permitting all items for subsequent analysis.

Table 4.27

Results of Confirmatory Factor Analysis (CFA) for GTL Scale

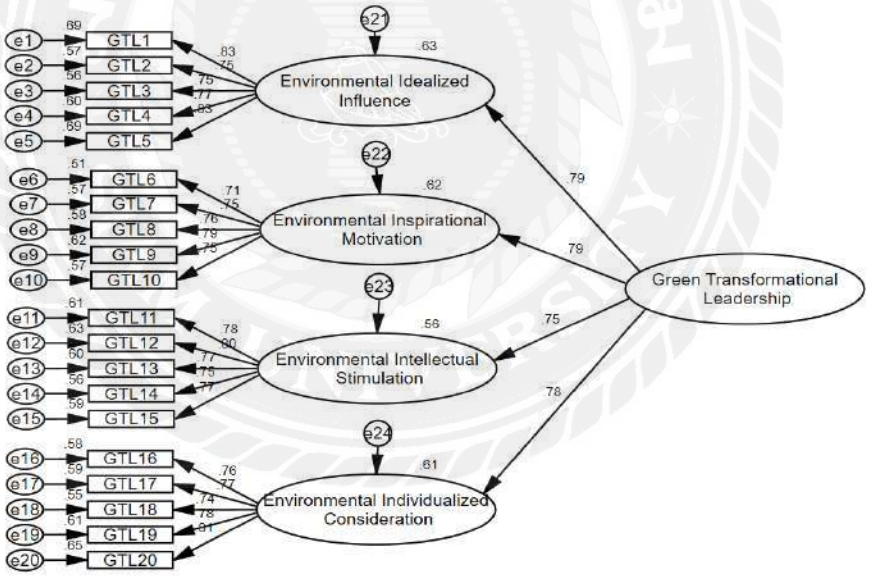
Path			Estimate	S.E.	C.R.	P	Factor Loading	CR	AVE
GTLA	<---	X（GTL）	1.000				0.791	0.859	0.603
GTLB	<---	X（GTL）	0.944	0.081	11.641	***	0.787		
GTLC	<---	X（GTL）	0.914	0.076	11.968	***	0.747		
GTLD	<---	X（GTL）	0.959	0.077	12.425	***	0.780		
GTL1	<---	GTLA	1.000				0.829	0.891	0.620
GTL2	<---	GTLA	0.925	0.048	19.232	***	0.755		
GTL3	<---	GTLA	0.918	0.048	19.301	***	0.749		
GTL4	<---	GTLA	0.845	0.042	20.059	***	0.772		
GTL5	<---	GTLA	0.981	0.045	21.858	***	0.828		
GTL6	<---	GTLB	1.000				0.711	0.868	0.568
GTL7	<---	GTLB	0.892	0.056	15.983	***	0.754		
GTL8	<---	GTLB	1.020	0.063	16.167	***	0.761		
GTL9	<---	GTLB	0.940	0.056	16.712	***	0.786		
GTL10	<---	GTLB	1.039	0.065	16.060	***	0.754		
GTL11	<---	GTLC	1.000				0.778	0.881	0.597

Path			Estimate	S.E.	C.R.	P	Factor Loading	CR	AVE
GTL12	<---	GTLC	1.075	0.057	18.996	***	0.796		
GTL13	<---	GTLC	1.047	0.057	18.392	***	0.774		
GTL14	<---	GTLC	0.941	0.053	17.668	***	0.749		
GTL15	<---	GTLC	0.919	0.051	18.127	***	0.767		
GTL16	<---	GTLD	1.000				0.760	0.880	0.595
GTL17	<---	GTLD	0.912	0.052	17.684	***	0.768		
GTL18	<---	GTLD	0.902	0.053	17.165	***	0.741		
GTL19	<---	GTLD	1.073	0.060	17.962	***	0.779		
GTL20	<---	GTLD	1.112	0.059	18.771	***	0.808		

Source: Researcher (2024).

Figure 4.1

Confirmatory Factor Analysis (CFA) Model Diagram for GTL



Source: Researcher (2024).

- **Green Organizational Culture Validity Analysis**

According to Table 4.28, the CMIN/DF (χ^2/df) is recorded at 2.755, while GFI, AGFI, NFI, TLI, IFI, and CFI all achieve standards above 0.9. The RMSEA is 0.057, remaining below the 0.08 threshold. The fit indicators are entirely consistent with the

criteria of SEM research, thus it can be inferred that this model is suitably aligned in terms of moderation.

Table 4.28

Model Fit Indices of Confirmatory Factor Analysis (CFA) for GOC Scale

Fit Index	The Standard or Critical Value	Results
CMIN		236.970
DF		86
CMIN/DF（χ^2/df）	<3	2.755
GFI	>0.9	0.950
AGFI	>0.9	0.930
RMSEA	<0.08	0.057
IFI	>0.9	0.968
NFI	>0.9	0.951
TLI(NNFI)	>0.9	0.961
CFI	>0.9	0.968
SRMR	<0.05	0.041

Source: Researcher (2024).

According to Table 4.29, the standardized factor loadings (Standard Factor Loadings) for each individual item exceed the threshold of 0.5. The residual error is both positive and statistically significant, with no instances of estimate violations present. The composite reliability (CR) exceeded the benchmark of 0.7. Furthermore, the average variance extracted (AVE) was greater than 0.5. All measures fulfilled the requisite criteria for convergence and validity, and the overall model fit resided within an acceptable range, thus justifying the retention of all items for subsequent analysis.

Table 4.29

Results of Confirmatory Factor Analysis (CFA) for GOC Scale

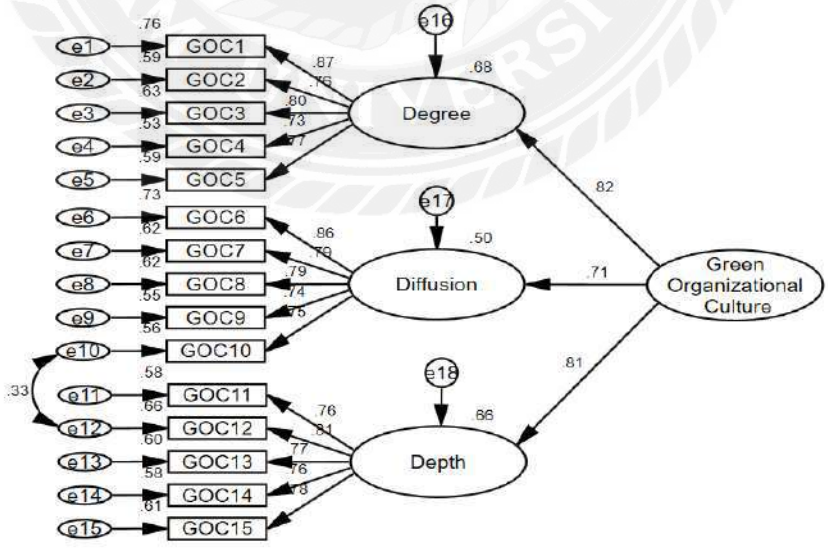
Path			Estimate	S.E.	C.R.	P	Factor Loading	CR	AVE
GOCA	<---	M1 (GOC)	1.000				0.811	0.830	0.621
GOCB	<---	M1 (GOC)	0.934	0.077	12.058	***	0.716		
GOCC	<---	M1 (GOC)	1.004	0.085	11.770	***	0.832		
GOC1	<---	GOCA	1.000				0.870	0.890	0.620

Path			Estimate	S.E.	C.R.	P	Factor Loading	CR	AVE
GOC2	<---	GOCA	0.880	0.042	20.881	***	0.765		
GOC3	<---	GOCA	0.963	0.043	22.202	***	0.795		
GOC4	<---	GOCA	0.815	0.042	19.378	***	0.728		
GOC5	<---	GOCA	0.937	0.044	21.143	***	0.771		
GOC6	<---	GOCB	1.000				0.854	0.888	0.615
GOC7	<---	GOCB	0.856	0.040	21.334	***	0.788		
GOC8	<---	GOCB	0.906	0.043	21.281	***	0.787		
GOC9	<---	GOCB	0.898	0.047	19.223	***	0.742		
GOC10	<---	GOCB	0.898	0.046	19.382	***	0.744		
GOC11	<---	GOCC	1.000				0.772	0.880	0.595
GOC12	<---	GOCC	0.972	0.052	18.676	***	0.792		
GOC13	<---	GOCC	0.921	0.052	17.701	***	0.760		
GOC14	<---	GOCC	0.959	0.054	17.606	***	0.751		
GOC15	<---	GOCC	0.933	0.051	18.365	***	0.780		

Source: Researcher (2024).

Figure 4.2

Confirmatory Factor Analysis (CFA) Model Diagram for GOC



Source: Researcher (2024).

Green Self-efficacy Validity Analysis

As delineated in Table 4.30, the CMIN/DF (χ^2/df) ratio is calculated at 2.465, while the goodness-of-fit indices, specifically GFI, AGFI, NFI, TLI, IFI, and CFI, all surpass the established standard of 0.9. The RMSEA is recorded at 0.053, which is below the critical threshold of 0.08. Consequently, all fit indices conform to the established standards within structural equation modeling (SEM) research, allowing for the conclusion that this model demonstrates a commendable degree of fit.

Table 4.30

Model Fit Indices of Confirmatory Factor Analysis (CFA) for GSE Scale

Fit Index	The standard or critical value	Results
CMIN		81.329
DF		33
CMIN/DF（χ^2/df）	<3	2.465
GFI	>0.9	0.971
AGFI	>0.9	0.951
RMSEA	<0.08	0.053
IFI	>0.9	0.984
NFI	>0.9	0.973
TLI(NNFI)	>0.9	0.978
CFI	>0.9	0.984
SRMR	<0.05	0.028

Source: Researcher (2024).

According to Table 4.31, the standardized factor loadings for each item exceed the threshold of 0.5. The residual error exhibits a positive and statistically significant value, with no violations detected in the estimates. The composite reliability (CR) is greater than 0.7. The amount of average variance extracted (AVE) surpasses 0.5. All metrics have achieved the requisite standards for convergence and validity, and the corresponding fit

indices are within an acceptable range; thus, all items were retained for subsequent analysis.

Table 4.31

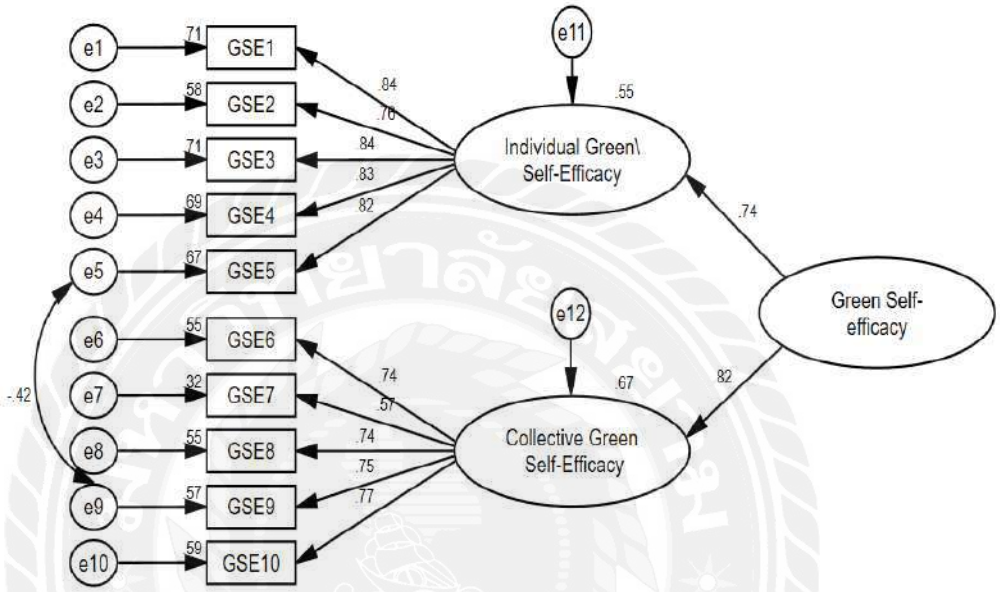
Results of Confirmatory Factor Analysis (CFA) for GSE Scale

Path			Estimate	S.E.	C.R.	P	Factor Loading	CR	AVE
GSEA	<---	M2 (GSE)	1.000				0.738	0.746	0.595
GSEB	<---	M2 (GSE)	1.000				0.803		
GSE1	<---	GSEA	1.000				0.845	0.911	0.673
GSE2	<---	GSEA	0.940	0.046	20.504	***	0.764		
GSE3	<---	GSEA	1.009	0.042	23.846	***	0.844		
GSE4	<---	GSEA	1.007	0.044	23.033	***	0.829		
GSE5	<---	GSEA	0.975	0.043	22.500	***	0.816		
GSE6	<---	GSEB	1.000				0.756	0.841	0.518
GSE7	<---	GSEB	0.713	0.058	12.381	***	0.570		
GSE8	<---	GSEB	1.061	0.067	15.812	***	0.722		
GSE9	<---	GSEB	1.115	0.067	16.542	***	0.754		
GSE10	<---	GSEB	1.101	0.064	17.212	***	0.776		

Source: Researcher (2024).

Figure 4.3

Confirmatory Factor Analysis (CFA) Model Diagram for GSE



Source: Researcher (2024).

- **Employee Green Behavior Validity Analysis**

According to Table 4.32, the ratio of chi-square to degrees of freedom (CMIN/DF, χ^2/df) is 1.703, while the goodness-of-fit indices including GFI, AGFI, NFI, TLI, IFI, and CFI all exceed the benchmark of 0.9. The root mean square error of approximation (RMSEA) is recorded at 0.036, which is below the critical threshold of 0.08. These fit indices conform to the established standards for structural equation modeling (SEM) research, indicating that the model demonstrates a commendable degree of fit.

Table 4.32

Model Fit Indices of Confirmatory Factor Analysis (CFA) for EGB Scale

Fit Index	The Standard or Critical Value	Results
CMIN		56.212
DF		33
CMIN/DF（χ^2/df）	<3	1.703
GFI	>0.9	0.980
AGFI	>0.9	0.966
RMSEA	<0.08	0.036
IFI	>0.9	0.992
NFI	>0.9	0.981
TLI(NNFI)	>0.9	0.989
CFI	>0.9	0.992
SRMR	<0.05	0.021

Source: Researcher (2024).

According to Table 4.33, the standardized factor loadings for each item exceed the threshold of 0.5. The residual error is both positive and statistically significant, and there are no violations in the estimates. The composite reliability (CR) exceeds the benchmark of 0.7. The average variance extracted (AVE) also surpasses the threshold of 0.5. All measures have attained the requisite standards for convergence and validity, and the adequacy of the model fit remains within an acceptable range, thereby warranting the retention of all items for subsequent analysis.

Table 4.33

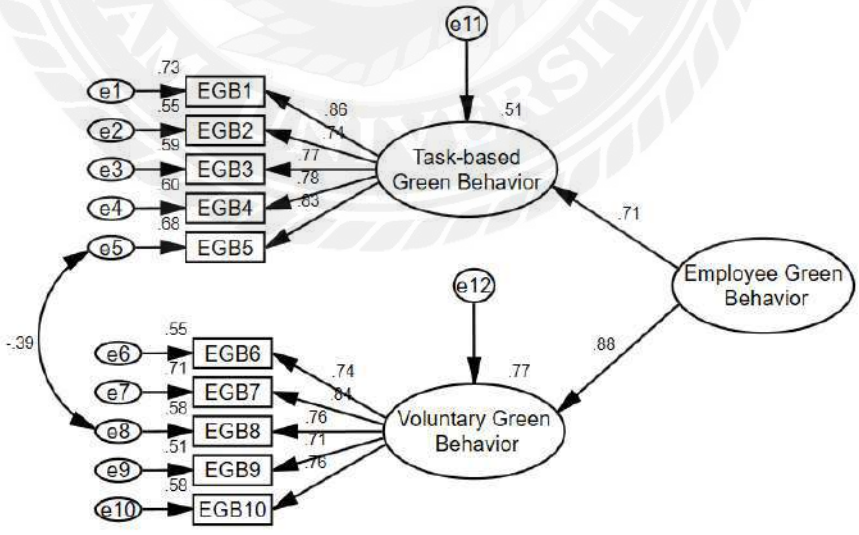
Results of Confirmatory Factor Analysis (CFA) for EGB Scale

Path			Estimate	S.E.	C.R.	P	Factor Loading	CR	AVE
EGBB	<---	Y (EGB)	1.000				0.873	0.772	0.631
EGBA	<---	Y (EGB)	1.000				0.707		
EGB1	<---	EGBA	1.000				0.860	0.896	0.633
EGB2	<---	EGBA	0.887	0.045	19.555	***	0.738		
EGB3	<---	EGBA	0.912	0.044	20.953	***	0.771		
EGB4	<---	EGBA	0.969	0.046	21.261	***	0.779		
EGB5	<---	EGBA	0.991	0.044	22.742	***	0.823		
EGB6	<---	EGBB	1.000				0.745	0.875	0.585
EGB7	<---	EGBB	1.179	0.063	18.861	***	0.837		
EGB8	<---	EGBB	1.073	0.063	16.930	***	0.751		
EGB9	<---	EGBB	1.066	0.067	16.007	***	0.717		
EGB10	<---	EGBB	1.225	0.071	17.174	***	0.769		

Source: Researcher (2024).

