



Roadmap to Achieve Green Project Performance: The Role of Knowledge Co-creation

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Received: 9 May 2023 / Accepted: 11 January 2024 / Published online: 8 February 2024
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Abstract

The current study has attempted to identify the factors that can contribute toward green project performance. Based on the social exchange theory, the current study highlights that green leadership directs and promotes green vision, bringing everyone on the same page to improve the green performance of the project. The mediating and moderating mechanisms of green creativity and co-creation have also been discussed. Utilizing the data from the development projects, the study tested the antecedents of green project performance by collecting data from 231 project employees in three waves. The study's findings confirm the importance of green leadership to achieve green project performance. Green co-creation does not moderate the relationship between green leadership and green creativity. It is essential to identify the factors that can help us deal with the energy crises. Roadmap to achieve green project performance through green leadership is highlighted in this study along with the intervening mechanisms. This study provides guidelines to practitioners that green competitive advantage can be achieved by empowering employees under green leaders through motivation and inspiration.

Keywords Green leadership · Green project performance · Green creativity · Green co-creation · Social exchange theory

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Introduction

Over the past 10 years, environmental sustainability has gained popularity, and businesses are now favoring environmentally friendly choices (Maltzman & Shirley, 2010; Vachon & Klassen, 2006; Verrier et al., 2014). Researchers highlight various factors that contribute toward green practices, such as the development of environmental policies (He et al., 2019), green behavior (Nguyen et al., 2019), green knowledge and skills (Hwang & Ng, 2013), and green management system (Kim et al., 2019). A massive amount of money is being spent to promote environment-friendly projects to adopt and achieve greener options to save resources (Yang et al., 2016). Green projects can be defined as low-carbon energy development, wind, and other renewable energy resources, green infrastructural projects, green infrastructural technologies, and any other project which simultaneously looks at the environment protection aspect including reuse of resources and pollution reduction. Some examples include the environment-friendly metro in Kuwait (AlKheder et al., 2022), environment-friendly projects in rural India (Krishnamurthy et al., 2014), and eco-friendly transportation facilities in South Korea (Kima et al., 2020). Even looking at the larger economies, China is spending about \$9 billion a month on clean energy (Eisen, 2010). These transformations from a non-environmental stage toward an environmental stage are performed in designated purposeful projects (Huemann, 2022; Silvius & Huemann, 2023). Such goals are either reached by the project (Lentfle & Söderlund, 2022) or using specific principles of sustainability (Silvius & Huemann, 2023). To this end, some of the projects are better planned than others and thus have well-defined goals in terms of time, cost, and quality. Some projects allow exact expected environmental standards, whereas others have more explicit moving goals or some that allow the project to evolve through creative or co-creative processes (Gennaro & Christodoulou, 2021). Also, there is a need to identify the barriers and elements which contribute toward achieving green project goals (Hwang et al., 2017). Traditional project management literature assumes that the role of leadership is critical for achieving project performance (Mubarak et al., 2021). Likewise, it has been evidenced that green project manager understands the green elements of the project (Maltzman & Shirley, 2010). However, we still need to see how green leadership helps achieve green project performance. Many scholars highlighted the importance of green leadership in different contexts (Boiral et al., 2014, 2018), because leaders can encourage and motivate followers to adopt green activities (Mittal & Dhar, 2015). In the case of green leaders, they will inspire employees and create opportunities to adopt green activities benefitting the project-based organizations (Lusiani et al., 2020). Green leaders are knowledgeable about the green technologies and processes, direct subordinates to avoid erroneous work to avoid resource loss, and disseminate green work procedures. Asbari et al. (2020) asserts that the leadership style determines the company's response to its environment. Following, Li et al. (2019), project-based organizations need a green leader to achieve green project performance.

Putting it in other words, growing emphases have been placed on managing green projects (Hwang & Tan, 2012). It is important to emphasize green

leadership style to manage resources not only for the project organization but also for the society in general (Weimann & Patel, 2017). Green leader helps to overcome the obstacles and challenges in the resource-constrained environment. Project manager, by ensuring control, manages, saves, and deploys resources by choosing greener options in organizations (e.g., project-based organizations) that help achieve green tasks (Senaratne & Hewamanage, 2015). Green leadership is defined as the ability of a leader to determine pro-environmental policies and should be able to influence organizations to support pro-environmental policies (Kardoyo et al., 2020, p. 461). Therefore, through support and influence, green leader may also impact project employees' green creativity. This happens because a leader mobilizes member participation toward green options and alternatives (Kardoyo et al., 2020), which may provoke them to look for creative options. Also, green leader exchanges environmental vision and green intellectual ideas (Chen & Chang, 2013a). Resultantly, green leaders might assist individuals in imitating green concepts by thinking creatively, resulting in green project outcomes (green project performance). We drew this on social exchange theory as the guidelines and exchange provided by the leader influence the outcomes (green creativity and green project performance) (Cropanzano & Mitchell, 2005). Likewise, the green exchange of ideas, skills, knowledge, and expertise by the green leader might result in employees' green creativity. Green leader exchanges creative thinking skills and motivation, which are essential to achieve green creativity (Bernarto et al., 2020; Sartika et al., 2020; Smyth et al., 2018). The function of green leadership (project manager) as an innovator is represented in the establishment of new, environment-friendly facilities, which boosts the green creativity of project employees (Pramono et al., 2020; Vizano et al., 2020). Thus, we propose the role of green leadership as a motivator toward active implementation of green environment-friendly output, i.e., green project performance through creativity.

