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Designing a Green Leadership Model in Digital-Age Organizations

ABSTRACT

The present study aimed to design a green leadership model for organizations in the digital age. This research was conducted within an interpretive paradigm and employed a qualitative approach, using the thematic analysis strategy to analyze the collected data. The statistical population consisted of experts from the National Nutrition and Food Technology Research Institute. Data were gathered through semi-structured interviews with 15 experts who were selected purposively. The inter-rater agreement was calculated using Cohen's Kappa coefficient, which was 0.75. Based on the findings, three overarching themes and seven subthemes were identified. The overarching themes included value-driven green leadership (organizational green vision, ethics-oriented leadership style); digital green leadership (environmental digital literacy, green transformational leadership, green technological creativity); and green synergy (digital social responsibility, cross-sectoral environmental collaboration). The findings indicate that digital green leadership, as an integrative approach, plays a crucial role in addressing environmental and technological challenges faced by contemporary organizations. Leaders with technological insight and environmental commitment can leverage emerging technologies and reinforce ethical and cultural values to foster sustainable transformation, enhance organizational agility, and institutionalize a culture of responsibility in the workplace.

Keywords: digital green leadership, digital transformation, artificial intelligence in management, environmental digital literacy, green innovation, value-driven leadership

Introduction

The twenty-first century has witnessed an unprecedented convergence of environmental imperatives and digital disruption, reshaping the way organizations approach leadership and sustainability. Growing awareness of climate change, resource depletion, and ecological degradation has compelled organizations to adopt proactive environmental strategies that go beyond compliance and aim for long-term sustainable value creation [1, 2]. Simultaneously, the rapid acceleration of digital technologies—such as artificial intelligence (AI), big data analytics, cloud computing, and the Internet of Things (IoT)—has revolutionized organizational structures, decision-making processes, and stakeholder engagement [3, 4]. Within this complex and evolving context, digital green leadership emerges as a strategic imperative to harmonize technological advancement with ecological stewardship and social responsibility [5, 6].

Leadership has long been recognized as a key determinant of organizational transformation, shaping culture, innovation, and sustainable behavior [7, 8]. Traditional transformational leadership, with its focus on vision creation, empowerment, and intellectual stimulation, has been identified as a strong driver of green organizational change [9, 10]. However, the digital era

calls for an expanded paradigm where leaders not only inspire and motivate but also leverage emerging digital technologies to drive sustainability-oriented innovation and performance [11, 12]. This integrative view recognizes that environmental responsibility and technological agility can no longer operate in isolation; instead, they must converge to create adaptive, future-ready organizations [3, 13].

One of the critical enablers of this convergence is environmental digital literacy, which equips leaders and employees with the interdisciplinary knowledge and skills required to identify, analyze, and address ecological issues using digital tools [5, 14]. As organizations adopt digital infrastructures for data-driven decision-making, predictive analytics, and real-time monitoring, the ability to integrate sustainability metrics into these platforms becomes essential [4, 15]. Research has shown that enhancing environmental literacy within digital frameworks can empower managers to embed sustainability in operations and foster a culture of accountability and continuous learning [16, 17].

Another defining aspect of digital green leadership is its alignment with green transformational leadership. This style extends beyond traditional leadership by emphasizing profound attitudinal and behavioral changes toward environmental stewardship and social responsibility [9, 10]. Green transformational leaders articulate a compelling eco-centric vision, inspire pro-environmental behaviors, and create conditions where creativity and ethical responsibility thrive [7, 18]. When digital capabilities—such as AI-powered decision support and blockchain-enabled supply chain transparency—are integrated into this style, leaders can accelerate sustainable transformation and make environmental accountability traceable and measurable [3, 12].

Green technological creativity is another fundamental pillar of digital green leadership. Organizations seeking to minimize their ecological footprint increasingly rely on technological innovation to redesign products, processes, and business models [5, 13]. By harnessing big data for eco-efficiency, IoT for smart resource utilization, and cloud platforms for collaborative innovation, leaders can advance solutions that reduce waste, optimize energy consumption, and generate sustainable value for stakeholders [3, 19]. Green creativity also cultivates an environment where employees feel empowered to experiment with novel approaches to environmental challenges, reinforcing organizational resilience and competitiveness [7, 14].

Beyond internal organizational dynamics, digital green leadership addresses the importance of green synergy through external collaboration and social responsibility. Scholars argue that sustainability challenges, such as climate adaptation and biodiversity loss, require systemic responses that transcend organizational boundaries [6, 18]. In this regard, digital social responsibility emerges as a framework for organizations to ethically and consciously use digital technologies to serve public interests, protect the environment, and promote transparency [1, 5]. For instance, blockchain can be employed to ensure supply chain traceability, and digital platforms can engage communities in environmental campaigns and knowledge sharing [3, 16].