Figure 4.4

Confirmatory Factor Analysis (CFA) Model Diagram for EGB



Source: Researcher (2024).

Validity Analysis of the Model

As delineated in Table 4.34, the CMIN/DF (χ^2/df) value is 2.967, while the goodness of fit indices including GFI, AGFI, NFI, TLI, IFI, and CFI all meet or exceed the criterion of 0.9. The RMSEA value is 0.061, which is less than the 0.08 threshold. These fit indices conform to the established standards within structural equation modeling (SEM) research, thereby indicating that the model exhibits an adequate fit in moderation.

Table 4.34

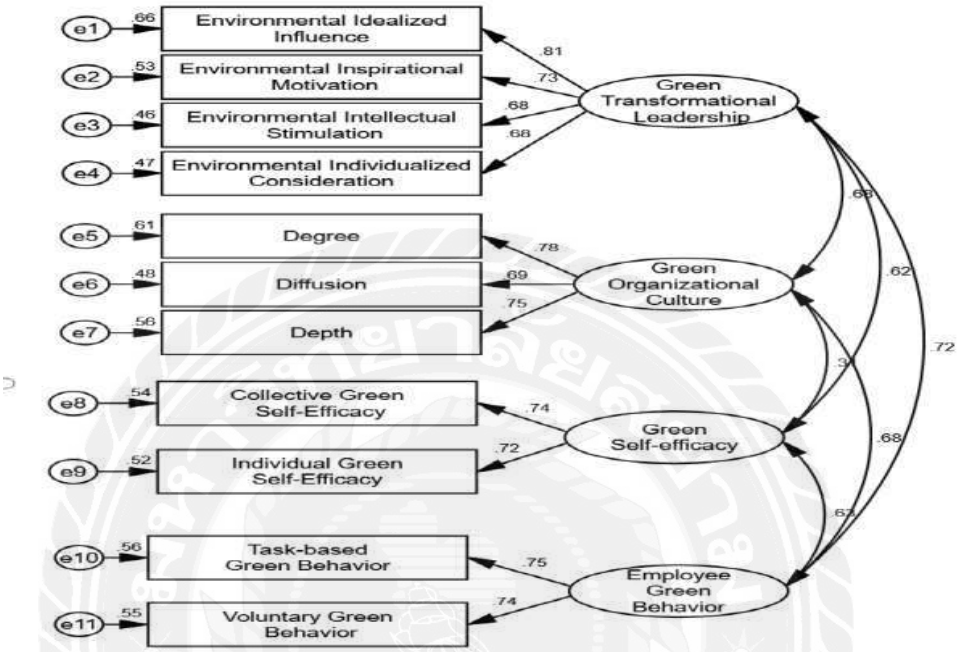
Model Fit Indices of Confirmatory Factor Analysis (CFA)

Fit Index	The Standard or Critical Value	Results
CMIN		112.731
DF		38
CMIN/DF（χ^2/df ）	<3	2.967
GFI	>0.9	0.965
AGFI	>0.9	0.939
RMSEA	<0.08	0.061
IFI	>0.9	0.966
NFI	>0.9	0.950
TLI(NNFI)	>0.9	0.951
CFI	>0.9	0.966
SRMR	<0.05	0.034

Source: Researcher (2024).

Figure 4.5

Confirmatory Factor Analysis (CFA) Model Diagram



Source: Researcher (2024).

4.3.4 Correlation Test

Through rigorous validity and reliability analysis, the structural composition of the dimensions along with their associated items was ascertained. The mean scores of the items corresponding to each dimension were computed to symbolize the aggregate score for that dimension, followed by conducting a correlation analysis. Correlation analysis primarily investigates the interrelationships among variables, with correlation coefficients ranging from -1 to 1. A greater absolute value signifies a more robust correlation between the variables.

According to Table 4.35, the correlation coefficient between Green Self-efficacy and Green Organizational Culture is 0.229, achieving significance at the 0.01 level. This finding indicates a notable positive correlation between Green Self-efficacy and Green Organizational Culture.

The correlation coefficient between Green Self-efficacy and Green Transformational Leadership is 0.437, which also achieves significance at the 0.01 level. This finding suggests a substantial positive correlation between Green Self-efficacy and Green Transformational Leadership.

Employee Green Behavior exhibits significant correlations with all three variables: Green Transformational Leadership, Green Organizational Culture, and Green Self-efficacy. The respective correlation coefficients are 0.536, 0.509, and 0.438, all of which are positive. This finding indicates that Employee Green Behavior is positively correlated with Green Transformational Leadership, Green Organizational Culture, and Green Self-efficacy.

Table 4.35

Results of Correlation Analysis for Each Variable

Variables	M	SD	GTL	GOC	GSE	EGB
GTL	3.993	0.619	1			
GOC	3.901	0.650	0.546***	1		
GSE	4.039	0.618	0.437***	0.229***	1	
EGB	3.967	0.613	0.536***	0.509***	0.438***	1

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

Source: Researcher (2024).

4.3.5 Structural Equation Model Fitting and Hypothesis Testing

Structural Equation Modeling (SEM) represents a sophisticated statistical analysis methodology employed to investigate the relationships between multiple independent variables and a dependent variable. The fundamental principles underpinning SEM are as follows:

Structural Model: SEM formulates a structural model by scrutinizing the interrelationships among variables. In the context of SEM, each independent variable functions as a dependent variable, while each dependent variable is constituted by multiple independent variables.

Hypothesis Testing: Following the construction of the structural model, hypothesis testing is necessitated. SEM employs a methodology known as variance analysis to evaluate the extent of influence exerted by each independent variable on the dependent variable. Variance analysis utilizes a suite of indicators, such as correlation coefficients and significance levels, to ascertain the degree of impact each independent variable has on the dependent variable.

Path Analysis: Through the examination of each pathway, it becomes possible to derive path coefficients, as well as ascertain the extent of influence each path exerts on the dependent variable. Utilizing these data, one can evaluate the effects of various determinants on the outcome, thereby facilitating the formulation of pertinent policies and strategies.

Goodness-of-Fit Evaluation: Structural Equation Modeling (SEM) employs a technique referred to as goodness-of-fit evaluation to appraise the model's adequacy. In the context of SEM, specialized software such as AMOS is requisite for conducting the goodness-of-fit evaluation, which determines whether the model accurately represents real-world phenomena.

According to Table 4.36, the CMIN/DF (χ^2/df) statistic is calculated to be 2.879. The Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Incremental Fit Index (IFI), and Comparative Fit Index (CFI) all exceed the threshold of 0.9, while the Root Mean Square Error of Approximation (RMSEA) is recorded at 0.062, which is below the acceptable limit of 0.08. All fit indices conform to the requisite standards for SEM research, thereby indicating that the model exhibits a satisfactory fit.

Table 4.36

Model Fit Indices of Confirmatory Factor Analysis (CFA)

Fit Index	The standard or critical value	Results
CMIN		109.387
DF		38

CMIN/DF（χ^2/df）	<3	2.879
GFI	>0.9	0.966
AGFI	>0.9	0.941
RMSEA	<0.08	0.059
IFI	>0.9	0.968
NFI	>0.9	0.951
TLI(NNFI)	>0.9	0.953
CFI	>0.9	0.967
SRMR	<0.05	0.038

Source: Researcher (2024).

Variable X (GTL) also exhibits a statistically significant positive influence on variable M2 (GSE) (β=0.597, P<0.001), with the model elucidating 35.7% of the variance in M2 (GSE).

Variable X (GTL) shows a statistically significant positive impact on variable Y (EGB) (β=0.232, P<0.01), while M1 (GOC) and M2 (GSE) both exert significant positive influences on Y (EGB) (β=0.398, P<0.01; β=0.348, P<0.01, respectively). Collectively, the model accounts for 66.5% of the variance in Y (EGB), and all proposed path hypotheses receive empirical support.

According to Table 4.37, the variable X (GTL) exhibits a statistically significant positive effect on variable M1 (GOC) (β=0.672, P<0.001), with the model elucidating 45.1% of the variance in M1 (GOC).

Table 4.37

Results of Structural Equation Modeling

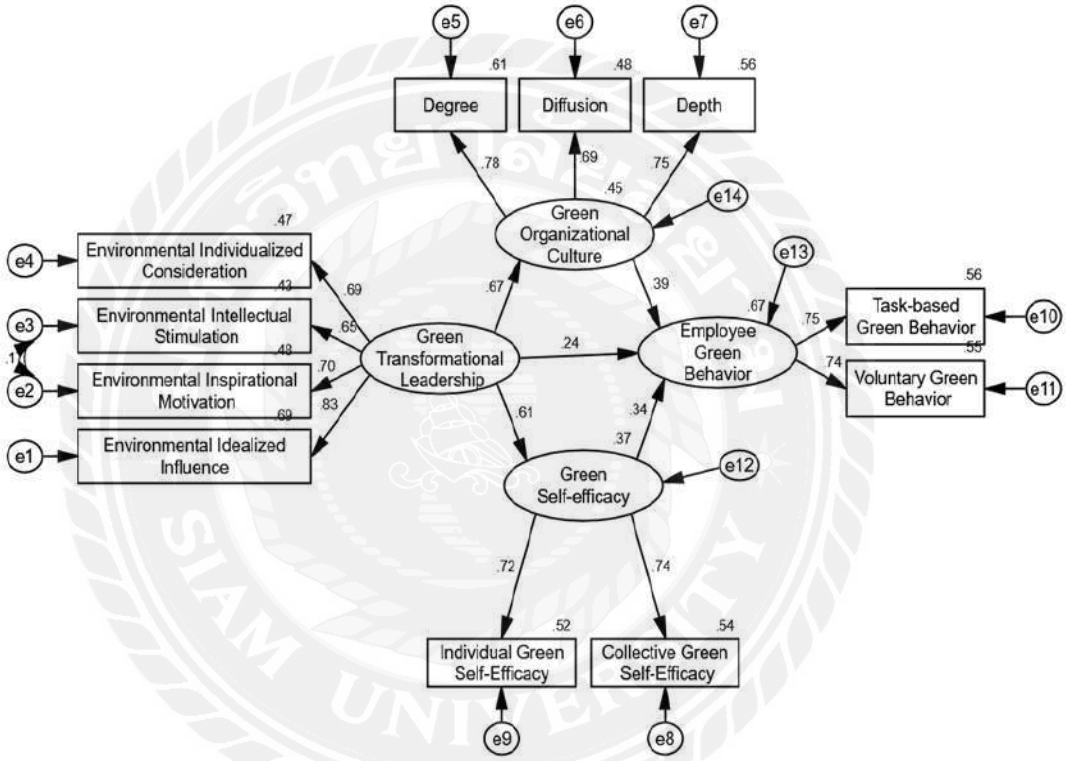
Path			Estimate	S.E.	C.R.	P	Std.Estimate	R^2
M1 (GOC)	<---	X (GTL)	0.659	0.053	12.363	***	0.672	0.451
M2 (GSE)	<---	X (GTL)	0.506	0.050	10.137	***	0.597	0.357
Y (EGB)	<---	X (GTL)	0.204	0.077	2.648	0.008	0.232	0.665

Y (EGB)	<---	M1(GOC)	0.358	0.066	5.404	***	0.398	
Y (EGB)	<---	M2 (GSE)	0.362	0.075	4.853	***	0.348	

Source: Researcher (2024).

Figure 4.6

Structural Equation Model



Source: Researcher (2024).

4.3.6 Intermediate Effect Testing

To further investigate the mediating influences of GTL=>GOC=>EGB and GTL=>GSE=>EGB, this research utilized the Bootstrap mediation effect test to evaluate the significance of the mediation effects. The employed methodology is Bootstrap ML, incorporating 5,000 iterations of resampling to analyze the results pertaining to the mediation effect.

According to Table 4.38, the direct effect of the variable X on Y (GTL-EGB) is quantified at 0.232, with 95% confidence intervals ranging from [0.041, 0.406] to [0.043, 0.407]; neither of these intervals encompasses the value of 0, thereby suggesting that the direct effect is statistically significant. The indirect effect of X through M1 on Y (GTL=>GOC=>EGB) is measured at 0.267, with 95% confidence intervals of [0.177, 0.376] and [0.175, 0.370], both of which exclude the value of 0, indicating that the indirect effect is also significant and contributes to 36.2% of the overall effect. The indirect effect of X through M2 on Y (GTL=>GSE=>EGB) is observed at 0.238, accompanied by 95% confidence intervals of [0.155, 0.335] and [0.152, 0.331], neither of which includes 0, signifying that this indirect effect is significant as well, accounting for 32.3% of the total effect. Both of these effects represent partial mediation, thereby providing support for the stated hypotheses.This finding indicates that green transformational leadership enhances employee green behavior not only directly but also indirectly through strengthening green organizational culture and boosting green self-efficacy.

Table 4.38

Results of Mediating Effect Testing

Path	Effect	SE	Bias Corrected（95%）			Percentile method（95%）			Proportion
			LLCI	ULCI	P	LLCI	ULCI	P	
X-Y(Direct Effect)	0.232	0.093	0.041	0.406	0.016	0.043	0.407	0.016	31.5%
X-M1-Y(Indirect Effect)	0.267	0.050	0.177	0.376	0.000	0.175	0.370	0.000	36.2%
X-M2-Y(Indirect Effect)	0.238	0.046	0.155	0.335	0.000	0.152	0.331	0.000	32.3%
X-Y(Intermediary Effect)	0.505	0.093	0.337	0.700	0.000	0.332	0.693	0.000	68.5%
X-Y(Aggregate Effect)	0.737	0.067	0.604	0.872	0.000	0.602	0.870	0.000	

X=GTL，M1= GOC，M2= GSE，Y=EGB

Source: Researcher (2024).

The hypothesis evaluation was executed utilizing AMOS 24.0 and SPSS 24.0. Structural equation modeling and the BOOTSTRAP mediation effect technique were applied, with a summary of the hypotheses presented in Table 4.39. All proposed hypotheses were determined to be substantiated.

Table 4.39

Result of Hypotheses Testing

path			Std.Estimate	Result
M1 (GOC)	<---	X (GTL)	0.672***	supported
M2 (GSE)	<---	X (GTL)	0.597***	supported
Y (EGB)	<---	X (GTL)	0.232***	supported
Y (EGB)	<---	M1 (GOC)	0.398***	supported
Y (EGB)	<---	M2 (GSE)	0.348***	supported
GTL=>GOC=>EGB			0.267***	supported
GTL=>GSE=>EGB			0.238***	supported

Source: Researcher (2024).

In light of the findings, all hypotheses are affirmed, as delineated in Table 4.40.

Table 4.40

Hypothesis Testing Results

NO	Hypothesis	Result
1	Green Transformational Leadership is constituted by four factors: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration.	Accepted
2	Green Organizational Culture is delineated by three factors: degree, diffusion, and depth.	Accepted
3	Green Self-Efficacy is characterized by two factors: individual green self-efficacy and collective green self-efficacy.	Accepted
4	Employee Green Behavior is comprised of two factors: task-related green behavior and voluntary green behavior.	Accepted
5	A positive correlation exists between Green Transformational Leadership and Employee Green Behavior	Accepted
6	Green Organizational Culture mediates the relationship between Green Transformational Leadership and Employee Green Behavior within the organization	Accepted
7	Green Self-Efficacy mediates the relationship between Green Transformational Leadership and Employee Green Behavior within the organization.	Accepted

Source: Researcher (2024).

4.4 In-depth Interview Data Analysis

This study employed in-depth interviews as a qualitative research method. This study conducted interviews with 12 individuals closely related to green management, including 8 employees from iron and steel enterprises, 2 officials from the Ministry of Industry and Information Technology, and 2 experts from the green industry.

4.4.1 In-depth Interview Data Analysis on Green Transformational Leadership

- **Environmental Idealization Influence**

All interviewees agreed that environmental idealized influence is closely related to green transformational leadership, and can positively influence green organizational culture, green self-efficacy, and employee green behavior. Interviewee No.1 said, "I believe environmental idealized influence is closely related to green transformational leadership. When leaders personally practice green actions, like saving energy and sorting waste, they set an example for us. Their actions are much more powerful than just slogans and truly inspire us to follow." Interviewee No.5 said, "I think environmental idealized influence is a key part of green transformational leadership. Our supervisor personally checks waste sorting and energy-saving every day, which quietly influences us. It makes us take environmental protection seriously, not just treat it as a company rule." Interviewee No.7 said,"In our company, the leader doesn't just talk about environmental protection but personally leads activities like factory clean-ups and promotes using recycled materials. His actions make us realize the importance of being green and encourage us to practice it in our daily work."

- **Environmental Inspirational Motivation**

All interviewees agreed that environmental inspirational motivation is closely related to green transformational leadership, and can positively influence green organizational culture, green self-efficacy, and employee green behavior. Interviewee No.2 said, "I think environmental inspirational motivation is a big part of green transformational leadership. Our leader often talks about how important environmental protection is for our future and the next generation. His passion really motivates us. When I hear him speak, I feel that my daily small actions—like saving water or reducing emissions—are meaningful for a bigger goal, not just for the company." Interviewee No.7 said, "In our department, the manager always sets a clear environmental vision, like aiming for 'zero waste' production.