Moreover, instilling green creativity by the green leader is impossible without exchanging valuable green knowledge in a project. Green co-creation by the green leader about green ideas and environmental concerns would assist employees in creating environmentally friendly solutions, i.e., green creativity of project employees (Keays & Huemann, 2017). Green co-creation empowers organizations (e.g., project-based organizations) to exploit resources and knowledge to create innovative products (Wong, 2013), which can come through the green leader. Green knowledge is critical to help enterprises manage and apply their knowledge of green products/services (Lin & Chen, 2017), which is not possible without green co-creation.

Researchers and practitioners have focused on the role of knowledge in providing firms with a durable competitive advantage and resulting in superior performance (Bajwa et al., 2015; Massey et al., 2007). Co-creation has always been a challenging task since it requires both the “giving” and “receiving” of knowledge from various social participants (Cleveland & Ellis, 2015). Conceptually, co-creation is an ingredient of learning and is inherent in creativity (Eriksson et al., 2017). Relevant skills are needed to match green co-creation by the green leader that may give a platform for exchanging ideas, resulting in green creativity (Ahmed et al., 2016). Green leaders help alert employees about environmental hazards and harms and recognize communication difficulties to achieve green project performance. Co-creation,

creativity, and project performance are intertwined (Suh et al., 2010). The same may be necessary for green projects, where the social exchange process results in the flow of information and motivation to complete green activities. Especially, its contextual importance cannot be denied as the developing countries including Pakistan are facing massive resource shortage and energy constraint and certainly are in dire need of green leaders to persuade green options (Ali et al., 2021a, b). Many scholars have emphasized the role of environmentally sustainable orientation with the behavior of the individuals (Cicchello et al., 2023). Though we can see the work of different scholars oriented to focus on the need of green projects (Kaswan et al., 2023), there is no clear evidence regarding the role a project leader can play toward green project performance by understanding the green aspects. Therefore, it is crucial to identify the role of green leadership toward green project performance through influencing individuals' green co-creation and green creativity.

Theory

The current study is based on the social exchange theory, which holds that mutual and complementary arrangements are fundamental components of social exchange (Molm, 1994). The green leader manages and motivates employees to achieve green project performance. According to social exchange literature, an action by one party (green leadership and green co-creation) leads to a response by another (green creativity of project employee) (Gergen, 1969). Through exchange process, exchange of ideas, vision, knowledge, and expertise results in cooperation resulting in desired outcomes (i.e., green project performance) (Cropanzano & Mitchell, 2005). Therefore, a green leader will exchange green vision, knowledge, and expertise to achieve green outcomes. Social exchange theory has been used previously in a similar context (Gould-Williams & Davies, 2005; Hinkin & Schriesheim, 2015; Zhang et al., 2018). Therefore, based on the social exchange theory, there are three main objectives of the current study: (a) to identify the significance of green leadership toward green project performance, (b) to identify the mediating role of green creativity between green leadership and green project performance, and (c) to identify the moderating role of green co-creation between green leadership and green creativity also (see Fig. 1).

Literature Review

Green Leadership and Green Project Performance

A major assumption is that environmental problems are severe and growing (Huemann & Silvius, 2017). Today, sustainable development through green initiatives is the norm, and businesses are under more pressure to adopt green policies to gain a long-term competitive edge (Martens & Carvalho, 2017). As a result, the idea of environmental debate is frequently used to refer to environmental change on a global scale. There is a need to have greater emphasis on the environmental risks

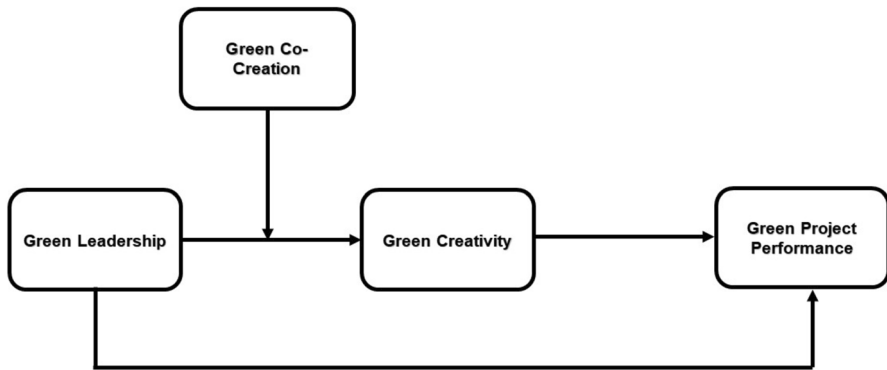


Fig. 1 Impact of green leadership on green project performance through green creativity and moderating role of green co-creation