Similarly, cross-sectoral environmental collaboration has become indispensable for tackling complex sustainability issues [6, 20]. Partnerships between governments, private industry, universities, and civil society are increasingly mediated through digital ecosystems that facilitate data exchange, joint problem-solving, and real-time impact assessment [17, 21]. Digital platforms enable such collaborations by breaking down silos and fostering networks where diverse expertise converges to create innovative solutions to environmental challenges [10, 13].

The emerging literature on green digital leadership underscores its strategic significance in balancing environmental responsibility with competitive advantage [5, 12, 15]. In highly dynamic markets, companies must integrate sustainability into

their digital transformation journeys, turning environmental goals into innovation drivers rather than compliance burdens [3, 16]. As noted in prior studies, green digital transformation not only mitigates environmental impact but also strengthens corporate reputation, stakeholder trust, and long-term profitability [1, 2, 18].

Within the Iranian context, the need for such integrative models is particularly critical. Despite growing environmental concerns and the global move toward digital economies, public and private organizations in Iran often lack a coherent framework for embedding sustainability into their digital strategies [16, 17, 21]. Previous research has proposed green management models for governmental and educational institutions but has rarely addressed how digital technologies can be systematically incorporated [11, 20]. This gap limits the ability of leaders to respond effectively to both technological disruption and ecological pressures.

Furthermore, studies highlight the critical role of leadership mindset and culture in enabling successful digital green transformation [5, 12]. Leaders who embrace a green digital mindset—characterized by environmental awareness, technological curiosity, and ethical orientation—are better positioned to inspire sustainable digital innovation [7, 13]. Conversely, the absence of such leadership capacities can result in fragmented sustainability initiatives and underutilized digital tools [3, 4].

In addition to leadership capabilities, employee engagement plays a mediating role in translating green visions into actionable behaviors [10, 14]. Encouraging voluntary pro-environmental behavior, promoting knowledge sharing, and fostering creative self-efficacy are essential to embedding green values across organizational levels [7, 9]. Digital platforms can amplify these efforts by enabling real-time collaboration, gamified sustainability challenges, and transparent tracking of environmental performance [6, 15].

Given the growing body of evidence, the present study addresses a vital research gap by designing an integrative green leadership model suited for digital-age organizations.

Methodology

This study, which is developmental in purpose, was conducted using a qualitative approach and thematic analysis. The stages of thematic analysis followed the model of Braun and Clarke (2006) and are as follows: this step included selecting the topic, formulating the research problem, defining the objectives and research questions, choosing the research design, and determining the scope, population, and sample.

The primary inclusion criteria for participation were holding a doctoral degree and possessing specialized knowledge in the field of public management, along with work experience and research activity in the related domain at the National Nutrition and Food Technology Research Institute. Participants were selected purposively. Data were collected through semi-structured interviews with 15 experts. Interviews continued until theoretical saturation was reached.

In the next stage, after transcribing the interviews and complementing them with notes taken during the sessions, the researcher conducted careful and repeated reviews of the interview texts, identifying independent ideas as basic themes and assigning a code to each. The process included the identification of basic, organizing, and overarching themes and the abstraction and mapping of the thematic network. The thematic network illustrated the nonlinear relationships among themes. The findings section provides a detailed discussion of the themes, the thematic network, and its interpretation.

To ensure research reliability, inter-coder agreement was applied. In addition to the primary researcher who performed the initial coding, another researcher independently coded the findings. The closeness of the two coding sets indicated agreement and thus reliability. Cohen's Kappa coefficient was calculated to measure the level of agreement, resulting in a value of 0.75, which indicates acceptable reliability. To ensure research validity, in addition to applying researcher sensitivity throughout the process, the findings were shared with three academic experts and confirmed by them. In the thematic analysis process, interviews were first transcribed and then supplemented with field notes taken during the interview sessions.

Findings and Results

The demographic characteristics of the experts are presented in Table 1.