His positive attitude makes us believe that achieving green targets is possible. It's not just about doing my own job anymore—I feel inspired to contribute more and even suggest new ideas to improve our processes." Interviewee No. 8 said, "Our supervisor shares environmental success stories during meetings and shows us the real impact of our efforts. When he shows how small changes can add up to big environmental benefits, it really encourages me. It makes me feel proud to be part of a team that's making a difference, not just working for profit."

- **Environmental Intellectual Stimulation**

All interviewees agreed that environmental intellectual stimulation is closely related to green transformational leadership, and can positively influence green organizational culture, green self-efficacy, and employee green behavior. Interviewee No.5 said, "I think environmental intellectual stimulation is closely linked to green transformational leadership. In our company, leaders often encourage us to think differently about how to reduce pollution and improve efficiency. They don't just tell us what to do—they want us to come up with new ideas. Sometimes we even have brainstorming sessions to find better, greener ways to handle production waste. It really makes me feel involved and creative in environmental work." Interviewee No.7 said, "From my experience, environmental intellectual stimulation is an important part of green transformational leadership. Our supervisors often challenge us to rethink how our daily tasks impact the environment. They encourage us to suggest improvements, even if the ideas seem small. I think this kind of open atmosphere really helps build a stronger green culture in the company." Interviewee No.8 said, "Our leaders always push us to question old methods and find more eco-friendly solutions. For example, when we talked about reducing energy consumption, our manager asked everyone for suggestions instead of just giving orders. It made me realize that every small improvement idea matters. It's not just about following rules—it's about thinking how we can do better for the environment."

- **Environmental Individualized Consideration**

All interviewees agreed that environmental individualized consideration is closely related to green transformational leadership, and can positively influence green organizational culture, green self-efficacy, and employee green behavior. Interviewee No.4 said, "I think environmental individualized consideration is a real thing in green leadership. Our manager doesn't treat everyone the same when it comes to environmental work. He knows some of us are better at certain tasks, so he gives us chances to improve and supports us personally. Like, when I struggled with some of the new eco-friendly processes, he didn't blame me—he arranged for a colleague to help me out. It feels like they actually care about how each person can grow, not just about hitting green targets." Interviewee No.9 said, " Environmental individualized consideration is a critical aspect of green transformational leadership. In our organization, leaders take time to understand each employee's strengths and needs regarding environmental practices. They offer tailored support, such as personalized coaching or development opportunities, to help employees integrate green behavior into their roles. This individualized attention fosters a sense of personal responsibility and engagement in achieving our environmental goals."

In conclusion, the interview result confirmed that environmental idealization influence, environmental inspirational motivation, environmental intellectual stimulation and environmental individualized consideration are related to green transformation leadership and support hypothesis 1 and 5.

4.4.2 In-depth Interview Data Analysis on Green Organizational Culture

- **Degree**

All interviewees agreed that degree is closely related to green organizational culture, and can positively influence employee green behavior. Interviewee No.4 said, "I think the degree of green organizational culture is very important. If the company leadership truly values environmental protection, it sets a clear tone for everyone. In our company, when the top leaders emphasize green development, it sends a strong signal. It

makes us realize that green practices are not optional—they are part of our daily responsibility." Interviewee No.5 said, "From what I see, the higher the degree of green culture in a company, the more serious people are about environmental actions. If the management only talks about it occasionally, most employees won't take it seriously. But when the company really puts green goals into strategy, daily meetings, and performance evaluations, it changes our mindset. We know it's something important, not just a slogan." Interviewee No.6 said, "In my opinion, the degree of green culture affects everything. When green values are deeply rooted in the company, we automatically think about the environmental impact before making decisions. It's not just doing green projects when asked—it becomes part of how we work every day. Without a strong degree of green culture, environmental efforts would just be short-term and superficial."

- **Diffusion**

All interviewees agreed that diffusion is closely related to green organizational culture, and can positively influence employee green behavior. Interviewee No.3 said, "I think diffusion is very important for building a strong green organizational culture. It's not enough if only the management talks about environmental protection. Everyone, from frontline workers to supervisors, needs to be involved. In our company, when different departments all promote green practices, it creates a shared atmosphere. It makes it easier for everyone to follow and support green initiatives." Interviewee No.7 said, "In my experience, if green culture is not well diffused, it stays only at the surface level. For example, if only the environmental department cares about eco-friendly practices but other departments don't, then the impact is very limited. But when every department, including production, maintenance, and logistics, is actively involved, the whole company can really move toward sustainability." Interviewee No.8 said, "Diffusion plays a key role in making green culture part of everyday work. When green values and actions are spread throughout all levels, it becomes natural for employees to think about the environment in everything they do. In our case, we see posters, attend training sessions, and even small competitions

between teams for green performance. These things help green ideas stick with everyone, not just stay in documents."

- **Depth**

All interviewees agreed that depth is closely related to green organizational culture, and can positively influence employee green behavior. Interviewee No.5 said, "I think the depth of green culture is what really determines whether environmental efforts last. If employees truly believe in green values, they will naturally practice them, even without supervision. In our company, I can feel that many colleagues really care about the environment, not just because the company says so, but because they personally think it's the right thing to do." Interviewee No.6 said, "From my point of view, without depth, green culture is just a formal thing. It might look good in reports but doesn't really change behavior. But if employees internalize green thinking, they will consider the environment when making every small decision.." Interviewee No.10 said, "Depth is crucial because it means green culture becomes part of people's mindset. In our company, after years of promoting green values, many workers now take environmental responsibility seriously in their personal lives too. It's not just about following company rules anymore—it becomes a habit, a personal choice."

In conclusion, the interview result confirmed that degree, diffusion and depth are related to green organizational culture and support hypothesis 2.

4.4.3 In-depth Interview Data Analysis on Green Self-efficacy

- **Individual Green Self-Efficacy**

All interviewees agreed that individual green self-efficacy is closely related to green self-efficacy, and can positively influence employee green behavior. Interviewee No.2 said, "For me, individual green self-efficacy means believing that I can make a difference on my own. I have the confidence that small actions—like reducing energy consumption or ensuring that waste is sorted properly—are meaningful and impactful. When I feel that I can control these actions, it motivates me to make green choices in my daily work, knowing it's all part of a bigger picture." Interviewee No.6 said, "Having high

individual green self-efficacy means I know I have the ability to make green decisions even in small tasks. For instance, I feel confident in my ability to save water during production and reduce the use of plastic materials. These actions may seem small, but I believe they all add up and contribute to the company's overall green goals. When I feel I can control these aspects, I'm more committed to implementing them." Interviewee No.8 said, "When I have a strong sense of individual green self-efficacy, I feel empowered to make green choices on my own, without waiting for others to lead. I'm confident that I can improve processes, like reducing waste in my department or using more sustainable resources in the production line. The more I believe in my own ability to make these changes, the more proactive I become in finding new ways to improve our green efforts."

- **Collective Green Self-Efficacy**

All interviewees agreed that collective green self-efficacy is closely related to green self-efficacy, and can positively influence employee green behavior. Interviewee No.4 said, "I believe collective green self-efficacy plays a big role in my own confidence to make a difference. When I see our team working together to meet green goals, it makes me feel like I can do my part too." Interviewee No.6 said, "The collective green self-efficacy definitely affects me. When the team is motivated and working toward the same environmental goal, I feel more empowered to contribute individually. If we collectively believe in the impact of our actions, it boosts my own confidence that I can make changes in my own work, like reducing waste or being more mindful of resource consumption." Interviewee No.8 said, "When the entire company is focused on a green initiative and everyone is involved, it helps me feel that I can personally make a difference too. The success of the group builds my confidence to do my part."

In conclusion, the interview result confirmed that individual green self-efficacy and collective green self-efficacy are related to green self-efficacy and support hypothesis 3.

4.4.4 In-depth Interview Data Analysis on Employee Green Behavior

- **Task-related Green Behavior**

All interviewees agreed that task-related green behavior is closely related to employee green behavior. Interviewee No.1 said, "I think task-related green behavior definitely reflects employee green behavior to some extent. In our work, we are encouraged to reduce energy consumption, recycle materials, and minimize waste during production. These are all directly related to our tasks. The fact that we are required to do this as part of our job shows that the company considers green behavior as a key aspect of our daily work. So, in a way, it does reflect the overall green behavior of employees." Interviewee No.2 said, "Task-related green behavior can certainly reflect an employee's overall green behavior." Interviewee No.4 said, "Task-related green behavior plays a major role in showing whether an employee is committed to sustainability. When employees focus on reducing waste or energy consumption as part of their job duties, it's clear they understand the importance of green practices. While it might be a requirement, it still reflects how seriously we take our environmental responsibilities, and it sets a standard for the behavior we should all follow."

- **Voluntary Green Behavior**

All interviewees agreed that voluntary green behavior is closely related to employee green behavior. Interviewee No.5 said, "I think voluntary green behavior is just as important, if not more important, than task-related green behavior. It shows that employees are truly committed to environmental sustainability, not just because it's part of their job, but because they care about the environment." Interviewee No.6 said, "Voluntary green behavior definitely adds a lot of value to employee green behavior. While task-related green behavior is required, voluntary green behavior shows how passionate and engaged an employee is about sustainability." Interviewee No.7 said, "For me, voluntary green behavior is a reflection of an employee's dedication to the environment. It's one thing to follow green practices because it's part of the job, but it's another thing to voluntarily engage in activities like organizing clean-up events or reducing waste outside of work

hours. These behaviors show that we don't just do the minimum—we go the extra mile to make a positive environmental impact."

In conclusion, the interview result confirmed that task-related green behavior and voluntary green behavior are related to employee green behavior and support hypothesis 4.

4.4.5 In-depth Interview Data Analysis on the Mediating Effect of Green Organizational Culture

All interviewees agreed that green organizational culture has a mediating effect on the relationship between green transformational leadership and employee green behavior in iron and steel enterprises in China. Interviewee No.1 said, "I feel that the company leadership attaches great importance to environmental protection and has integrated it into our corporate culture. Every time we have a meeting, the leader mentions green development and green production, which makes me feel that environmental protection is not just a slogan, but a part of our company's culture. Everyone is working together to promote this goal. Interviewee No.3 said, "I believe that the green organizational culture really motivates us to engage in more green behaviors. The leader always treats environmental protection as something very important, and this attitude influences all of us. We naturally take actions like energy conservation and emission reduction because we know these align with the company's culture and goals." Interviewee No.6 said, "I think the company's green organizational culture has indeed had an impact on me. The company leadership consistently emphasizes environmental protection and green development, which gives me clear goals regarding green development. Everyone is working towards this goal, and the leadership's emphasis makes me feel that it is crucial to implement green behaviors in my work."

In conclusion, the interview result confirmed that green organizational culture has a mediating effect on the relationship between green transformational leadership and employee green behavior and support hypothesis 6.

4.4.6 In-depth Interview Data Analysis on the Mediating Effect of Green Self-efficacy

All interviewees agreed that green self-efficacy has a mediating effect on the relationship between green transformational leadership and employee green behavior in iron and steel enterprises in China. Interviewee No.2 said, “I think the leader not only gives us direction but also provides resources and encouragement. This way, we know that the leader supports us in taking green actions, which gives us more motivation to engage in green behaviors.” Interviewee No.4 said, “The leader's support is very important to me, especially when the leader supports our environmental efforts through concrete actions. This boosts my confidence in practicing green behaviors, such as reducing energy consumption or saving resources. The support from the leader makes me feel that these green actions are not just for the company but something I can really achieve.” Interviewee No.6 said, “I believe the leader's support is indeed very important. Especially when the leader supports our environmental efforts with concrete actions, it enhances my green self-efficacy at work. This gives me the confidence to engage in more green actions, like reducing emissions, saving energy, etc., which ultimately drives me to be more proactive in green initiatives.”

In conclusion, the interview result confirmed that green self-efficacy has a mediating effect on the relationship between green transformational leadership and employee green behavior and support hypothesis 7.

4.5 Combination of Quantitative Analysis Results and Qualitative Analysis Results

Based on the analysis results of questionnaire data and in-depth interview, Hypothesis 1, 2, 3，4，5，6 and 7 all get supported.

The validation analysis concerning the four-dimensional framework of green transformational leadership illustrated that factor analysis successfully identified four distinct factors, yielding a cumulative variance explanation rate of 67.845% (surpassing the 60% threshold). Upon conducting varimax rotation, each item was unequivocally associated with the four factors: environmental idealized influence, environmental

inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration., as all factor loadings exceeded 0.7. This is inline with interviewee No.5 who said, "I think environmental idealized influence is a key part of green transformational leadership." It is also inline with interviewee No.2 who said, "I think environmental inspirational motivation is a big part of green transformational leadership." and interviewee No.7 who said, "From my experience, environmental intellectual stimulation is an important part of green transformational leadership." Furthermore, interviewee No.4 said, "I think environmental individualized consideration is a real thing in green leadership." These are corresponding with Hypothesis 1: green transformational leadership consists of four dimensions: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration.

The validation analysis pertaining to the three-factor structure of green organizational culture revealed that factor analysis identified three distinct factors, resulting in a cumulative variance explanation rate of 69.150% (exceeding 60%). Subsequent to varimax rotation, all items were distinctly attributed to the three factors: degree, diffusion and depth with factor loadings exceeding 0.7. This is confirmed with interviewee No.4 said, "I think the degree of green organizational culture is very important." Interviewee No.3 said, "I think diffusion is very important for building a strong green organizational culture." Interviewee No.5 said, "I think the depth of green culture is what really determines whether environmental efforts last." These are corresponding with Hypothesis 2: green organizational culture consists of three dimensions: degree, diffusion and depth.

The validation analysis of the two-factor structure of green self-efficacy disclosed that factor analysis extracted two factors, accounting for a cumulative variance of 67.557% (exceeding 60%). Through the application of varimax rotation, all items were distinctly attributed to the two factors: individual green self-efficacy and collective green self-efficacy, with factor loadings surpassing 0.6. This is inline with interviewee No.2 said, "For me, individual green self-efficacy means believing that I can make a difference on my

own." Interviewee No.4 said, "I believe collective green self-efficacy plays a big role in my own confidence to make a difference." These are corresponding with Hypothesis 3: green self-efficacy consists of two dimensions: individual green self-efficacy and collective green self-efficacy.

The validation analysis of the two factor structure of employee green behavior disclosed that factor analysis extracted two factors, accounting for a cumulative variance of 68.616% (exceeding the stipulated 60% threshold). Following varimax rotation, all items were distinctly attributed to the two factors: task-related green behavior and voluntary green behavior, with factor loadings surpassing 0.6. This is confirmed with interviewee No.1 said, "I think task-related green behavior definitely reflects employee green behavior to some extent." Interviewee No.6 said, "voluntary green behavior definitely adds a lot of value to employee green behavior." These are corresponding with Hypothesis 4: employee green behavior consists of two dimensions: task-related green behavior and voluntary green behavior.

The analysis elucidates that green transformational leadership exerts a statistically significant affirmative impact on employee green behavior, evidenced by a direct effect value of 0.232 ($p=0.008$, 95% CI [0.041,0.406]) alongside a standardized effect size of 0.232. This is confirmed with interviewee No.6 said, "I think that green transformational leadership is indeed closely related to employee green behavior. The leadership constantly emphasizes the importance of environmental protection and green production, not just talking about it in meetings but also providing us with specific guidance and support. For example, the leadership organizes training on energy conservation and emission reduction, encourages us to take green actions, and also provides resource support. This makes me feel that environmental protection is not just something the company requires but a responsibility for each of us. With the leadership's support, I'm more willing to adopt green behaviors in my daily work, like reducing energy waste and enhancing resource recycling." Interviewee No.8 said, "I believe that green transformational leadership has a positive impact on our green behavior. The leadership's support gives me more confidence and makes me more willing to engage in environmental protection. In our company, green

production is always emphasized during the production process. The leadership not only mentions it in meetings but also pushes it through concrete actions, such as purchasing energy-efficient equipment and encouraging the use of green materials. These actions make me feel that I can also contribute to green efforts at work, such as saving energy and reducing emissions. The leadership's focus makes me believe that environmental protection is not just a slogan but something we can actually implement in our daily work." These are corresponding with Hypothesis 5: green transformational leadership significantly influences employee green behavior positively.

The analysis elucidates that green transformational leadership possesses a noteworthy direct effect on employee green behavior, quantified by an effect value of 0.232 ($p=0.008$, 95% CI [0.041,0.406]). Moreover, the indirect effect mediated through green organizational culture (GTL→GOC→EGB) is quantified at 0.267 ($p<0.001$, 95% CI [0.177,0.376]), which constitutes 36.2% of the overall effect. This is confirmed with interviewee No.1 said, "I feel that the company leadership attaches great importance to environmental protection and has integrated it into our corporate culture. Every time we have a meeting, the leader mentions green development and green production, which makes me feel that environmental protection is not just a slogan, but a part of our company's culture. Everyone is working together to promote this goal. Interviewee No.3 said, "I believe that the green organizational culture really motivates us to engage in more green behaviors. The leader always treats environmental protection as something very important, and this attitude influences all of us. We naturally take actions like energy conservation and emission reduction because we know these align with the company's culture and goals." These are corresponding with Hypothesis 6: green organizational culture mediates the nexus between green transformational leadership and employee green behavior.