through transitioning economies by smarter resource usage (Cicchello et al., 2022). Therefore, businesses must pay closer attention to obtaining green services like green leadership (Chen & Chang, 2013a). Leaders must be able to decide how businesses may become more ethical, environmentally friendly, and economically viable, and businesses must adapt to environmental problems today. Based on Asbari et al. (2020), the leadership approach will impact the company's reaction to its surroundings. Green leader influences their followers to achieve the green environmental objectives of the organization (Huxham & Vangen, 2000), which is green project performance in case of projects (Abdi et al., 2018). Green leadership motivates and directs employees to achieve green goals by providing green opportunities and vision (Akaiqhe & Okon, 2021). The same can be applied in projects as a leader through exchange and trust helps in better engagement of the project tasks improving the project performance (Green, 2004). Therefore, a green leader might guide and motivate employees to work toward green objectives and goals, resulting in green project performance. Traditional project performance measurement uses the earned value management (EVM) to measure time, cost, and scope (Koke & Moehler, 2019). However, green project performance is about green efficiency of project operations, green quality of produced work, etc.

The capacity to integrate project components is a critical obligation for project leaders in today's complex development environments (Sotarauta & Suvinen, 2019). Leadership is directly tied to attempts to increase green development paths (Green, 2004), as according to Müller and Turner (2007), project managers' leadership style influences projects. As a result, green leaders are required for projects to drive systems, functions, and workers toward attaining green project performance. Leaders also adopt actions to motivate subordinates to fulfill the intended targets (Wang et al., 2018). In the presence of green leadership, subordinates will be driven to achieve green project performance. Green project performance leads to a green image and green competitive advantage, which can only be obtained through the leader's vision (Elkhwesky et al., 2022), i.e., green leadership. Green leadership shows exemplary environmental attitude and care by providing facilities to promote

green actions and inspiration (Lusiani et al., 2020), all of which can contribute to green project performance (Li et al., 2019, 2020). In contrast, it is fallacious to believe that going toward green options will impede project performance and profitability (Chen et al., 2015). However, most of the studies provided traces of the argument that implementing green projects might also depend on green leadership. Therefore, we need to identify the exact phenomena to clarify whether it contributes to green project performance.

H1: Green leadership is positively and significantly related to green project performance.

Creativity as a Mediator Between Green Leadership and Project Performance

Inefficient resource utilization, industrial pollution, waste of resources, and cost overrun can be avoided through the green creativity of the project employees and a green leader to implement and appreciate their creative suggestions. Businesses who lead the way in green innovation or creativity also benefit from a first-mover advantage, which helps them gain a competitive edge and reduce waste, pollution, and costs (Chen, 2008). Organizations (e.g., project-based organizations) are keener to implement a variety of environmentally friendly practices to respond to environmental demands (Chang & Chen, 2012), which is possible through green creativity. So, project organizations should promote green creativity to produce green alternatives, processes, and practices. Green creativity is defined as the generation of innovative ideas for green products, services, processes, or behaviors deemed innovative, novel, and valuable (Chen & Chang, 2013b). There is not much research on the causes of green creativity, despite the fact that the factors that influence it have gotten a lot of attention and one of those factors is green leader. One cannot deny the fact that leaders influence followers' behavior (Mansoor et al., 2021), including creativity of their employees.

The employee's creativity is insufficient unless the boss provides the opportunities and encouragement. Organizational leaders should increase employees' green motivation so that they can innovate environmentally friendly and sustainable products and services (Li et al., 2020). Green leader is intended to favor green innovations to create a competitive advantage for the organization (Miller & Friesen, 1983). Green leaders promote green innovation and creativity (Cropley et al., 2011). Thus, green leaders might create an environment that encourages and motivates individual project employees to show green creativity. Employees need opportunities from the green leader to be creative. Some of the previous studies link the leader's role to the employees' green creativity, e.g., Arici and Uysal (2022) indicated a strong and positive correlation between leadership and green creativity. This is because green outcomes are significantly associated with the presence of green leaders (Aboramadan et al., 2021). They can provide green vision, opportunities, and motivation to be creative (i.e., green creativity). If the leader is concerned about the environment, one may inspire and drive employees to demonstrate green creativity.

Achieving green creativity through green leadership may also be associated to green project performance. Atkinson (2000) states that developing higher-order thinking skills, such as creativity and problem-solving, is necessary to create green designs that result in high performance. Green creativity will generate methods and ideas that will improve the project's green performance. Superior green performance is the outcome of green innovation (Cronin et al., 2011). As creativity is the first step of creation, the benefits of creativity include lower pollution costs, decreased legal liability, enhanced productivity, a better business reputation, and support from customers and stakeholders (Chen et al., 2016). Thus, based on the above arguments, we propose that green leadership through green creativity results in green project performance. Therefore, the following hypothesis is proposed:

H2a: Green leadership is positively associated with green creativity.