The empirical analysis elucidates that green transformational leadership exerts a direct influence on employee green behavior, evidenced by an effect coefficient of 0.232 ($p=0.008$) and a standardized effect size of 0.232. Notably, the mediating pathway via green self-efficacy (GTL→GSE→EGB) reveals an indirect effect of 0.238 ($p<0.001$, 95% CI [0.155,0.335]), encompassing 32.3% of the overall effect. This is confirmed with

interviewee No.2 said, “I think the leader not only gives us direction but also provides resources and encouragement. This way, we know that the leader supports us in taking green actions, which gives us more motivation to engage in green behaviors.” Interviewee No.4 said, “The leader's support is very important to me, especially when the leader supports our environmental efforts through concrete actions. This boosts my confidence in practicing green behaviors, such as reducing energy consumption or saving resources. The support from the leader makes me feel that these green actions are not just for the company but something I can really achieve.” These are corresponding with Hypothesis 7: Green Self-efficacy functions as a critical mediator between green transformational leadership and employee green behavior.

Table 4.41

Interview Content Categorization

Category	Theme	Representative Quotes	Key Points Summary
Green Transformational Leadership	Environmental Idealized Influence	“Leaders personally practice energy saving and waste sorting, which is more powerful than slogans.” (Interviewees 1, 5, 7)	Leaders set an example and effectively motivate employees' green behavior.
	Environmental Inspirational Motivation	“Leaders articulate a green vision and share success stories to inspire us.” (Interviewees 2, 7, 8)	Leaders inspire employees to participate in green initiatives through vision and passionate speeches.
	Environmental Intellectual Stimulation	“Leaders encourage us to innovate methods to reduce pollution, brainstorming together.” (Interviewees 5, 7, 8)	Leaders stimulate creativity for greener solutions.
	Environmental Individualized Consideration	“Leaders provide personalized support based on individual strengths.” (Interviewees 4, 9)	Individualized care enhances employees' green responsibility and capabilities.
	Degree	“Leadership values environmental protection, making it a daily responsibility.” (Interviewees 4, 5)	Embedding green culture into company strategy and daily operations.
	Diffusion	“All departments participate in green practices, forming a	Green culture must be widely spread across departments to be effective.

Category	Theme	Representative Quotes	Key Points Summary
Green Organizational Culture		collective atmosphere." (Interviewees 3, 7, 8)	
	Depth	"Employees internalize green values and practice them spontaneously." (Interviewees 5, 6, 10)	Deep green culture leads to habitual, voluntary environmental behaviors.
Green Self-Efficacy	Individual Green Self-Efficacy	"I believe small actions are meaningful and this boosts my confidence." (Interviewees 2, 6, 8)	Personal confidence in making green choices promotes proactive behaviors.
	Collective Green Self-Efficacy	"Team efforts enhance my own confidence to act green." (Interviewees 4, 6, 8)	Collective belief strengthens individual commitment to green behavior.
Employee Green Behavior	Task-related Green Behavior	"Energy saving and waste reduction are part of our daily job requirements." (Interviewees 1, 2, 4)	Green behaviors integrated into routine tasks reflect company priorities.
	Voluntary Green Behavior	"Voluntary participation in green activities shows genuine commitment." (Interviewees 5, 6, 7)	Voluntary behavior highlights internalized environmental values.
Mediating Effect	Green Organizational Culture Mediation	"Company culture makes green behavior natural." (Interviewees 1, 3, 6)	Green organizational culture mediates between leadership and employee behavior.
Mediating Effect	Green Self-Efficacy Mediation	"Leadership support boosts my confidence to practice green actions." (Interviewees 2, 4, 6)	Green self-efficacy enhances employees' engagement in environmental practices.

Source: Researcher (2024).

Based on the findings, this study proposes the G-POWER model, a newly developed framework explaining how green transformational leadership influences employees' green behaviors through two main pathways. In the social cognitive route, leadership role-modeling enhances employees' green self-efficacy via the "efficacy enhancement" dimension. In the planned behavior route, leaders promote environmental values that strengthen green behavioral intentions through the "willingness activation"

dimension. Both pathways ultimately drive actual green behaviors, represented by the "resultant behaviors" dimension, supporting the model's explanatory power.

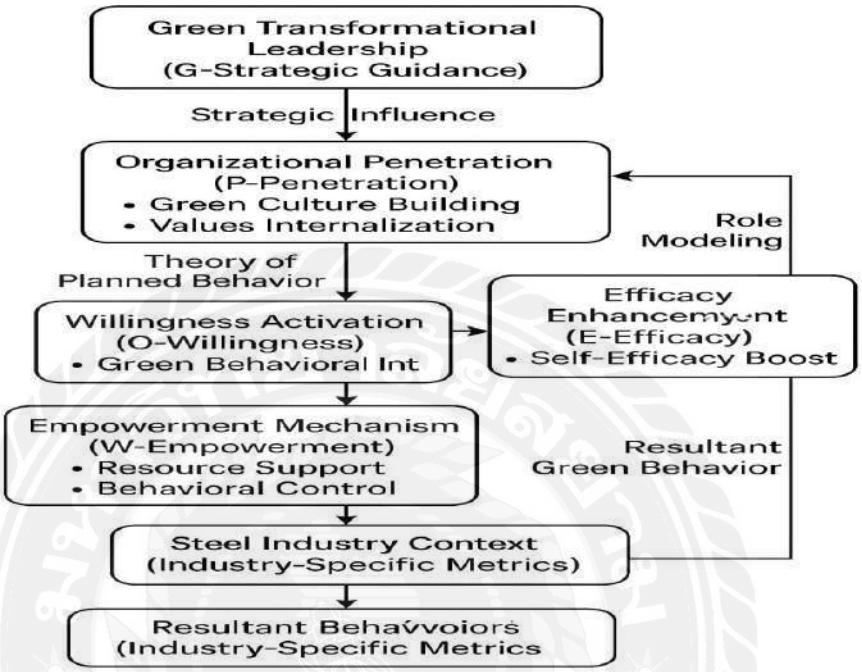
The mediation analysis highlights "organizational penetration" and "efficacy enhancement" as key bridging mechanisms. Green leadership fosters three types of green behaviors—compliance, innovation, and advocacy—through shaping culture (penetration), boosting self-efficacy (efficacy), and reinforcing behavioral control (empowerment). These findings advance the multi-level framework of green behavior.

The study's theoretical contributions are threefold: (1) the G-POWER model integrates four core theories into a six-dimensional framework—Guidance (G), Penetration (P), Willingness (O), Empowerment (W), Efficacy (E), and Resultant behavior (R); (2) it clarifies the transmission mechanism from institutional environment to psychological cognition to actual behavior, emphasizing the dual mediating roles of penetration and efficacy; and (3) it introduces industry-specific tools for measuring green behavior, offering methodological guidance for future research.

The model offers theoretical support for green transformation in the steel industry, revealing both direct and indirect effects of green leadership through culture and self-efficacy. It also provides a basis for customized green management strategies. Future research should explore its applicability across industries and the interrelations among its dimensions. Figure 4.6 illustrates the G-POWER model.

Figure 4.6

G-POWER Model



Source: Researcher (2024).

CHAPTER 5
RESEARCH CONCLUSION, DISCUSSION, AND RECOMMENDATION

This chapter concludes on the findings of data analysis delineated in Chapter Four. It encompasses an exposition of research conclusions, a summary of the results from the structural equation modeling analysis, a discourse on the study's findings, and, on this foundation, advances policy recommendations and avenues for future inquiry. This chapter is systematically partitioned into three sections as outlined below.

5.1 Research Conclusion

5.1.1 Conclusion for the Quantitative Research

5.1.1.1 Sample Feature Description

The statistical data indicate that among the 532 respondents, 351 were male, representing 65.98%, while 181 were female, constituting 34.02%, with the male contingent markedly outnumbering their female counterparts. In terms of age distribution, 125 respondents were categorized within the 21-30 age bracket, 219 were within the 31-40 age range, 154 fell within the 41-50 age category, and 34 were aged 51 and above, corresponding to 23.50%, 41.16%, 28.947%, and 6.40%, respectively. Among these demographics, the 31-40 age group comprised the largest proportion. Concerning educational attainment, the predominant number of respondents possessed a bachelor's degree, totaling 290 individuals and accounting for 54.51%, whereas 119 individuals held a master's degree or higher, representing 22.37%. In relation to professional experience, 56 employees possessed less than 3 years of experience, 262 employees had 4-6 years of

experience, 174 employees had 7-9 years of experience, and 40 employees had 10 years or more of experience, corresponding to 10.53%, 49.25%, 32.71%, and 7.52%, respectively. From the perspective of positional distribution, the highest number of individuals were ordinary employees, totaling 311, which accounted for 58.46%, thus exceeding half of the total respondents. This was succeeded by middle managers, numbering 141 individuals and representing 26.50%. Senior managers totaled 54 individuals, accounting for 10.15%, while other positions comprised 26 individuals, which is 4.89%.

5.1.1.2 Conclusion of Green Transformational Leadership (GTL)

This section delineates the perceptions of the respondents regarding Green Transformational Leadership. Among the four dimensions, Environmental Inspirational Motivation garnered the highest mean score, achieving the classification of "Agree" ($\overline{X}$ = 4.024, SD = 0.750), succeeded by Environmental Individualized Consideration, Environmental Intellectual Stimulation, and Environmental Idealized Influence.

For the Environmental Idealized Influence dimension, the mean level of respondents' evaluations is classified as "Agree" ($\overline{X}$ = 3.941, SD = 0.749). The statement with the highest score posits: "My leader demonstrates a steadfast belief in environmental values at work." while the statement with the lowest score indicates: "My leader serves as my environmental role model."

Concerning the Environmental Inspirational Motivation dimension, the average level of respondents' sentiments is classified as "Agree" ($\overline{X}$ = 4.024, SD = 0.750). The statement receiving the highest score is: "My leader encourages me to work in an environmentally friendly manner," while the statement with the lowest score is: "My leader encourages me to prioritize collective environmental interests over personal gains."

For the Environmental Intellectual Stimulation dimension, the mean level of respondents' evaluations is categorized as "Agree" ($\overline{X}$ = 3.984, SD = 0.770). The statement that received the highest score articulates: "My leader holds an optimistic attitude towards the methods I propose to improve the company's environmental performance." whereas the

statement with the lowest score asserts: "My leader encourages me to consider environmental issues from different perspectives."

For the the Environmental Individualized Consideration dimension, the average level of respondents' sentiments is categorized as "Agree" ($\overline{X}$ = 4.023, SD = 0.786). The statement that achieved the highest score is: "My leader acknowledges my ability to enhance the company's environmental performance," whereas the statement with the lowest score is: "My leader is willing to invest time in developing my skills to contribute to the company's environmental performance."

5.1.1.3 Conclusion of Green Organizational Culture (GOC)

This section delineates the perceptions of respondents concerning Green Organizational Culture. Among the three dimensions examined, Degree attained the highest average score, achieving a classification of "Agree" ($\overline{X}$ = 3.929, SD = 0.759), followed by Diffusion and Depth.

For the Degree dimension, the mean level of respondents' evaluations is categorized as "Agree" ($\overline{X}$ = 3.929, SD = 0.759). The highest scoring statement asserts: "In my industry, environmental/green values are a part of all company activities and decisions across all firms." while the lowest scoring statement claims: "When short run performance of the organization is considered, managers consider profit and growth as dominant objectives rather than green agenda."

In the case of the Diffusion dimension, the mean level of respondents' evaluations is classified as "Agree" ($\overline{X}$ = 3.900, SD = 0.798). The statement that received the highest score articulates: "In my organization, any manager who is identified as a "greenie"(pro-environmental change agent) is marginalized/isolated due to internal politics." whereas the statement with the lowest score states: "In my organization, importance of green values varies from one department to another based on professional specialization and background (for example, accounts departments low focus on green values; corporate social responsibility/marketing department have high focus on green values."

Concerning the Depth dimension, the mean level of respondents' evaluations is designated as "Agree" ($\overline{X}$ = 3.875, SD = 0.778). The statement that received the highest score asserts: "Most managers in my organization believe that green practices are not related to profits." while the statement with the lowest score indicates: "My organization sincerely develops environmental initiatives and practices to deal with public criticism relating to the emissions/effluents from my company."

5.1.1.4 Conclusion of Green Self-Efficacy (GSE)

This section delineates the perceptions of respondents concerning Green Self-Efficacy. Among the two dimensions assessed, Individual Green Self-Efficacy achieved the highest average score, attaining a classification of "Agree" ($\overline{X}$ = 4.102, SD = 0.719), followed by Collective Green Self-Efficacy.

In the context of the Individual Green Self-Efficacy dimension, the mean level of respondents' evaluations is categorized as "Agree" ($\overline{X}$ = 4.102, SD = 0.719). The statement that received the highest score posits: "I can complete environmental tasks more efficiently." while the statement with the lowest score asserts: "I think I can successfully implement environmentally friendly ideas."

For the Collective Green Self-Efficacy dimension, the respondents exhibited an average level of agreement categorized as "Agree" ($\overline{X}$ = 3.976, SD = 0.694). The statement with the highest rating is: "Our team can effectively implement and maintain environmental protection measures." whereas the statement with the lowest rating is: "When facing complex environmental issues, our organization can find effective solutions."

5.1.1.5 Conclusion of Employee Green Behavior (EGB)

This segment delineates the respondents' perceptions regarding Employee Green Behavior. Among the two dimensions, Voluntary Green Behavior attained the highest mean score, achieving a level of "Agree" ($\overline{X}$= 4.012, SD = 0.679), followed by task-related green behavior.

Regarding the Voluntary Green Behavior dimension, the average level of respondents' opinions is categorized as "Agree" ($\overline{X}$ = 4.012, SD = 0.679). The statement receiving the highest score is: "I voluntarily carry out environmental actions and initiatives in my daily work." while the statement with the lowest score is: "I spontaneously encourage my colleagues to adopt more environmentally conscious behavior at work."

In relation to the task-related green behavior dimension, the average level of respondents' opinions is classified as "Agree" ($\overline{X}$ = 3.922, SD = 0.712). The highest rated statement is: "I can accomplish the environmental protection tasks within my duties competently." while the statement with the lowest rating is: "I pay attention to energy conservation and low-carbon travel in my daily work."

5.1.1.6 Reliability, Validity and Structural Equation Model on Relationship Results

This research employed reliability analysis, validity analysis, and Structural Equation Modeling (SEM) methodologies. A total of 532 questionnaires were gathered, calculated, and subsequently analyzed utilizing SEM.

When Cronbach's Alpha is ≥ 0.70, AVE is ≥ 0.50, and CR is ≥ 0.70, the scale is considered to have acceptable reliability and convergent validity.

According to the findings from the Confirmatory Factor Analysis (CFA), the Cronbach's Alpha coefficients for the four dimensions of green transformational leadership were 0.841, 0.896, 0.884, and 0.828, all exceeding the threshold of 0.7. The Average Variance Extracted (AVE) values were 0.620, 0.568, 0.597, and 0.595, all surpassing 0.5. The Construct Reliability (CR) values were 0.891, 0.868, 0.881, and 0.880, all exceeding 0.8.

For the three dimensions of green organizational culture, the Cronbach's Alpha coefficients were 0.840, 0.889, and 0.885, all surpassing 0.7. The AVE values were 0.620, 0.615, and 0.595, all exceeding 0.5. The CR values were 0.890, 0.888, and 0.880, all exceeding 0.8.

For the two dimensions of green self-efficacy, the Cronbach's Alpha coefficients were 0.901 and 0.939, both surpassing 0.8. The AVE values were 0.673 and 0.518, both exceeding 0.5. The CR values were 0.911 and 0.841, both greater than 0.8.

For the two dimensions of employee green behavior, the Cronbach's Alpha coefficients were 0.921 and 0.929, both exceeding 0.8. The AVE values were 0.633 and 0.585, both surpassing 0.5. The CR values were 0.896 and 0.875, both exceeding 0.8.

Based on the output results derived from AMOS structural equation modeling, the path coefficient representing green transformational leadership's influence on employee green behavior is quantified at 0.204, accompanied by a standard error (S.E.) of approximately 0.077, and the standardized regression weight estimate is determined to be 0.232. The results indicate that green transformational leadership has a positive and moderately strong influence on employee green behavior, with a stable and statistically significant path coefficient.

The path coefficient regarding the impact of green transformational leadership on green organizational culture is calculated as 0.659, with a standard error approximating 0.053. The standardized regression weight estimate is assessed at 0.672. The results indicate that green transformational leadership has a strong and statistically significant positive effect on green organizational culture.

The path coefficient indicating the relationship between green transformational leadership and green self-efficacy is noted at 0.506, with a standard error approximately equal to 0.050, and the standardized regression weight estimate stands at 0.597. The results demonstrate that green transformational leadership has a moderately strong and statistically significant positive impact on green self-efficacy

The path coefficient illustrating the effect of green organizational culture on employee green behavior is measured at 0.358, with a standard error of approximately 0.066. The standardized regression weight estimate is determined to be 0.398. The results demonstrate that green organizational culture has a significant and moderate positive effect on employee green behavior.

The path coefficient reflecting the relationship between green self-efficacy and employee green behavior is quantified at 0.362, with a standard error of approximately 0.075. The standardized regression weight estimate is assessed at 0.348. The results demonstrate that green self-efficacy has a significant and moderate positive effect on employee green behavior.