H2b: Green creativity is positively associated with green project performance.

H2c: Green creativity mediates the relationship between green leadership and green project performance.

The Moderating Role of Green Co-creation

Every project has a unique locality, scope, demand, etc. (Couto et al., 2022). Projects usually start with minimal knowledge because of their uniqueness (Chueri & Araujo, 2018). In such circumstances, it is crucial to jointly create an exceptional employee experience through co-creation (Ramaswamy, 2009). In case of coping with uncertainty, co-creation can not only enable different perspectives to meet but also find meaningful outcomes (Dahlin et al., 2020). Such iteration between different actors may benefit from thinking in scenarios. Learning in project-based organizations depends on information management strategies and co-creation mechanisms to solve complex problems of the project (Almeida & Soares, 2014). Similarly, green co-creation is crucial for managing complex environmental issues to move toward greener options. Green co-creative behavior is the degree to which an individual co-creates with other members of their organization (Lin & Chen, 2017). It is vital to co-create, particularly in project scenarios wherein traditional information is limited. Projects are typically associated with highly uncertain data accompanied, which add volatility and may therefore benefit from co-creation (Wuni et al., 2023). Thus, green co-creation to produce green outcomes is essential, especially in project-based organizations.

Social exchange theory is one dominant theoretical perspective, according to which the strengthened exchange relationship is essential to produce outcomes (Wang et al., 2019). Likewise, the green leaders and member's green co-creation of ideas, and expertise through quality green co-creation, may produce greener outcomes, such as green creativity and green project performance. This is because environmental co-creation influences employees' green behavior (Zhang et al., 2021). Extrinsic rewards from leaders and green co-creation help implement green co-creation ideas successfully (Sulistiyani & Rahardja, 2018), affecting project employees' green creativity. The leader's co-creation with the followers and co-creative behavior

helps demonstrate creativity (Thanh, 2020). Employees require constant motivation and freedom to improve creativity (Liao & Chen, 2018) that the green leader can provide.

Green projects are invariably fraught with hazards (Zhao et al., 2016), and creative behavior necessitates an employee's willingness to participate in risks (Dewett, 2006). Green leader's motivation and creative behavior result in green project performance by overcoming the risks. Green leadership through green co-creation supports green climate necessary to achieve green outcomes (green creativity and green project performance). According to Son et al. (2017), a leader influences creativity and co-creation, which are important to enhance performance. Green co-creation and leadership positively affect green creativity (Riva et al., 2021), which may result in green project performance (Sang et al., 2018). Hence, if the leader has a green vision, co-creation, and ideas, green creativity through green co-creation affects green project performance. Therefore, the following are proposed:

H3a: Green co-creation plays a moderating role between green leadership and green creativity in such a way that enhanced co-creation strengthens the relationship between green knowledge leadership and green creativity.

H3b: It is anticipated that higher green co-creation will have a positive impact on green project performance via green creativity, whereas less green co-creation would have the opposite effect.

Methodology

This study was conducted on development projects (construction, infrastructure, and development). Some of the Pakistan's main development projects include the Sindh resilience project, the Karachi neighborhood improvement project, the Polio eradication project, Ranolia hydropower project, etc. It is essential to achieve green performance in these projects because Pakistan is struggling to meet its energy need (Babar et al., 2022). Therefore, we evaluated the impact of green leadership on green project performance in development projects. However, the exact population of the employees working on these projects was unknown; therefore, we used g power analysis to get the minimum sample size. Firstly, each organization's human resource department was sent an email requesting them to participate in this study. We seek approval from higher authorities in the human resources department before interacting with employees to gather data for research purposes. Once permission has been granted, we receive the employees' permission and explain the motive of the study. A purposive sampling technique was used to collect data from the employees who had completed at least one project previously. Purposive sampling as randomly selecting units without replacement from the section of the population was believed to yield samples that will give the best estimate of the population parameter of interest (Guarte & Barrios, 2006). Cross lag design was used to collect data to avoid common method bias. Data were collected in three ways using secret codes with last four numbers of the CNIC with the father's initials. Respondents were directed to respond with respect to their previous project.

In the first wave, we collected data regarding demographics and green leadership (Table 1). In the second wave, we collected data regarding green creativity and co-creation. In the third wave, we collected data regarding green project performance. According to *g* power, the minimum sample size that we had to achieve was 119. Firstly, we distributed 500 questionnaires of which 407 were received back, of which 389 were sent second time after discarding the ones with the missing values. Three hundred forty-one were received in the second round, of which 311 were sent back for the third round after discarding the ones with the missing values. Two hundred fifty-six were received back in the third wave of which 231 were considered for final analysis after discarding missing values. A response rate of 46.2% was achieved.