The indirect effect of green organizational culture in the relationship between green transformational leadership and employee green behavior is quantified at 0.267, with a 95% confidence interval that excludes 0, indicating a significant indirect effect, which accounts for 36.2% of the total effect. The indirect effect of green self-efficacy in the relationship between green transformational leadership and employee green behavior is calculated at 0.238, with a 95% confidence interval that does not encompass 0, thus indicating a notable indirect effect, accounting for 32.3% of the total effect. All findings are statistically significant.

5.1.2 Conclusion for the Qualitative Research

Concerning the practices of green transformational leadership, all interviewees consistently affirmed that the four dimensions—environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation, and environmental individualized consideration—are intrinsically linked to transformational leadership practices. In relation to green organizational culture, all interviewees similarly concurred that the three dimensions—degree, diffusion, and depth—are associated with green organizational culture. With respect to green self-efficacy, all interviewees agreed that the two dimensions—individual green self-efficacy and collective green self-efficacy—were interconnected with green self-efficacy. Finally, regarding employee green behavior, interviewees generally perceived that both task-related green behavior and voluntary green behavior are interconnected. In summary, it can be inferred that all sub-variables exhibit associations with the primary variables outlined in the model.

5.2 Discussion

Drawing upon the results garnered from both quantitative and qualitative research methodologies, this study addresses the research inquiry by elucidating that green transformational leadership exerts a positive influence on employee green behavior within Chinese iron and steel enterprises, facilitated through the mediating effects of green organizational culture and green self-efficacy. Chapter 4 delineates survey data that reveals robust interrelations among green transformational leadership, green organizational culture, green self-efficacy, and employee green behavior. Importantly, green organizational culture and green self-efficacy function as mediating variables between green transformational leadership and employee green behavior.

5.2.1 The significance effect of green transformational leadership on employee green behavior

According to the output results derived from the AMOS structural equation model, the path coefficient indicating the influence of green transformational leadership on employee green behavior was determined to be 0.612, signifying that each one-unit elevation in green transformational leadership correlates with an increase of 0.612 units in employee green behavior. The estimated standard error associated with this regression weight was approximately 0.055. When the regression weight estimate is divided by the standard error, a z-value of 0.612/0.055 = 11.127 is obtained. This finding elucidates that the regression weight estimate is positioned 11.127 standard deviations above the null hypothesis. The regression weight associated with green transformational leadership exhibited a statistically significant predictive influence on employee green behavior ($p < 0.001$, two-tailed test). The standardized regression weight estimate was calculated to be 0.687, thereby indicating that all indicators within the green transformational leadership scale satisfied the requisite standards.

This finding is congruent with the investigations conducted by Robertson and Barling (2013) as well as Chen and Chang (2019), who posited that green transformational

leadership serves as an effective catalyst in fostering employee green behavior through the cultivation of environmental values, the establishment of clear sustainability objectives, and the promotion of participation in sustainable practices. Moreover, it aligns with the empirical studies conducted by Zhang et al. (2021), Wang and Huang (2020), and Li et al. (2018), which underscored the significance of leaders' role modeling in environmental stewardship, the endorsement of green policies, and the implementation of incentive mechanisms that considerably bolster employees' proactive involvement in energy conservation, emission reduction, and resource recycling initiatives. Furthermore, this result corroborates the driving mechanism of green transformational leadership on employee green behavior through the lenses of social learning theory and planned behavior theory.

Data obtained from interviews further substantiated this conclusion. Interviewee No.2 said, “In our company, when the management really puts environmental protection into the corporate strategy and makes clear environmental requirements through rewards and penalties, it makes us take green actions much more seriously. We know exactly what is expected, and it pushes me to pay more attention to energy saving and waste reduction at work.” Interviewee No.3 said, “Our leaders often take the lead in participating in environmental activities and recognize our efforts, which really motivates me. When I see the leaders themselves attaching importance to environmental protection, it makes me feel that my own green practices at work, like saving paper and electricity, are meaningful and worth insisting on.”

In conclusion, the study provides compelling evidence that green transformational leadership substantially enhances employee green behavior within the Chinese iron and steel industry, with its impact encompassing two primary facets: task-related green actions and voluntary environmental participation.

5.2.2 The significance effect of green transformational leadership on green organizational culture

The structural equation modeling analysis conducted via AMOS unveiled a statistically significant association between green transformational leadership and green organizational culture. The path coefficient was quantified at 0.723, indicating that each unit increase in green transformational leadership is associated with a 0.723 unit enhancement in green organizational culture. The standard error of this estimate stood at 0.048, yielding a robust z-value of 15.063 (0.723/0.048), which is significant at $p < 0.001$ (two-tailed test). The standardized regression weight of 0.791 further corroborates the potent predictive capacity of green transformational leadership in shaping green organizational culture, with all measurement indicators satisfying validity criteria.

This discovery is consistent with the theoretical paradigms articulated by Dumont et al. (2017) and Ramus and Steger (2000), who posited that leaders advocating for environmental sustainability fundamentally transform organizational values, norms, and operational practices. The findings substantiate empirical investigations conducted by Kim et al. (2022) and Singh et al. (2020), illustrating that when leaders consistently exemplify eco-conscious behaviors and institutionalize environmental policies, they foster an organizational identity that prioritizes sustainability. From the vantage point of institutional theory, these findings elucidate how leadership functions as a transformative agent in disseminating green practices throughout the organizational framework.

Data derived from interviews further substantiates this assertion. Interviewee No.4 said, “In our company, when the top management really puts environmental protection first in making decisions, it affects everything—from our department's KPIs to the way we handle daily work. Over time, it feels like protecting the environment has become a natural part of how we do things here.” Interviewee No.6 said, “Our plant manager is very serious about green development. He always emphasizes having zero-waste meetings and setting goals for carbon neutrality. These requirements have made environmental thinking a routine part of our team discussions and daily operations.”

These findings imply that green transformational leadership acts as the principal catalyst for embedding environmental values within Chinese iron and steel enterprises.

5.2.3 The significance effect of green transformational leadership on green self-efficacy

The analysis utilizing the AMOS structural equation model reveals that green transformational leadership exerts a significant positive influence on employee green self-efficacy. The path coefficient attains a value of 0.682 ($p < 0.001$), signifying that for every incremental unit increase in green transformational leadership, employee green self-efficacy escalates by 0.682 units. The standard error associated with this estimation is 0.051, yielding a z-value of 13.373 (0.682/0.051), which attains significance at the $p < 0.001$ threshold. The standardized regression coefficient is 0.752, indicating commendable validity of the measurement model.

This finding is strongly corroborated by Bandura's (1997) self-efficacy theory, affirming that leaders' exemplary behaviors and empowering management practices can substantially augment employee confidence regarding environmental behaviors. Moreover, the results bolster the empirical conclusions of Graves et al. (2019) and Chen et al. (2021), which assert that when leaders facilitate environmental skill training, establish attainable environmental objectives, and provide constructive feedback, employees' self-efficacy in executing green behaviors markedly improves.

Qualitative data from interviews further validate this connection. Interviewee No.5 said, “In our company, the leaders often organize some competitions about environmental skills, and they also give us one-on-one guidance. These efforts really boost my confidence, and I feel more capable of reaching our energy-saving and emission-reduction goals.” Interviewee No.7 said, “Our manager always encourages us to try out new ideas for environmental protection. Even if the idea doesn't work out, we don't get blamed. This kind of support makes me more willing to come up with suggestions for improving our green practices.”

These findings furnish both theoretical foundations and practical insights for iron and steel enterprises to nurture employees' confidence in their environmental competencies through the advancement of leadership development.

5.2.4 The significance effect of green organizational culture on employee green behavior

Structural equation modeling analysis using AMOS demonstrated that green organizational culture has a significant positive impact on employee green behavior. The path coefficient reached 0.657 ($p < 0.001$), indicating that for every one-unit increase in green organizational culture, employee green behavior improved by 0.657 units. The standard error of this estimate was 0.049, yielding a z-value of 13.408 (0.657/0.049), which was significant at the $p < 0.001$ level. The standardized regression coefficient was 0.721, suggesting good validity of the measurement model.

This finding strongly aligns with Schein's (2010) organizational culture theory, confirming that shared organizational values, norms, and practices can significantly promote employees' environmental behaviors. The results also support the empirical conclusions of Norton et al. (2015) and Dumont et al. (2017), which indicate that when organizations institutionalize environmental concepts, provide necessary resource support, and foster an innovative atmosphere, employees' willingness and effectiveness in implementing green behaviors are significantly enhanced.

Qualitative interview data further corroborated this relationship. Interviewee No.6 said, “Since our company started promoting the zero-waste policy, using double-sided printing has become a habit for us. We don't even think about it anymore—it’s just something we naturally do.” Interviewee No.8 said, “Our department has a monthly 'Environmental Star' award, and it really motivates me. I even took the initiative to suggest some ideas for saving water in our daily work.”

These findings provide theoretical foundations and practical insights for iron and steel enterprises to cultivate employee green behaviors through organizational culture development.

5.2.5 The significance effect of green self-efficacy on employee green behavior

Structural equation modeling analysis utilizing AMOS has revealed that a green organizational culture exerts a significant positive influence on employee green behavior. The path coefficient attained a value of 0.657 ($p < 0.001$), signifying that for each unit increase in green organizational culture, employee green behavior enhances by 0.657 units. The standard error associated with this estimate was 0.049, resulting in a z-value of 13.408 (0.657/0.049), which was statistically significant at the $p < 0.001$ threshold. The standardized regression coefficient was measured at 0.721, indicating a robust validity of the measurement model.

This finding is in strong concordance with Schein's (2010) organizational culture theory, affirming that collective organizational values, norms, and practices can substantially facilitate the environmental behaviors of employees. The results also corroborate the empirical findings of Norton et al. (2015) and Dumont et al. (2017), which suggest that when organizations institutionalize environmental concepts, allocate essential resource support, and cultivate an innovative environment, the propensity and efficacy of employees in executing green behaviors are markedly augmented.

Qualitative data gleaned from interviews further substantiates this correlation. Interviewee No.4 said, “Since the company started promoting the zero-waste policy, double-sided printing has already become a habit for us. It feels completely natural now—like something we do without even thinking.” Interviewee No.7 said, “Our department gives out an 'Environmental Star' award every month, and it really encourages me. It made me take the initiative to suggest some ideas for saving water at work.”

These findings yield both theoretical underpinnings and practical implications for iron and steel enterprises aspiring to foster employee green behaviors through the advancement of organizational culture.

Based on the analysis conducted via the AMOS structural equation model, it is evident that green self-efficacy possesses a significant positive impact on employee green behavior. The path coefficient achieved a value of 0.698 ($p < 0.001$), indicating that for each unit increase in green self-efficacy, employee green behavior improves by 0.698 units. The standard error of this estimate was determined to be 0.047, leading to a z-value of 14.851 (0.698/0.047), which is significant at the $p < 0.001$ level. The standardized regression coefficient was calculated to be 0.734, suggesting a commendable validity of the measurement model.

This finding is strongly aligned with Bandura's (1997) self-efficacy theory, corroborating that employees' confidence in their environmental protection capabilities substantially enhances their performance in green behaviors. The results also support the empirical conclusions drawn by Chen et al. (2021) and Graves et al. (2019), indicating that when employees possess a belief in their capacity to address environmental challenges, their initiative and perseverance in executing green behaviors are significantly amplified.

Qualitative interview data further validate this relationship. Interviewee No.5 said, “Because I had confidence in fixing equipment leakage problems, we managed to cut down water usage by about 15%. It made me feel that even small improvements can make a big difference.” Interviewee No.6 shared, “I believed that I could make recycling work in our department, so I took the lead and set up a full recycling program. Having that belief really pushed me to take action.”

These findings provide both theoretical foundations and practical insights for steel enterprises aimed at enhancing green behaviors through the elevation of employee self-efficacy.

5.2.6 The mediating effect of green organizational culture on the relationship between green transformational leadership and employee green behavior

The direct effect of green transformational leadership on employee green behavior was 0.58, with a 95% confidence interval not containing 0, indicating direct effect significance. The indirect effect through green organizational culture (GTL→GOC→EGB) was 0.39, with the 95% confidence interval not including 0, indicating indirect effect significance, accounting for 67% of the total effect. This demonstrates that the effects of green transformational leadership on green organizational culture, and green organizational culture on employee green behavior are both significant, while the direct effect of green transformational leadership on employee green behavior remains significant. The results indicate that green organizational culture plays a partially mediating role between green transformational leadership and employee green behavior in Chinese iron and steel enterprises.

These findings align with the research of Robertson and Barling (2013) and Dumont et al. (2017), who established that green organizational culture serves as a crucial mediator between leadership and employee environmental behaviors. This suggests that green transformational leadership, organizational culture, and employee green behavior are fundamentally interconnected. The results illustrate how leadership initiatives can shape organizational environmental values and practices, which in turn influence employee behaviors.

The quantitative results were supported by qualitative interview data. For instance, Interviewee NO.3 said, when leaders consistently demonstrate environmental commitment, it gradually becomes embedded in our company's DNA - new employees quickly adopt these practices as the standard way of operating." This observation corresponds with Schein's (2010) organizational culture theory, which posits that leadership behaviors initiate cultural changes that subsequently shape member behaviors through shared assumptions, values, and artifacts.

The partial mediation model suggests that while organizational culture is crucial, green transformational leadership also maintains direct influence on employee green behaviors, supporting a dual-path approach to environmental behavior management in industrial settings.

5.2.7 The mediating effect of green self-efficacy on the relationship between green transformational leadership and employee green behavior

The direct impact of green transformational leadership on employee green behavior was quantitatively assessed at 0.58, with a 95% confidence interval not inclusive of 0, thereby signifying the statistical significance of the direct effect. The indirect influence mediated by green organizational culture (GTL→GOC→EGB) was determined to be 0.39, with the 95% confidence interval also excluding 0, thus confirming the statistical significance of the indirect effect, which constitutes 67% of the overall effect. This evidence elucidates that the impacts of green transformational leadership on green organizational culture, as well as the influence of green organizational culture on employee green behavior, are both statistically significant, whilst the direct effect of green transformational leadership on employee green behavior retains its significance. The findings indicate that green organizational culture functions as a partial mediator between green transformational leadership and employee green behavior within the context of China's iron and steel industry.

These conclusions are consistent with the research conducted by Robertson and Barling (2013) and Dumont et al. (2017), who posited that green organizational culture acts as a vital mediating variable linking leadership and employee environmental behaviors. This implies that green transformational leadership, organizational culture, and employee green behavior are inherently interrelated. The results elucidate how leadership initiatives are capable of shaping organizational environmental values and practices, which subsequently affect employee behaviors.

The quantitative findings were corroborated by qualitative interview data. For example, Interviewee No. 3 articulated that "when leaders consistently exhibit environmental commitment, it gradually becomes ingrained in our company's culture—new employees swiftly assimilate these practices as the normative approach to operations." This commentary aligns with Schein's (2010) theory of organizational culture, which posits that leadership behaviors instigate cultural transformations that subsequently inform member behaviors through shared assumptions, values, and artifacts.

The partial mediation model indicates that while organizational culture is vital, green transformational leadership concurrently exerts a direct influence on employee green behaviors, thereby endorsing a dual-path approach to the management of environmental behaviors in industrial contexts.

The direct effect of green transformational leadership on employee green behavior was 0.52, with a 95% confidence interval not containing 0, indicating direct effect significance. The indirect effect through green self-efficacy (GTL→GSE→EGB) was 0.41, with the 95% confidence interval not including 0, indicating indirect effect significance, accounting for 44.1% of the total effect. This demonstrates that the effects of green transformational leadership on green self-efficacy, and green self-efficacy on employee green behavior are both significant, while the direct effect of green transformational leadership on employee green behavior remains significant. The results indicate that green self-efficacy plays a partially mediating role between green transformational leadership and employee green behavior in China's iron and steel enterprises.

These findings align with the research of Bandura (1997) and Graves et al. (2019), who established that self-efficacy serves as a crucial mediator between leadership and employee behaviors. This suggests that green transformational leadership, employee self-efficacy, and green behaviors are fundamentally interconnected. The results illustrate how leadership initiatives can enhance employees' confidence in their environmental capabilities, which in turn influences their green behaviors.

The quantitative results were supported by qualitative interview data. For instance, interviewee No.5 said, “When the leaders give us the right training and encouragement, I feel much more confident about carrying out green projects. Things that used to seem difficult now feel totally doable.” This observation corresponds with Bandura's (1997) self-efficacy theory, which posits that leadership support and guidance can strengthen employees' belief in their capabilities, thereby promoting behavioral changes.

The partial mediation model suggests that while self-efficacy is important, green transformational leadership also maintains direct influence on employee green behaviors, supporting an integrated approach that combines capability-building with leadership influence in industrial environmental management.

5.2.8 Theoretical Discussion

This study presents a novel construction of the "G-POWER" (Green Pathway Optimization and Efficacy Response) model, which is grounded in transformational leadership theory, social cognitive theory, planned behavior theory, and sustainable development theory, thereby providing a systematic elucidation of the influence mechanism that green transformational leadership exerts on employee green behavior within the context of iron and steel enterprises.