Measurement

The measurement scales for the constructs green creativity and green leadership were adopted from the previous literature. However, the scale of green project performance and green co-creation were adapted. Detail is given in the subsection. According to Chen and Chang (2013a) and Aga et al. (2016), job experience, gender, and educational level all impact green project success. As a result, we included age, education, gender, and experience as control factors in our research. Responses were collected on a 5-point Likert scale. The detail of each scale is as follows.

Green Leadership

Green leadership scale was adopted from the scale of Nawaz Khan (2023). All items were measured on a 5-point Likert scale. Some of the scale items include “Our leader offers promotions and rewards to employees for green performance, our

Table 1 Demographics

Measures	Details	Frequency	Percentage
Gender	Male	142	61.5
	Female	89	38.5
Age (years)	18 to 25	80	34.6
	26 to 33	113	48.9
	34 to 41	31	13.4
	42 to 49	6	2.6
	50 and above	1	0.4
Education	Technical diploma	15	6.5
	Undergraduate	117	50.6
	Postgraduate	99	42.9
Work experience	5 years and less	143	61.9
	6 to 13 years	72	31.2
	14 to 21 years	12	5.2
	22 to 29 years and above	4	1.7

leader specifically acknowledges green business innovation,” etc. Alpha reliability of the scale was 0.92.

Green Creativity

In order to measure green creativity, we looked into the scale provided by Rego et al. (2007) and Barczak et al. (2010) to measure green creativity. We finally used six-item scale used by Chen and Chang (2013a). Sample scale item includes “The members of the green product development project suggest new ways to achieve environmental goals.” Alpha reliability of the scale was 0.92.

Green Co-creation

We adapted the scale of Bock et al. (2005) and Chen and Chang (2013a) to measure green co-creation. My green co-creation (e.g., eliminating pollution, environmental protection, and SDGs) with other organizational members is good. Alpha reliability of the scale was 0.84.

Green Project Performance

To analyze the project performance, a scale developed by Aladwani (2002) was adapted with an alpha reliability of 0.94. The responses were obtained through 5-point Likert scale ranging from 1=Strongly disagree to 5=Strongly agree to gauge whether a project produces high-quality green deliverables. The respondents are asked to rate how strongly they agree or disagree with respect to the green performance, i.e., green efficiency of operations and green quality of produced work.

Results

Data Analysis

To analyze the data, SPSS 23 and Amos 23 were used. Confirmatory factor analysis (CFA) and structural model testing were used to conduct the analysis (Pesämaa et al., 2021). To determine whether the measured items support the proposed latent variables, CFA was utilized as a first stage in the data analysis procedure (Kline, 2015). Then, a structural equation model (SEM) was used to test the proposed associations (Jöreskog, 1993).

Common Method Bias

We initially used Harman’s single-factor test to rule out the possibility of common technique bias in the present study (Podsakoff et al., 2003). The findings showed that the common technique bias was not a severe concern, as the single component

explained only 21.3% of the variation (less than the 50% critical threshold; Shah & Huang, 2021).

Confirmatory Factor Analysis

The constructs achieved CR values more than 0.8, displaying outstanding internal consistency (Bagozzi, 1983). Estimated average variance (AVE) values were used to evaluate the convergent validity. There is no issue with the convergent validity of these constructs, as all of the components' AVE values are more than 0.5 (Sarstedt et al., 2016). Fornell-Larcker approach was used to evaluate the discriminant validity (Fornell & Larcker, 1981). The condition was satisfied because, as indicated in Table 2, the square root of the AVE value for each construct was larger than the correlation between all constructs (the square root of AVE is given in diagonal in italic numbers).

Measurement Model

Prior to testing the hypotheses, CFA was carried out to assess the measurement model. According to CFA results, the four main factor models identify the significance of the data when contrasted to substitute models, including a single-factor model in which all variables were mounted on one factor, two-factor models in which variables were loaded on two factors, and resulting models in which variables were mounted on multiple three different factors. Founded on these approaches as suggested by past studies (Shah et al., 2018; Zhang et al., 2020b), we performed a sequence of model comparison assessments to confirm the model. The hypothesized four-factor model (M0) provided a good fit ($\chi^2=287.827$, $\chi^2/df=1.418$, RMSEA=0.043, comparative fit index (CFI)=0.967, Normed fit index (NFI)=0.898, and Tucker Lewis Index (TLI)=0.963). In the first alternative two-factor model (M1) (F1=GL+GC, F2=GPP+GCC), $\chi^2=1345.102$, $\chi^2/df=6.467$, RMSEA=0.154, CFI=0.560, NFI=0.522, and TLI=0.511. Compared to the hypothesized model, χ^2 increased by 1057.275; χ^2/df increased with 5.049; NFI, TLI, and CFI decreased by 0.376, 0.452, and 0.407, respectively; whereas the RMSEA increased with 0.111. In the second alternative two-factor model (M2) (F1=GL+GCC, F2=GC+GPP), $\chi^2=1355.145$, $\chi^2/df=6.515$, NFI=0.519, CFI=0.556, TLI=0.507, and RMSEA=0.155. However, compared