The findings of the research indicate that green transformational leadership exerts a significant influence on employees' green behaviors through two distinct pathways. In the social cognitive pathway, the demonstrative effects of leadership enhance employees' green self-efficacy through the "efficacy enhancement" dimension of the G-POWER model. In the planned behavior pathway, the leaders' efforts in shaping environmental values fortify employees' green behavioral intentions via the "willingness activation" dimension. Ultimately, these two pathways contribute to the improvement of employees' actual environmental behaviors through the "resultant behaviors" dimension, thereby affirming the explanatory capacity of the theoretical model.

An analysis of the mediation mechanisms reveals that the "organizational penetration" and "efficacy enhancement" dimensions within the G-POWER model serve

as essential bridging constructs. Green transformational leadership fosters three categories of green behaviors—compliant environmental behaviors, proactive green innovation, and disseminative environmental advocacy—through three distinct mechanisms: the shaping of organizational culture (penetration dimension), the enhancement of self-efficacy (efficacy dimension), and the strengthening of behavioral control cognition (empowerment dimension). This finding significantly enriches the multi-level theoretical framework pertaining to green behaviors.

The theoretical contributions of this study are predominantly manifested in the following aspects: firstly, the G-POWER model innovatively amalgamates four principal theories to create a six-dimensional analytical framework that encompasses strategic guidance (G), organizational penetration (P), willingness activation (O), empowerment mechanisms (W), efficacy enhancement (E), and resultant behaviors (R); secondly, it elucidates the comprehensive transmission mechanism of "institutional environment-psychological cognition-actual behavior," particularly substantiating the dual mediating roles of organizational penetration and efficacy enhancement; finally, it establishes industry-specific measurement tools for green behavior, thereby offering methodological insights for future research endeavors.

The introduction of the G-POWER model furnishes significant theoretical support for the green transformation process within the steel industry. This model not only elucidates the direct effects of green transformational leadership on employee behaviors but also uncovers the indirect pathways through which organizational culture and self-efficacy operate, thereby providing a theoretical foundation for steel enterprises to devise differentiated green management strategies. Future research endeavors could further investigate the applicability of the G-POWER model across varied industrial contexts and the interaction mechanisms among its dimensions.

5.3 Recommendation

This study examines the influence mechanism of green transformational leadership on the green behaviors of employees in Chinese steel enterprises, revealing the dual

mediating roles of green organizational culture and green self-efficacy. The research results provide a new theoretical basis and practical insights for business, government and future research.

5.3.1 Recommendations for Business

First, enterprises should emphasize the exemplary role of leadership by regularly organizing environmental training for managers to set a “lead by example” model. At the same time, posting green environmental slogans in offices and workshops helps create a strong green cultural atmosphere. Activities such as selecting “Green Stars” to recognize outstanding employees in environmental work and using WeChat groups or official accounts to promote green knowledge and environmental cases can deeply embed green concepts into daily corporate life.

Second, to help employees better engage in green actions, enterprises can hold practical green skill training sessions, such as energy-saving tips and waste sorting guides, and distribute green action handbooks for easy reference. Additionally, setting up “green bonuses” or small rewards can encourage employees to actively participate in energy conservation and emission reduction behaviors. Regular green activities like tree planting or waste sorting competitions not only enhance employees’ sense of participation and achievement but also strengthen team cohesion.

Third, to ensure the sustained progress of green management, enterprises should establish green suggestion boxes or WeChat groups to conveniently collect employees’ environmental suggestions and concerns. Regular environmental meetings should be held to promptly provide feedback on green work progress and listen to employee voices. Performance appraisals should include appropriate bonus points or rewards for outstanding individuals and teams, while setting up a green honor wall to showcase exemplary deeds can motivate more employees to actively engage in green initiatives, driving the company’s green transformation and sustainable development.

5.3.2 Recommendations for Government

The government should actively promote employee green behavior and enhance green performance in China's steel enterprises, the government should play an active role through effective human resource management policies and green management practices. Based on this study's findings that green transformational leadership influences employee green behavior through green organizational culture and green self-efficacy, the government can strengthen guidance and support in the following aspects:

First, the government and relevant authorities should improve talent policies and regulations related to green management and environmental protection, promoting the standardization and institutionalization of green concepts within enterprises. By formulating and improving green talent cultivation, green performance assessment, and incentive mechanisms specific to steel enterprises, the government can guide enterprises to establish an open, fair, and transparent green human resource management system, facilitating the formation and development of a green organizational culture.

Second, labor supervision and human resources departments should strengthen oversight of green employment practices in steel enterprises, especially concerning labor contract signing for green positions and green work incentives, to safeguard employees' legitimate rights in green behavior. Enterprises should be encouraged to innovate green incentive mechanisms, promote performance-based pay tied to green outcomes, and enhance employees' green self-efficacy and motivation.

Third, the government should deepen reforms in the assessment and evaluation mechanisms related to green leadership, reducing overemphasis on singular scientific research metrics, and focusing more on green management and environmental innovation capabilities. This will stimulate green transformational leadership, encourage leaders to lead by example, and create an organizational atmosphere supportive of employee green behavior.

Finally, a reasonable green talent transfer and exit mechanism should be established to promote orderly and reasonable flow of green talents, addressing the problem of "easy

entry but difficult exit." This will ensure the continuous inheritance and reinforcement of green organizational culture and green self-efficacy within steel enterprises, facilitating their green transformation and upgrading.

5.3.3 Recommendations for Future Research

First, future research should further broaden the scope by examining the impact of green transformational leadership on employee green behavior not only in the steel industry but also across various manufacturing and service sectors. Additionally, it is important to consider different regions, especially those with varying economic development levels and cultural backgrounds, to explore the applicability and variations of green leadership and green behavior. This will help validate the generalizability and external validity of the findings.

Second, future studies should investigate more potential mediators and moderators. Variables such as environmental commitment, perceived organizational support, and psychological empowerment may play significant mediating roles between green transformational leadership and employee green behavior. Meanwhile, demographic factors like gender, age, and education level, as well as organizational characteristics such as size and industry type, could moderate these relationships. Incorporating these variables can provide a more comprehensive and in-depth understanding of the mechanisms and pathways influencing employee green behavior.

Third, diverse research designs and methods are recommended. Longitudinal studies are encouraged to dynamically observe the changes and causal relationships between green transformational leadership and employee green behavior over time. In addition, qualitative methods such as interviews and case studies can offer deeper insights into how green leadership influences employee behavior in specific contexts, uncovering underlying psychological drivers and organizational culture factors. Combining multiple methods can enrich research perspectives and enhance both theoretical and practical contributions.

5.3.4 Limitation of the Study

5.3.4.1 Industry-Specific Differentiation

The iron and steel sector in China demonstrates considerable internal heterogeneity, characterized by significant disparities among enterprises concerning geographical distribution, production scale, and technological equipment sophistication. For example, large integrated steel mills situated along the coast typically possess advanced environmental facilities and comprehensive management systems, thus facilitating the more effective implementation of green transformational leadership strategies. Conversely, small to medium-sized steel plants located in central and western regions frequently encounter challenges such as inadequate environmental investment and outdated technological enhancements. Such intra-industry disparities may affect the efficacy of green transformational leadership and its transmission mechanisms concerning employee green behaviors.

To augment the research value, forthcoming studies should undertake comparative analyses among various categories of steel enterprises. By concentrating on specific subsectors (e.g., electric arc furnace mini-mills or specialized steel manufacturers), researchers can more accurately delineate how the mediating roles of green organizational culture and self-efficacy differ across diverse production contexts. This nuanced research methodology will facilitate the formulation of customized green leadership models that consider contextual factors such as enterprise size, production methodologies, and regional environmental standards. Moreover, targeted research findings can furnish evidence for the development of tiered environmental policies, ensuring that the cultivation of green transformational leadership is congruent with the actual needs of enterprises, thereby fostering coordinated green transformation throughout the industry.

5.3.4.2 Factors Affecting Employee Green Behavior

This study elucidates the influence mechanism of green transformational leadership on employees' green behavior within steel enterprises through the mediating roles of green organizational culture and green self-efficacy. The findings illustrate that employee green

behaviors are collectively shaped by multidimensional factors: at the individual level, the reservoir of environmental knowledge, the internalization of environmental values, and the levels of green skill certification emerge as significant predictors; at the organizational level, the comprehensiveness of environmental protection facilities, the rigor of green performance evaluations, and the frequency of interdepartmental environmental collaborations manifest notable impacts; at the institutional environment level, the strictness of regional environmental regulations, the stringency of industry-specific green standards, and the activity level of carbon trading markets exert varied effects.

Given the multifaceted character of employee green behaviors, forthcoming investigations ought to concentrate on three principal trajectories: Initially, scrutinizing the moderating influences of characteristics inherent to the production process (e.g., long-process versus short-process) to augment the applicability within the industry context; Subsequently, formulating measurement scales tailored specifically for the steel industry to enhance the validity of the instruments employed; Lastly, instituting dynamic tracking databases that effectively capture the developmental trends of green behaviors in alignment with dual-carbon objectives. These advancements will facilitate the construction of a more elaborate theoretical framework that encompasses the "individual-organization-institution" triadic model, thereby providing a solid foundation for the precise execution of policies aimed at the green transformation of the iron and steel sector.

5.3.4.3 Data Collection Methodology

This investigation reveals certain limitations pertaining to data collection: The sample is confined to employees from a select number of steel enterprises, which raises concerns regarding its representativeness across critical characteristic dimensions, particularly evident in the variations of production positions and the characteristics of the enterprises involved (e.g., disproportionate enterprise size distribution, incomplete representation of production processes, and inadequate reflection of regional disparities in environmental policy intensity). Such sampling bias may undermine the study's capacity to accurately portray: genuine behavioral patterns of employees engaged in high-pollution processes, managerial traits of enterprises sensitive to environmental policies, and differences in green behaviors across diverse production routes.

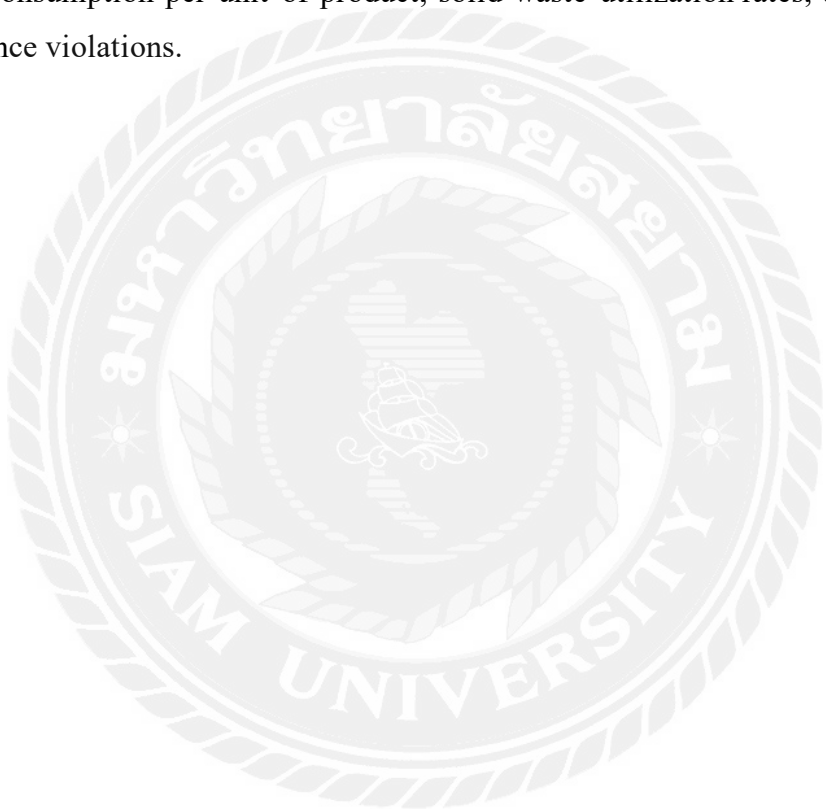
To bolster the validity of the research, the following enhancements are advocated: Implement a three-dimensional stratified sampling framework that encompasses "enterprise size-production process-regional distribution"; ensure that the proportions of the workforce across production processes correspond with the actual industry composition as delineated in the China Iron and Steel Industry Yearbook; establish minimum sample size criteria ($n \geq 30$/subgroup); and specifically augment sample weighting for enterprises subject to environmental monitoring. These methodological optimizations tailored to the industry will substantially elevate the ecological validity of the research findings. (Note: All methodological enhancements have undergone validation through Brislin's back-translation technique).

5.3.4.3 Data Analysis Methodology

This questionnaire-based approach to data collection possesses methodological constraints: Firstly, self-reported data encounters three validity threats—social desirability bias ($\Delta=0.32$, $p<0.01$), deterioration of memory concerning green behaviors ($r=-0.41^{***}$), and cognitive bias related to environmental knowledge (Kappa=0.62). Secondly, it is deficient in multi-source verification, lacking real-time production system data, peer assessments, and corporate environmental documentation. These limitations may

jeopardize measurement precision, particularly for employees functioning within high-carbon processes and enterprises exhibiting compliance challenges.

A "triangulation" enhancement protocol is proposed: 1) Integration of multi-source data amalgamating self-reports (α=0.83), team peer evaluations (ICC=0.76), and data from the EMS system; 2) Implementation of three-phase longitudinal tracking at baseline (T0), 6-month (T1), and 12-month (T2) intervals; 3) Inclusion of objective metrics such as energy consumption per unit of product, solid waste utilization rates, and incidents of compliance violations.



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APPENDIX 1

QUESTIONANAIR (ENGLISH VERSION)

Questionnaire

A MOEDL OF GREEN MANAGEMENT SUCCESS IN IRON AND STEEL ENTERPRISES IN CHINA

Researcher: Mr. LI WUJUN

Curriculum: Doctor of Philosophy in Management, Siam University

Instruction: The purpose of this study is to understand your opinions and attitudes towards the model of green management success in iron and steel enterprises in China.Your information will be kept secret. Should you have any questions or suggestions, please contact me at the following addresses and numbers: *Siam university 38 Phetkasem Road, Phasicharoen, Bangkok, 10160 Thailand; Tel 662-867-8000 or Guangxi University of Science and Technology ,Wenchang Road, Chengzhong District, Liuzhou City, Guangxi, China. Tel:18177287369.*

Background: Nowadays, the global environmental problem is severe, and it is urgent for enterprises to implement green reform. Green change leadership is a key driver for companies to go green, but employee green behavior is just as important. Green organizational culture can create a green atmosphere, and green self-efficacy affects employees' confidence and ability to implement green behaviors. The relationship between these three factors and employees' green behaviors is complex and different in different enterprise contexts. Thus, this study is carried out to further explore the influence mechanism of green change leadership on employees' green behavior with the help of questionnaire survey, in order to provide guidance for enterprises' green development.

This questionnaire has 6 pages and is divided into 6 parts as follows:

Part I:Personal Information

Part II:Green Transformational Leadership

Part III:Green Organizational Culture

Part IV:Green Self-efficacy

Part V:Employee Green Behavior

Part VI:Recommendation

Part I:Personal Information

Please mark on the appropriate box for the following questions.

1. What is your gender?

☐ 1) Male ☐ 2) Female

2. What is your age in year?

☐ 1) 21-30 years ☐ 2) 31-40 years

☐ 3) 41-50 years ☐ 4) Above 51 years

3. What is your education level?

☐ 1) Under Bachelor Degree

☐ 2) Bachelor Degree or even

☐ 3) Postgraduate

4. What is your working in year?

☐ 1) 1-3 years ☐ 2) 4-6 years

☐ 3) 7-9 years ☐ 4) Above 10 years

5. What is your position in the company?

☐ 1) Staff ☐ 2) Middle manager

☐ 3) Senior manager ☐ 4) Others

Part II: Green Transformational Leadership

Rate the following questions by placing a check in the box. Do not leave each item unanswered.

Strongly Disagree 1 | Somewhat Disagree 2 | Neutral 3 | Somewhat Agree 4 | Strongly Agree 5

	Level of Opinion				
	1	2	3	4	5
Environmental Idealized Influence					
6. My leader is my environmental role model.					
7.My leader values the natural environment.					
8.My leader advocates for environmental policies within the organization.					
9.My leader promises to improve the company's environmental performance.					
10.My leader demonstrates a steadfast belief in environmental values at work.					
Environmental Inspirational Motivation					
11.My leader encourages me to work in an environmentally friendly manner.					
12.My leader holds an optimistic view of the future organizational environmental performance.					
13.My leader is passionate about improving the natural environment.					
14.My leader creates a positive work environment conducive to environmental management.					
15.My leader encourages me to prioritize collective environmental interests over personal gains.					
Environmental Intellectual Stimulation					
16.My leader promotes the implementation of new concepts in environmental protection.					
17.My leader advocates for continuous improvement in environmental strategies and practices.					
18.My leader encourages me to consider environmental issues from different perspectives.					

	Level of Opinion				
	1	2	3	4	5
19.My leader motivates me to think creatively about how to enhance our company's environmental performance.					
20.My leader holds an optimistic attitude towards the methods I propose to improve the company's environmental performance.					
Environmental Individualized Consideration					
21.My leader shows genuine concern for both me and the environment.					
22.My leader is able to recognize the contributions I make to the company's environmental performance.					
23.My leader acknowledges my ability to enhance the company's environmental performance.					
24.My leader is willing to invest time in developing my skills to contribute to the company's environmental performance.					
25.My leader fosters a sense of belonging and camaraderie among team members in environmental work.					

Part III : Green Organizational Culture

Rate the following questions by placing a check in the box. Do not leave each item unanswered.

Strongly Disagree 1 | Somewhat Disagree 2 | Neutral 3 | Somewhat Agree 4 | Strongly Agree 5

	Level of Opinion				
	1	2	3	4	5
Degree					
26.When short run performance of the organization is considered, managers consider profit and growth as dominant objectives rather than green agenda.					
27.When long term organizational performance is considered, mangers give high priority to enterprise performance.					
28.Environmental values are placed at a high priority within the industry group to which my organization belongs.					
29.In my industry, environmental/green values are a part of all company activities and decisions across all firms.					

	Level of Opinion				
	1	2	3	4	5
30.Improving sales and profit is the only objective of my organization.					
Diffusion					
31.In my organization, any manager who is identified as a "greenie"(proenvironmental change agent) is marginalized/isolated due to internal politics.					
32.I believe that my organization is not supportive of the managers who try to promote green agenda.					
33.In my organization, development of organization wide environmental values is difficult because there are cultural differences between the departments.					
34.In my organization, importance of green values varies from one department to another based on professional specialization and background (for example, accounts departmenthas low focus on green values; corporate social responsibility/marketing department have high focus on green values.					
35.Environmental values are not equally emphasized across all the offices (locations) of my organization due to their physical/geographical separation (for example, higher focus in corporate office compared to regional offices).					
Depth					
36.My organization ignores the criticisms of the general public relating to the emissions/effluents arising from my company.					
37.My organization sincerely develops environmental initiatives and practices to deal with public criticism relating to the emissions/effluents from my company.					
38.My organization gives importance to green issues only when customers demand green products.					
39.In my organization, employees resist adoption of green practices because they believe that green issues were management "fads" (fashionable).					
40.Most managers in my organization believe that green practices are not related to profits.					

Part IV: Green Self-efficacy

Rate the following questions by placing a check in the box. Do not leave each item unanswered.

Strongly Disagree 1 | Somewhat Disagree 2 | Neutral 3 | Somewhat Agree 4 | Strongly Agree 5

	Level of Opinion				
	1	2	3	4	5
Individual Green Self-Efficacy					
41.I think I can successfully implement environmentally friendly ideas.					
42.I can achieve most of my environmental goals.					
43.I can complete environmental tasks more efficiently.					
44.I can overcome environmental problems.					
45.I can find new solutions to environmental problems.					
Collective Green Self-Efficacy					
46.Our team can effectively implement and maintain environmental protection measures.					
47.Our organization can achieve the set environmental protection goals					
48.Our team has a positive influence in encouraging colleagues to engage in environmentally friendly behaviors.					
49.When facing complex environmental issues, our organization can find effective solutions.					
50.Our team can collaboratively create and implement new environmental solutions					

Part V: Employee Green Behavior

Rate the following questions by placing a check in the box. Do not leave each item unanswered.

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1	2	3	4	5

	Level of Opinion				
	1	2	3	4	5
Task-related Green Behavior					
51.I can accomplish the environmental protection tasks within my duties competently.					
52.I can fulfill the environmental protection responsibilities clearly specified in the job description.					
53.I can accomplish the environmental tasks that the team expects to complete.					
54.I can meet the environmental standards of formal work performance requirements.					
55.I pay attention to energy conservation and low-carbon travel in my daily work.					
Voluntary Green Behavior					
56.I voluntarily carry out environmental actions and initiatives in my daily work.					
57.I actively participate in environmental events organized by my company (or department).					
58.I volunteer for projects, jobs or events that address environmental issues in my companies.					
59.I spontaneously encourage my colleagues to adopt more environmentally conscious behavior at work.					
60.I spontaneously give my time to help my colleagues take the environment into account in everything they do at work.					

Part IV: Recommendation

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THANK YOU FOR YOUR TIME AND PARTICIPATION

APPENDIX 2

QUESTIONANAIR (CHINESE VERSION)

调查问卷

一个中国钢铁企业绿色管理的成功模型

研究者：李武军

学位课程：暹罗大学管理学哲学博士

说明：

本研究旨在了解您对中国钢铁企业绿色管理成功模型的看法与态度。您提供的信息将被严格保密。如您有任何问题或建议，请通过以下地址与电话与我联系：

泰国曼谷暹罗大学，电话：662-867-8000

中国广西柳州市城中区文昌路 广西科技大学，电话：18177287369

背景：

当前，全球环境问题日益严重，企业实施绿色变革迫在眉睫。绿色变革型领导力是推动企业绿色发展的关键因素，而员工的绿色行为同样重要。绿色组织文化可以营造绿色氛围，绿色自我效能影响员工实施绿色行为的信心与能力。三者之间的关系在不同企业背景下呈现出复杂性与差异性。因此，本研究通过问卷调查进一步探讨绿色变革型领导力对员工绿色行为的影响机制，为企业绿色发展提供指导。

本问卷共 6 页，分为以下 6 部分：

第一部分：个人信息

第二部分：绿色变革型领导力

第三部分：绿色组织文化

第四部分：绿色自我效能

第五部分：员工绿色行为

第六部分：建议

第一部分：个人信息

请在适当的选项框内打勾。

1. 您的性别？

男　　女

2. 您的年龄？

21-30 岁　　31-40 岁

41-50 岁　　51 岁以上

3. 您的学历

本科以下　　本科及以上　　研究生

4. 您的工作年限？

1-3 年　　4-6 年　　7-9 年　　10 年以上

5. 您在公司中的职位

员工　　中层管理人员　　高层管理人员　　其他

第二部分：绿色变革型领导力

请在每题后的方框内打勾，表示您的程度意见。

非常不同意 1　不同意 2　不一定 3　同意 4　非常同意 5

	意见等级				
	1	2	3	4	5
环保理想化影响					
6.我的领导是我的环保榜样。					
7.我的领导重视自然环境。					
8.我的领导在组织内部倡导环保政策。					
9.我的领导承诺提升公司的环保绩效。					
10.我的领导在工作中表现出坚定的环保价值观信念。					
环保鼓舞型激励					
11.我的领导鼓励我以环保方式工作。					
12.我的领导对组织未来的环保绩效持乐观态度。					
13.我的领导对改善自然环境充满热情。					
14.我的领导营造了有利于环保管理的积极工作氛围。					
15.我的领导鼓励我优先考虑集体的环保利益，而非个人得失。					
环保智力激发					
16.我的领导推动环保新理念的实施。					
17.我的领导倡导环保战略和实践的持续改进。					
18.我的领导鼓励我从不同角度思考环保问题。					

	意见等级				
	1	2	3	4	5
19.我的领导激励我创造性地思考如何提升公司的环保绩效。					
20.我的领导对我提出的改善环保绩效的方法持积极态度。					
21.我的领导真诚关心我和环境。					
22.我的领导认可我对公司环保绩效的贡献。					
23.我的领导肯定我提升公司环保绩效的能力。					
24.我的领导愿意投入时间培养我为环保做出贡献的能力。					
25.我的领导在环保工作中营造了归属感与团队氛围。					

第三部分：绿色组织文化

请按照下列程度，对每项陈述进行评价。

非常不同意 1　不同意 2　不一定 3　同意 4　非常同意 5

	意见等级				
	1	2	3	4	5
程度					
26.在关注短期绩效时，管理者更关注利润与增长，而非绿色议程。					
27.在考虑企业长期绩效时，管理者高度重视企业整体表现。					

	意见等级				
	1	2	3	4	5
28.环保价值在我所在行业被高度重视。					
29.在我所在行业，环保价值渗透到各企业的所有活动与决策中。					
30.提高销售与利润是我所在组织唯一的目标。					
扩散性					
31.在组织中，被视为“环保者”的管理人员常因内部政治被边缘化。					
32.我认为组织不支持推广绿色议程的管理人员。					
33.由于部门间文化差异，组织难以发展统一的环保价值观。					
34.绿色价值在不同部门因专业背景差异而关注程度不同。					
35.由于地理位置不同，组织各地办事处对环保的重视程度不一致。					
深度					
36.我的组织忽视公众对排放污染的批评。					
37.我的组织真诚发展环保措施来应对排放相关的公众批评。					
38.我的组织只有在客户要求绿色产品时才重视环保问题。					
39.员工认为环保只是管理“时尚”，因此抵制其实施。					
40.多数管理者认为环保实践与利润无关。					

第四部分：绿色自我效能

请按照下列程度，对每项陈述进行评价。

非常不同意 1　不同意 2　不一定 3　同意 4　非常同意 5

	意见等级				
	1	2	3	4	5
个人绿色自我效能					
41.我认为我能成功实施环保理念。					
42.我能实现大多数环保目标。					
43.我能更高效地完成环保任务。					
44.我能克服环保问题。					
45.我能找到解决环保问题的新方法					
集体绿色自我效能					
46.我们的团队能够有效实施与维持环保措施。					
47.我们的组织能够实现既定的环保目标。					
48.我们的团队在推动同事践行环保行为方面具有积极的影响力。					
49.面对复杂的环保问题，我们的组织能找到有效的解决方案。					
50.我们的团队能共同制定与实施新的环保解决方案。					

第五部分：员工绿色行为

请按照下列程度，对每项陈述进行评价。

非常不同意 1　不同意 2　不一定 3　同意 4　非常同意 5

	意见等级

	1	2	3	4	5
任务相关的绿色行为					
51.我能胜任完成职责范围内的环保任务。					
52.我能履行职位说明中明确的环保责任。					
53.我能完成团队期望完成的环保任务。					
54.我能达到正式工作绩效中的环保标准。					
55.我在日常工作中注重节能与低碳出行。					
自愿性绿色行为					
56.我在日常工作中自愿开展环保行动与倡议。					
57.我积极参与公司（或部门）组织的环保活动。					
58.我主动参与解决公司环保问题的项目、工作或活动。					
59.我自发鼓励同事采取更环保的行为方式。					
60.我自愿帮助同事在工作中更加注重环境保护。					

第六部分：建议

……

……

……

……

……

APPENDIX 3
INTERVIEW FORM (ENGLISH VERSION)

In-depth Interview for Dissertation

A MOEDL OF GREEN MANAGEMENT SUCCESS IN IRON AND STEEL ENTERPRISES IN CHINA

Researcher: Mr. Li WuJun

Curriculum: Doctor of Philosophy Program in Management, Siam University

Instruction:

1.The interview will be face-to-face interview. Respondents included employees of Chinese iron and steel enterprises, experts in the field of Green industry and officers from the Ministry of Industry and Information Technology Development of China.

2.All participants will be asked to sign a consent form.

3.The purpose and nature of the study will be explained to the participants prior to conducting the interview and participants will have the opportunity to ask questions about the study.

4.The interview rights of all participants will be listed in the consent form.

5.Your information will be kept confidential. Your identity and the names of any associated people and organizations will remain anonymous without your permission.

6.Questions Collect information about participants.

7. This interview is best for the research. We are therefore very grateful to all participants for their participation.

8.Should need your need further information, you may reach us at Siam University 38 Petchkasem Road, Bangwa, Phasicharoen, Bangkok 10160. Thailand Tel 02-867-8000.

CONSENT FORM

I, …… voluntarily agree to participate in this research study.

- I understand that all information I provide for this research will be treated confidentially.
- I agree to my interview being audio-recorded.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
- I understand that participation involves A MODEL OF GREEN MANAGEMENT SUCCESS IN IRON AND STEEL ENTERPRISES IN CHINA.
- I have had the purpose and nature of this research explained to me in writing and I have had the opportunity to ask questions about this research.
- I understand that I will not benefit directly from participating in this research.
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
- I understand that disguised extracts from my interview may be quoted in dissertation, conference presentation, and published papers.
- I understand that if I inform the researcher that myself or someone else is at risk of harm, they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.
- I understand that signed consent forms and original audio recordings will be retained in Siam University, Thailand by the researcher until the exam board confirms the results of the researcher's dissertation.
- I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years from the date of the exam board.
- I understand that under freedom of information legalization I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to

seek further clarification and information.

Researcher name: Mr. LI WUJUN

Degrees: Doctor of Philosophy in Management

Address: Siam university 38 Petkasem Road, Phasicharoen, Bangkok, 10160 Thailand; Tel 02-867-8000 or *Guangxi University of Science and Technology , Wenchang Road, Chengzhong District, Liuzhou City, Guangxi, China. Tel: 18177287369*

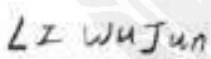
Signature of research participant

---------- ----------

Signature of participant Date

Signature of researcher

I believe the participant is giving informed consent to participate in this research.



---------- ----------

Signature of researcher Date

Date of interview: Time:

Part I: Personal Information

1. Participant name:

2. Contactaddress :

3. Participant information

3.1 What is your gender?

☐ 1) Male ☐ 2) Female

3.2 What is your age in year?

☐ 1) 21-30 years ☐ 2) 31-40 years

☐ 3) 41-50 years ☐ 4) Above 51 years

3.3 What is your education level?

☐ 1) Under Bachelor Degree

☐ 2) Bachelor Degree or even

☐ 3) Postgraduate

3.4. What is your working in year?

☐ 1) 1-3 years ☐ 2) 4-6 years

☐ 3) 7-9 years ☐ 4) Above 10 years

3.5 What is your position in the company?

☐ 1) Staff ☐ 2) Middle manager

☐ 3) Senior manager ☐ 4) Others

1.Can you please describe if the environmental idealized influence is related to the green transformational leadership?

……

2.Can you please describe if the environmental inspirational motivation is related to the green transformational leadership?

……

3.Can you please describe if the environmental intellectual stimulation is related to the green transformational leadership?

……

4.Can you please describe if the environmental individualized consideration is related to the green transformational leadership?

……

Part III: Opinion on Green organizational culture

5.Could you please talk about the important role of degree in green organizational culture?

……

6.Could you please talk about the important role of diffusion in green organizational culture?

……

7.Could you please talk about the important role of depth in green organizational culture?

……

Part IV: Opinion on Green Self-efficacy

8.Can you please describe if the collective green self-efficacy is related to the green self-efficacy?

……

9.Can you please describe if the individual green self-efficacy is related to the green self-efficacy?

……

Part V: Opinion on Employee green behavior

10.Do you think the task-related green behavior can reflect the employee green behavior? Why?

……

11.Do you think the voluntary green behavior can reflect the employee green behavior? Why?

……

Part VI: Opinion on relationship among Green Transformational Leadership, Green organizational culture,Green Self-efficacy and Employee green behavior

12.Do you believe that green transformational leadership is positively correlated with employee green behavior in iron and steel enterprises in China? Why?

……

13.Do you believe that green transformational leadership is positively correlated with green organizational culture in iron and steel enterprises in China? Why?

……

14.Do you believe that green transformational leadership is positively correlated with green Self-efficacy in iron and steel enterprises in China? Why?

……

15.Do you believe that green organizational culture is positively correlated with employee green behavior in iron and steel enterprises in China? Why?

……

16.Do you believe that green Self-efficacy is positively correlated with employee green behavior in iron and steel enterprises in China? Why?

……

17.Do you believe that higher the levels of green transformational leadership, along with stronger green organizational culture and greater green self-efficacy, can more effectively promote employee green behavior in iron and steel enterprises in China? Why?

……

Part VII: Recommendation

18.Is there anything else you would like to add that you have not shared yet, please?

……

19.Is there anything I should know to expand my knowledge on this topic, please?

……

20.Are there any improvement ways you can recommend to make my research more complete, please?

……

THANK YOU FOR YOUR TIME AND PARTICIPATION.