Table 2 Mean, standard deviation, validity, and correlation

	CR	AVE	MSV	GCC_C	GPP_P	GCCC_C	GLL_L
GC	0.843	0.575	0.152	<i>0.714</i>			
GPP	0.910	0.628	0.152	0.390	<i>0.792</i>		
GCC	0.901	0.648	0.093	0.305	0.172	<i>0.805</i>	
GL	0.865	0.563	0.138	0.327	0.371	-0.002	<i>0.750</i>

AVE average variance extracted, CR composite reliability, GL green leadership, GC green creativity, GCC green co-creation, GPP green project performance

to the hypothesized four-factor model, χ^2 increased by 1067.318; χ^2/df increased with 5.097; NFI, TLI, and CFI decreased with 0.379, 0.386, and 0.456, respectively; whereas the RMSEA increased with 0.112. In the third alternative three-factor model (M3) (F1 = GL + GPP, F2 = GC, F3 = GCC), $\chi^2 = 1860.7$, $\chi^2/df = 3.92$, NFI = 0.843, CFI = 0.859, TLI = 0.866, and RMSEA = 0.109. It also did not offer better fit than the hypothesized four-factor model, in which χ^2 increased by 1572.873; χ^2/df increased with 2.502; NFI, TLI, and CFI decreased with 0.055, 0.104, and 0.101, respectively; whereas RMSEA slightly increased with 0.06. In the third alternative three-factor model (M4) (F1 = GL + GPP, F2 = GC, F3 = GCC), $\chi^2 = 704.406$, $\chi^2/df = 3.419$, NFI = 0.750, CFI = 0.807, TLI = 0.784, and RMSEA = 0.103. It also did not offer better fit than the hypothesized four-factor model, in which χ^2 increased by 416.579; χ^2/df increased with 1.731; NFI, TLI, and CFI decreased with 0.148, 0.179, and 0.16, respectively; whereas RMSEA slightly increased with 0.06. In the last single-factor model (M5), $\chi^2 = 1716.382$, $\chi^2/df = 8.212$, NFI = 0.390, CFI = 0.417, TLI = 0.355, and RMSEA = 0.177. It also did not offer a better fit than the hypothesized four-factor model, in which χ^2 increased by 1428.555; χ^2/df increased with 6.794; NFI, TLI, and CFI decreased with 0.508, 0.543, and 0.546, respectively; whereas RMSEA increased with 0.134. Thus, the hypothesized four-factor model was better than all alternative models (see Table 3).

Structural Model Testing

Table 4 shows the SEM outcomes of direct pathways for the proposed model. Even though there was no significant relationship between the controls and green project performance, these results did not affect the linkages between the research variables. In terms of the main effect, the research found that green leadership and green project performance had a substantial positive relationship ($\beta = 0.23$, $P = 0.001$), supporting H1. H2a was further supported by the finding as green leadership was a significant determinant of green creativity ($\beta = 0.22$, $P = 0.001$). H2b was also acceptable because the results showed a statistically significant relationship between green creativity and green project performance ($\beta = 0.32$, $P = 0.001$).

To examine the indirect relationship in H2c (mediating role of green creativity between green leadership and green project performance), we implemented Preacher et al.'s (2007) recommendation and performed a bootstrap analysis.

Table 3 Confirmatory factor analysis of the measures

Models	χ^2	χ^2/df	NFI	TLI	CFI	RMSEA
Hypothesized 4-factor model	287.827	1.418	.898	.963	.967	.043
2-factor model (F1 = GL + GC, F2 = GPP + GCC)	1345.102	6.467	.522	.511	.560	.154
2-factor model (F1 = GL + GCC, F2 = GC + GPP)	1355.145	6.515	.519	.507	.556	.155
3-factor model (F1 = GL + GPP, F2 = GC, F3 = GCC)	1860.7	3.92	.843	.859	.866	.109
3-factor model (F1 = GL + GPP, F2 = GC, F3 = GCC)	704.406	3.419	.750	.784	.807	.103
Single-factor model	1716.382	8.212	.390	.355	.417	.177

GL green leadership, GCC green co-creation, GPP green project performance, GC green creativity

Table 4 Relationship between GL and GPP mediated by GKC moderated by GCC

Relationship	Coefficients	SE	<i>T</i>
Age → GPP	0.047	0.086	0.55
Education → GPP	0.012	0.060	0.19
Work experience → GPP	−0.019	0.090	−0.215
Gender → GPP	0.066	0.095	−0.693
GL → GPP	0.23**	0.058	3.992
GC → GPP	0.32**	0.079	4.071
GL → GC	0.22**	0.147	1.22
GL × GCC → GC	0.017	0.058	3.992