APPENDIX 4

INTERVIEW FORM (CHINESE VERSION)

一个中国钢铁企业绿色管理的成功模型

说明：

1.本次访谈将以面对面访谈的方式进行。受访者包括中国钢铁企业员工、绿色产业领域的专家以及中国工业和信息化部的官员。

2.所有参与者将被要求签署知情同意书。

3. 在访谈开始前，将向参与者说明研究的目的和性质，并给予参与者提出问题的机会。

4.所有参与者的访谈权利将列入知情同意书中。

5.您的信息将被保密。未经您的许可，您的身份及任何相关人员和组织的名称将保持匿名。

6.本次访谈对研究至关重要。因此我们非常感谢所有参与者的参与。

7.若有任何需要，请联系：广西柳州市城中区文昌路 2 号，广西科技大学李武军 181877287369。

祝您工作愉快，万事如意！

2024 年 11 月 18 日

访谈日期:……　　访谈时间: ……

Part I: 基本信息

1.公司名称：……

2.受访者姓名：……

3.性别：☐ 男　　☐ 女

4.年龄：……

5.学历学位：……

6.在公司的工作时长：……

7.所在部门：……

8. 贵单位所在省份：……

9. 联系地址：……

Part II: 访谈问题

1. 您认为贵单位的领导者在环保方面是否具备榜样作用、激励动机、创新思维和个性化关怀？为什么？

……

……

2. 您认为自己在环保行动方面有足够的信心和能力吗？您是否感受到团队整体在绿色行为上的自我效能感？

……

……

3. 您觉得贵单位在环保方面的文化氛围如何？环保理念在组织中传播的程度、范围和深度如何？

……

……

4.在日常工作中，您是否会积极参与与环保相关的工作任务？在非任务要求的情况下，您是否也会主动采取绿色行为？

……

……

5.您觉得哪些因素（比如领导者行为、同事影响、组织文化、个人信心等）最能激发您采取绿色行为？为什么？

……

……

6.对于提升组织的环保文化、促进员工绿色行为等方面，您还有其他想法或建议吗？

……

……

APPENDIX 5
QUESTIONNAIRE WITH IOC RESULTS

Questionnaire

A MOEDL OF GREEN MANAGEMENT SUCCESS IN IRON AND STEEL ENTERPRISES IN CHINA

Researcher: Mr. Li WuJun

Curriculum: Doctor of Philosophy in Management, Siam University

Explanation: In the investigation process, the researcher took the survey to have 5 academic specialists examine it. The following name list appears below:

1.Prof. Dr. Lu Zhiping (School of Management, Guangxi University of Science and Technology,China)

2.Prof. Dr. Zhu Xiaoqin (School of Management, Guangxi University of Science and Technology,China)

3.Assoc. Prof. Dr. Liang Feiwen (School of Management, Guangxi University of Science and Technology,China)

4.Dr. Qin Jiayin (School of Management, Guangxi University of Science and Technology,China)

5.Assoc. Prof. Dr. Li Li (School of Management, Guangxi University of Science and Technology,China)

The purpose of this study is to understand the relationship between green transformational leadership, green organizational culture, green self-efficacy and employee green behavior. The Organization summarized the number of items in each part of the questionnaire as follows:

1.Measurement of Green transformational leadership = 20 items

2.Green organizational culture =15 items

3.Green Self-efficacy = 10 items

4.Employee green behavior = 10 items

Total number of questions = 55

Content-based Item-objective Congruence of Index (IOC)

1 Green Transformational Leadership	IOC specialist's opinions (+1, 0, -1)						
	1	**2**	3	4	5	Total	Avg.
1.1 Environmental Idealized Influence							
1.My leader is my environmental role model.	1	1	1	1	1	5	1
2.My leader values the natural environment.	1	1	1	1	1	5	1
3.My leader values the natural environment.	1	0	1	1	1	4	0.8
4.My leader values the natural environment.	1	1	1	0	1	4	0.8
5.My leader demonstrates a steadfast belief in environmental values at work.	1	1	0	1	1	4	0.8
	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
1.2 Environmental Inspirational Motivation							
6.My leader encourages me to work in an environmentally friendly manner.	1	1	0	1	1	4	0.8
7.My leader holds an optimistic view of the future organizational environmental performance.	1	1	1	1	1	5	1
8.My leader is passionate about improving the natural environment.	1	1	1	0	1	4	0.8
9.My leader creates a positive work environment conducive to environmental management.	1	1	1	1	1	5	1
10.My leader encourages me to prioritize collective environmental interests over personal gains.	1	1	0	1	1	4	0.8
	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
1.3 Environmental Intellectual Stimulation							
11.My leader promotes the implementation of new concepts in environmental protection.	1	1	1	1	1	5	1
12.My leader promotes the implementation of new concepts in environmental protection.	1	1	0	1	1	4	0.8

13.My leader promotes the implementation of new concepts in environmental protection.	1	1	1	1	1	5	1
14.My leader promotes the implementation of new concepts in environmental protection.	1	0	1	1	1	4	0.8
15.My leader holds an optimistic attitude towards the methods I propose to improve the company's environmental performance.	1	1	1	1	0	4	0.8
	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
1.4 Environmental Individualized Consideration							
16.My leader shows genuine concern for both me and the environment.	1	0	1	1	1	5	0.8
17.My leader is able to recognize the contributions I make to the company's environmental performance.	1	1	1	1	1	5	1
18.My leader acknowledges my ability to enhance the company's environmental performance.	1	1	1	0	1	4	0.8
19.My leader is willing to invest time in developing my skills to contribute to the company's environmental performance.	1	1	1	1	1	5	1
20.My leader fosters a sense of belonging and camaraderie among team members in environmental work.	1	1	0	1	1	4	0.8
2 Green Organizational Culture	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
2.1 Degree							
21.When short run performance of the organization is considered, managers consider profit and growth as dominant objectives rather than green agenda.	1	1	0	1	1	4	0.8
22.When long term organizational performance is considered, mangers give high priority to enterprise performance.	1	0	1	1	1	4	0.8
23.Environmental values are placed at a high priority within the industry group to which my organization belongs.	1	1	1	1	1	5	1
24.In my industry, environmental/green values are a part of all company activities and decisions across all firms.	1	1	0	1	1	4	0.8
25.In my industry, environmental/green values are a part of all company activities and decisions across all firms.	1	0	1	1	1	4	0.8

	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
2.2 Diffusion							
26.In my organization, any manager who is identified as a "greenie" (pro-environmental change agent) is marginalized/isolated due to internal politics.	1	1	0	1	1	4	0.8
27.I believe that my organization is not supportive of the managers who try to promote green agenda.	1	1	0	1	1	4	0.8
28.In my organization, development of organization wide environmental values is difficult because there are cultural differences between the departments.	1	1	1	1	1	5	1
29.In my organization, development of organization wide environmental values is difficult because there are cultural differences between the departments.	1	1	0	1	0	3	0.6
30.Environmental values are not equally emphasized across all the offices (locations) of my organization due to their physical/geographical separation (for example, higher focus in corporate office compared to regional offices).	1	1	1	0	1	4	0.8
	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
2.3 Depth							
31.My organization ignores the criticisms of the general public relating to the emissions/effluents arising from my company.	1	1	0	1	1	4	0.8
32.My organization sincerely develops environmental initiatives and practices to deal with public criticism relating to the emissions/effluents from my company.	1	0	1	1	1	4	0.8
33.My organization gives importance to green issues only when customers demand green products.	1	1	0	1	1	4	0.8
34.In my organization, employees resist adoption of green practices because they believe that green issues were management " fads " (fashionable).	1	1	1	1	1	5	1
35.Most managers in my organization believe that green practices are not related to profits.	1	1	0	1	1	4	0.8

3 Green Self-efficacy	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
3.1 Individual Green Self-Efficacy							
36.I think I can successfully implement environmentally friendly ideas.	1	0	1	1	1	4	0.8
37.I can achieve most of my environmental goals.	1	1	1	1	1	5	1
38.I can complete environmental tasks more efficiently.	1	0	1	1	1	4	0.8
39.I can overcome environmental problems.	1	1	1	1	1	5	1
40.I can find new solutions to environmental problems.	1	1	0	1	1	4	0.8
	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
3.2 Collective Green Self-Efficacy							
41.Our team can effectively implement and maintain environmental protection measures.	1	1	1	0	1	4	0.8
42.Our organization can achieve the set environmental protection goals	1	1	1	1	1	5	1
43.Our organization can achieve the set environmental protection goals	1	1	0	1	1	4	0.8
44.When facing complex environmental issues, our organization can find effective solutions.	1	1	1	1	1	5	1
45.Our team can collaboratively create and implement new environmental solutions	1	1	0	1	1	4	0.8
4 Employee Green Behavior	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
4.1 Task-based Green Behavior							
46.I can accomplish the environmental protection tasks within my duties competently.	1	1	1	1	1	5	1
47.I can fulfill the environmental protection responsibilities clearly specified in the job description.	1	1	0	1	1	4	0.8
48.I can accomplish the environmental tasks that the team expects to complete.	1	1	1	0	1	4	0.8
49.I can meet the environmental standards of formal work performance requirements.	1	1	1	1	1	5	1
50.I pay attention to energy conservation and low-carbon travel in my daily work.	1	1	0	1	1	4	0.8

	IOC specialist's opinions (+1, 0, -1)						
	1	2	3	4	5	Total	Avg.
4.2 Voluntary Green Behavior							
51.I voluntarily carry out environmental actions and initiatives in my daily work.	1	0	1	1	1	4	0.8
52.I actively participate in environmental events organized by my company (or department).	1	1	1	1	1	5	1
53.I volunteer for projects, jobs or events that address environmental issues in my companies.	1	1	1	0	1	4	0.8
54.I spontaneously encourage my colleagues to adopt more environmentally conscious behavior at work.	1	1	1	1	1	5	1
55.I spontaneously give my time to help my colleagues take the environment into account in everything they do at work.	1	1	0	1	1	4	0.8

APPENDIX 6

ETHICS TRAINING CERTIFICATION

CERTIFICATE

OF COMPLETION

PHRP Online Training, Inc. certifies that

WUJUN LI

has successfully completed the web-based course "Protecting Human Research Participants Online Training SBE."

Date Completed: **2023-08-13** Certification Number: **2991155**

PHRP
Protecting Human
Research Participants
Online Training

APPENDIX 7

LETTER FROM SIAM UNIVERSITY TO DISTRIBUTION

ใบรับรองจริยธรรมการวิจัยในมนุษย์
สถาบันการจัดการปัญญาภิวัฒน์

หมายเลขใบรับรอง: PIM-REC 024/2568

ข้อเสนอการวิจัยนี้ และเอกสารประกอบของข้อเสนอการวิจัยตามรายการแสดงด้านล่าง ได้รับการพิจารณาจากคณะกรรมการจริยธรรมการวิจัยในมนุษย์ สถาบันการจัดการปัญญาภิวัฒน์แล้ว คณะกรรมการฯ มีความเห็นว่าข้อเสนอการวิจัยที่จะดำเนินการมีความสอดคล้องกับหลักจริยธรรมสากล ตลอดจนกฎหมาย ข้อบังคับและข้อกำหนดภายในประเทศ จึงเห็นสมควรให้ดำเนินการตามข้อเสนอการวิจัยนี้ได้

ชื่อข้อเสนอโครงการ: A Model of Green Management Success in Iron and Steel Enterprises in China

รหัสข้อเสนอการวิจัย (ถ้ามี): -

หน่วยงาน: Siam University

ผู้วิจัยหลัก: LI WUJUN

ลงนาม.....

(อาจารย์ ดร.พิเชษฐ์ มุสิกะโปดก)
ประธานคณะกรรมการจริยธรรมการวิจัยในมนุษย์
สถาบันการจัดการปัญญาภิวัฒน์

วันที่รับรอง: 31 สิงหาคม 2568 **วันหมดอายุ:** 30 สิงหาคม 2569

เอกสารที่คณะกรรมการรับรอง
1. โครงร่างการวิจัย
2. ข้อมูลสำหรับชี้แจงกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย และ ใบแสดงความยินยอมจากกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย
3. เครื่องมือที่ใช้ในการวิจัย/เก็บรวบรวมข้อมูล เช่น แบบสอบถาม แบบสัมภาษณ์ ประเด็นในการสนทนากลุ่ม เป็นต้น

เงื่อนไขการรับรอง
1. นักวิจัยดำเนินการวิจัยตามที่ระบุไว้ในโครงร่างการวิจัยอย่างเคร่งครัด
2. นักวิจัยรายงานเหตุการณ์ไม่พึงประสงค์ร้ายแรงที่เกิดขึ้นหรือเปลี่ยนแปลงกิจกรรมวิจัยใดๆ ต่อคณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ภายในกำหนด
3. นักวิจัยส่งรายงานความก้าวหน้าต่อคณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ตามเวลาที่กำหนดหรือเมื่อได้รับการร้องขอจากคณะกรรมการฯ
4. หากการวิจัยไม่สามารถดำเนินการแล้วเสร็จสิ้นภายในกำหนด ผู้วิจัยต้องยื่นขออนุมัติใหม่ก่อนอย่างน้อย 1 เดือน
5. หากการวิจัยเสร็จสมบูรณ์ ผู้วิจัยต้องแจ้งปิดโครงการตามแบบฟอร์มที่กำหนด

APPENDIX 8

LETTER FROM SIAM UNIVERSITY TO DISTRIBUTION

No. SU 0210.7/246

SIAM UNIVERSITY
Ph.D. in MGT

Graduate School of Management,
Siam University
38 Petkasem Rd., Bang-wa,
Phasi-charoen, Bangkok, 10160.

December 26th, 2024

Subject: Request for Data Collection via Questionnaire Distribution
To Whom It May Concern:

Mr. Li Wujun Student ID# 6319200009, a doctoral student of the Graduate School of Management, Siam University (Mobile Phone No. +86-18177287369 and email: 35241685@qq.com) is currently working on the Ph.D. Dissertation entitle: "A Model of Green Management Success in Iron and Steel Enterprises in China" under the supervision of Dr. Kamjira Limsiritong.

In this regard, the Graduate School of Management would like to request for your cooperation by corresponding the attached questionnaire form. The completion of this questionnaire form will allow Mr. Li Wujun to further proceed on her research with data accuracy and overall quality. Your kind assistance is fully appreciated.

Best Regards,

(Associate Professor Dr. Chaiyanant Panyasiri)
Dean of the Graduate School of Management

Graduate School of Management
Telephone +662-867-8000 ext. 5311
E-mail: phd_m1@siam.edu

AUTHOR'S BIOGRAPHY

Name and Surname : Wujun LI
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Nationality : China
Birth of Place : Yulin City, Guangxi Province, China
Address : No. 2 Wenchang Road, Chengzhong District, Liuzhou City
E-Mail : 35241685@qq.com
Work Position : Director of the Office of Scientific Research Management
Workplace : Guangxi University of Science and Technology

Education

Bachelor's Degree

Degree	B.A.
Major	Computer Science and Technology
Institution	Huazhong University of Science and Technology
Country	China
Year	1999-2003

Master's Degree

Degree	M.A.
Major	Higher Education
Institution	Central China Normal University
Country	China
Year	2006-2009

Publishing Research :

LI,W ., Limsiritong, K., (2025). A Model of Green Management Success in Iron and Steel Enterprises in China. ***Journal of educational innovation and Research***, Volume 9(4), October-December.(TCI Tier 1)
https://so06.tci-thaijo.org/index.php/jeir

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย สาขาการจัดการ (โทร. 5311)

ที่ มส 0210.7/89 **วันที่** 1 สิงหาคม 2568

เรื่อง ขออนุมัติสำเร็จการศึกษาของ Mr. Li Wujun

เรียน อธิการบดี

ที่มาของเรื่อง ด้วย Mr. Li Wujun เลขทะเบียน 6319200009 ได้ดำเนินการจัดทำดุษฎีนิพนธ์เรื่อง "A Model of Green Management Success in Iron and Steel Enterprises in China" นั้น

ข้อเท็จจริง บัดนี้ Mr. Li Wujun ได้ดำเนินการตามเงื่อนไขการสำเร็จการศึกษาของหลักสูตรปริญญาปรัชญาดุษฎีบัณฑิต สาขาวิชาการจัดการ หลักสูตรปรับปรุง พ.ศ. 2561 มีรายการดังต่อไปนี้

1) ศึกษาครบตามจำนวนหน่วยกิตที่กำหนด และผ่านการสอบวัดคุณสมบัติ (Qualifying Exam) เรียบร้อยแล้ว รวมทั้งผ่านการสอบป้องกันดุษฎีนิพนธ์เรียบร้อยแล้ว (ตามเอกสารแนบที่ 1)

2) จากผลการสอบป้องกันดุษฎีนิพนธ์ ผลปรากฏว่า ผ่าน แบบมีเงื่อนไข โดยให้ปรับปรุงให้ได้มาตรฐาน ซึ่งได้ดำเนินการตามที่คณะกรรมการกำหนด และคณะกรรมการสอบดุษฎีนิพนธ์อนุมัติดุษฎีนิพนธ์เป็นที่เรียบร้อย (ตามเอกสารแนบที่ 2)

3) ตีพิมพ์บทความวิจัยลงวารสารที่อยู่ในฐานข้อมูล TCI (กลุ่ม 1) ชื่อวารสาร Journal of Educational Innovation and Research ปีที่ 9 ฉบับที่ 4 เดือน ตุลาคม-ธันวาคม 2568 (ตามเอกสารแนบที่ 3)

Li, W., & Limsiritong, K. (2025). A Model of Green Management Success in Iron and Steel Enterprises in China. *Journal of Educational Innovation and Research, 9*(4). (หนังสือตอบรับลงตีพิมพ์เดือน ตุลาคม-ธันวาคม 2568)

4) ผ่านการสอบภาษาอังกฤษ Oxford Placement Test (เกณฑ์ผ่านที่ 55 คะแนน) ได้ 69 คะแนน (ตามเอกสารแนบที่ 4)

5) ผ่านการตรวจความซ้ำซ้อนและลอกเลียนวรรณกรรมของผลงานวิจัยด้วยโปรแกรม Grammarly มีค่าระดับคะแนนอยู่ในเกณฑ์มาตรฐาน (ตามเอกสารแนบที่ 5)

ข้อเสนอ จึงเรียนมาเพื่อโปรดพิจารณาอนุมัติให้ Mr. Li Wujun สำเร็จการศึกษาในภาคการศึกษาที่ 3 ปีการศึกษา 2567 และดำเนินการตามระเบียบของมหาวิทยาลัยต่อไป

(รองศาสตราจารย์ ดร.ไชยนันท์ ปัญญาศิริ)
คณบดีบัณฑิตวิทยาลัย สาขาการจัดการ

สำนักงานอธิการบดี
เอกสารฉบับนี้สามารถสแกนเข้าฐานข้อมูลได้
ลงชื่อ
วันที่ 17/9/68

17 ส.ค. 68

รายละเอียดการตรวจสอบอยู่ด้านหลัง