SE standard error, *GL × GCC* interaction term of green leadership and green co-creation, *GL* green leadership, *GCC* green co-creation, *GPP* green project performance, *GC* green creativity

** $P < .01$

Wang et al. (2017) asserted that the typical estimations of mediating impact do not adhere to the usual trend and might even result in bias, and the bootstrap method offers the most precise confidence intervals for indirect effect estimation. We anticipated 95% bias-corrected bootstrapped confidence intervals (CIs) using 5000 data samples due to their capacity to detect instances in which the sample distribution of the mediated effect is skewed away from 0 (Shrout & Bolger, 2002). The upper and lower range values for green creativity both omit 0, indicating that they are statistically significant. The bootstrap analyses show that green creativity has a favorable mediating effect among green leadership and green project performance ($\beta = 0.066$, $SE = 0.056$, $P < 0.05$, 95% $CI = 0.122, 0.345$). It should be emphasized that there was a substantial direct association between green leadership and green project performance, implying that green creativity significantly mediates the connection between green leadership and green project performance.

Moderated Mediation

To investigate hypotheses 3a and 3b, we used model 7 of PROCESS method to determine moderation and moderated mediation (Preacher & Hayes, 2008; Preacher et al., 2007). A moderated mediation model is distinguished by the involvement of a moderator; in this case, green co-creation was proposed as a moderator. According to Table 4, green co-creation insignificantly moderates the relationship between green leadership and green creativity ($\beta = 0.017$, $P < 0.001$). The bias-corrected percentile bootstrap results also revealed that the conditional indirect relationship between green leadership and green creativity was insignificant at a standard deviation (SD) above the mean (estimate = 0.0038, $SE = 0.024$, 95% $CI = -0.001, 0.093$) and at a SD below it (estimate = 0.04, $SE = 0.01$, 95% $CI = -0.15, 0.15$). Given this, both the direct and indirect approaches have not been controlled by green co-creation. As a result, hypotheses 3a and 3b were rejected.

Discussion

This study aimed to focus and highlight the leadership style essential to achieve sustainability. The study's findings are consistent with the theory and highlight green leadership's significant role in projects. Green leadership enacts and facilitates green processes by providing green targets, green mutual learning, and energy conservation practices (Shoib et al., 2021). Guidelines that can be implemented in organizations to produce greener outcomes (i.e., green project performance) are facilitated by green leadership (Nawaz Khan, 2023). Employees are given greater resources by green leadership to act more sustainably (Aboramadan et al., 2021). These results are in line with earlier research in this field (Afsar et al., 2016; Xing & Starik, 2017), which examined these relationships in various industries. The successful implementation and achievement of sustainable project management outcomes are referred to as “green project performance.” The incorporation of environmental factors and the adoption of sustainable practices throughout the project lifetime are necessary for achieving green project performance, managed by a green leader. However, the results of this study specifically highlight its role toward the performance of green projects. The rate of energy consumption has doubled in the last century and calls for the need to highlight procedures, skills, and behaviors required to achieve greener options (Desalegn & Tangl, 2022). The accelerating mechanism also includes the presence of a green leader. A green leader can understand and promote the need to opt green options including cost reduction, and efficient procedures (Yingfei et al., 2022).

This study also tried to highlight the underlying mechanism through which green leadership helps to achieve green project performance, i.e., green creativity. This is because green creativity is the basic requirement to produce energy-efficient solutions (Arici et al., 2022); it helps to reduce environmental risks and manage resources. Based on the social exchange theory and evidenced by the results, green leader promotes and appreciates green solutions and opportunities. Appreciation and promotion of green creativity leads toward green project performance. The study's findings are consistent with those of earlier research, which suggest that leadership is a key idea that motivates staff members—internal resources—to pursue an organization's environmental goals, such as green innovation and creativity (Bhutto et al., 2021; Zhang et al., 2020a, b). Many academics are now focusing on green innovation and creativity instead of more general discussions of innovation and creativity, with a special emphasis on the role of leadership in these environmentally friendly practices (Farooq et al., 2021; Li et al., 2019, 2020). Also, promoting green creativity through green leadership will help achieve green project performance. The same is supported by earlier research, which showed that an organization's level of creativity influences its quality, superior performance, and long-term growth. On the other hand, limiting green creativity may result in several shortcomings (AlQershi et al., 2023), which may include resource loss, energy depletion, extra costs, mismanagement of resources, and delayed tasks all of which may contribute toward poor project performance.

Furthermore, we evaluated the role of green co-creation as a moderator between green leadership and green creativity. However, results do not approve of its moderating relationship. It was asserted that green co-creation is a strategic resource to achieve sustainability as it helps to obtain, preserve, transmit, and use knowledge (Rubel et al., 2021; Yu et al., 2022). Also, we argued that green leader moves with a vision by designing and promoting green co-creative practices that may lead to green creativity (Huo et al., 2022). It is a fundamental resource (Kim et al., 2021) and is essential to achieve organizational sustainability (i.e., green project performance) (Batool et al., 2023). This may be because knowledge co-creation is not a simple task as it involves active process learning (Ruoslahti, 2020) and requires organizations to incorporate appropriate communication tools, institutional arrangements, and tailored funding possibilities. Sustainability requires critical reflection from the researchers, funders, and policy makers (Mauser et al., 2013). Our results may thus imply that green project is straightforward purposeful practices. The major responsibility lies on the shoulder of project manager to reset system for knowledge co-creation. The project tasks are connected and cannot work without co-creation especially for the sustainable projects where the knowledge is still in its developing stage.

Despite predictions, this study did not find support for the expected moderating effect of green co-creation on the connection between green leadership and green creativity. The potential reason for this unforeseen result could be the Asian administration and leadership philosophy. According to the findings of research conducted by Venkatesh et al. (2022) senior management does not believe in co-creation and collaborations with the subordinates. According to a few studies, creativity has a distinct connotation in Asian culture (Shao et al., 2019). They explained how co-creation among Asian managers is primarily seen as a means of achieving group unity as compared to improving knowledge quality and contribution (e.g., creativity). Asian managers used authoritarian leadership, adopting rules without much input from their employees, according to Ali et al., (2021a, b). According to Le and Lei (2019), co-creation is not a strong predictor of innovative thinking. We contribute to the project literature by arguing that co-creation has little to no impact on the association between green leadership, employee green creativity, and project performance.

Theoretical Implications

Over time, research on environmental policies has been conducted. However, a few researchers have focused on achieving green project performance. It emphasizes the significance of taking sustainability considerations and coordinating leadership techniques with environmental goals. It aids in defining the qualities and skills that green leaders need to effectively lead green projects. Based on social exchange theory, it has also been determined how green leadership is mirrored in project staff leading to green project performance.

Based on the typical norms of social exchange theory, green leaders boost green project performance through green exchange (ideas and vision) influencing outcomes (green creativity and green project performance). Regarding the moderating

role of co-creation, results are opposite to what was proposed previously, which is an interesting contribution of the current study: the role of green co-creation did not contribute as a moderator between co-creation and green creativity. This may be due to the Asian culture, where the leaders are most likely to refrain to involve employees to share and exchange knowledge. However, if the leader has green vision oneself that may promote creativity in employees, that helps to successfully complete the project.

Practical Implications

This study holds immense practical importance. Economies are striving to produce the green options. The alarming situation of the world where the race is to save resources, and this study provides a direction that along many factors which contribute to accomplish green projects, the role of green leadership cannot be neglected. Although a number of leadership styles have been studied in project domain, less has been emphasized on green projects. Project planning and execution methodologies can be influenced by the role of green leadership in advancing green project performance. Organizations can match their project management methods to sustainability objectives by incorporating environmental factors into resource allocation and decision-making. Green leadership results in various productive outcomes, leading to improved green project performance. Directions from the green leader will help achieve the desired green project performance because green project performance impacts climate change (Elliott, 2012). Practitioners can benefit by green leadership as it also contributes toward achieving green creativity. They should focus on green policies and alter the behavior of the employees to achieve green project performance. Project employees will tend to propose green solutions toward the project problems to save resources and the environment. However, the role of green co-creation did not moderate the relationship between green leadership and green creativity. This may be due to the Asian culture where the leaders do not involve the other members due to power distance. However, green leadership should be promoted, and green co-creation is not necessarily required. Organizations can stand out in the market, entice environmentally sensitive clientele, and cultivate a positive reputation as socially responsible companies by incorporating green leadership practices into project management. Overall, both the theoretical and the practical implications of this study offer insightful information about the function of green leadership in green project performance, providing direction for academics and professionals working to advance sustainability in project management.

Limitations and Future Research

The current study holds immense importance and provides a roadmap to achieve green project performance. However, the scope of the study is limited and can be extended by studying the other underlying mechanisms. Most importantly, the role of green co-creation should be evaluated in other cultures between the said

relationships because it did not affect the outcomes for the current study. Likewise, the current study provides a roadmap to achieve green project performance in development projects. Its role toward other sectors should also be tested to improve the generalizability of the results. There could have been many other underlying mechanisms that influence this relationship, e.g., the role of green leadership should also be studied through other mediators, i.e., green employee voice behavior and green employee engagement. In the future, real-time cases adapting green creativity should also be considered. As without employee voice, there cannot be any progress toward collaborative knowledge and co-creation which effects project performance. Same goes for green employee engagement. Also, this research was conducted in Asian culture where the leadership style differs from the Western culture where the leader lets employees to be more vocal. Thus, this research has its limitations depending on the context and leadership style. Moreover, there can also be some other moderators of the study including big data analytics and organizational data integration tools.

Declarations

Conflict of Interest The authors declare no competing interests.

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