Table 1

Research Interviewees

Work Experience	Organizational Position	Education	Gender	Age	Interviewee Code
More than 10 years	Faculty Member	PhD	Female	43	P1
More than 10 years	Faculty Member	PhD	Female	39	P2
5–10 years	Faculty Member	PhD	Female	40	P3
More than 10 years	Faculty Member	PhD	Female	44	P4
5–10 years	Faculty Member	PhD	Male	36	P5
More than 10 years	Faculty Member	PhD	Male	54	P6
More than 10 years	Faculty Member	PhD	Male	45	P7
More than 10 years	Faculty Member	PhD	Male	46	P8
5–10 years	Faculty Member	PhD	Male	57	P9
More than 10 years	Faculty Member	PhD	Male	47	P10
5–10 years	Senior Manager	Master's	Male	37	P11
More than 10 years	Senior Manager	Bachelor's	Male	56	P12
More than 10 years	Senior Manager	Master's	Female	37	P13
More than 10 years	Senior Manager	Bachelor's	Male	47	P14
More than 10 years	Senior Manager	Bachelor's	Female	51	P15

Subsequently, through careful and repeated review, independent ideas were first identified for each interview as basic themes, and each was assigned a unique code. When similar parts appeared in subsequent interviews, previously established codes were used as indicators. Table 2 presents a selection of open coding applied to the interview texts.

Table 2

Sample of Open Coding of Interview Texts

Interviewee Code	Interview Text	Basic Themes
I3	"Employee well-being for us is not just benefits and salaries. We are now implementing programs that include mental health, quality of work life, and even training in environmental and workplace sustainability. This has increased employees' commitment."	Commitment to employee well-being
I7	"In our policies, we tried to ensure continuous support for ethical decision-making, meaning not just as a slogan. For example, employees who made difficult decisions to protect the environment and workplace, even at higher costs, were supported and given positive points in evaluations."	Sustainable ethical support

Ultimately, the initial themes were extracted. After identifying the basic themes, the organizing and overarching themes were abstracted based on them. At this stage, the initial or basic themes were reorganized to derive more abstract concepts, leading researchers to broader and more central overarching themes. In this phase, 27 basic themes, 7 organizing themes, and 3 overarching themes were identified and presented in Tables 3 to 5.

Table 3

Thematic Analysis Results — Value-Driven Green Leadership

Organizing Themes	Basic Themes	Initial Themes
Value-Driven Green Leadership	Organizational Green Vision	Environmental foresight, Low-carbon goal setting, Organizational development with artificial intelligence, Raising organizational environmental awareness, Resource protection
	Ethics-Oriented Leadership Style	Decision-making based on ethical values, Transparency in management processes, Honesty in organizational communication, Justice in resource and opportunity allocation, Accountability for individual and organizational performance, Commitment to employee well-being, Sustainable ethical support

Value-driven green leadership refers to a style and approach to leadership shaped by moral beliefs, social responsibility, and a commitment to environmental sustainability. In this model, the green leader is not merely a manager of resources and processes but also a carrier and promoter of values that direct employees' and the organization's environmental and social behaviors. This dimension is defined through two components: organizational green vision and ethics-oriented leadership style.

An organizational green vision is a forward-looking, inspiring, and sustainable picture of the organization's desired position, framed by principles of environmental protection, sustainable development, social justice, and ethical use of modern technologies. This vision is developed and institutionalized by green leaders so that all organizational activities and decisions align with it.

On the other hand, an ethics-oriented leadership style is one in which managerial decisions, behaviors, and interactions are shaped by ethical values, honesty, fairness, mutual respect, transparency, and accountability. In this style, leaders are not only focused on organizational goals but also show serious commitment to public good, stakeholder interests, and human principles.

Table 4

Thematic Analysis Results — Digital Green Leadership

Overarching Themes	Organizing Themes	Basic Themes
Digital Green Leadership	Environmental Digital Literacy	Awareness-raising with artificial intelligence, Digital analytics of resource consumption
	Green Transformational Leadership	Inspiring employees, Green empowerment, Creating a sense of belonging to a sustainable future
	Green Technological Creativity	Innovation in pollution reduction, Integrating technology with environmental solutions

Digital green leadership is an emerging approach to organizational leadership in which leaders intelligently leverage digital technologies (such as the Internet of Things, artificial intelligence, cloud computing, blockchain, and big data) to achieve organizational goals in environmental sustainability, social responsibility, and green innovation. Digital green leadership is not only a response to environmental crises but also a forward-looking strategy for adapting to the competitive dynamics of the digital age. Digital green leaders are the drivers of green transformation; they not only manage natural resources but also direct organizational technological transformation toward sustainability and ethics. This dimension emphasizes environmental digital literacy, green transformational leadership, and green technological creativity.

Environmental digital literacy refers to an interdisciplinary set of knowledge, attitudes, and skills that enables individuals—particularly organizational leaders—to consciously use digital technologies to identify, analyze, manage, and solve environmental issues. Environmental digital literacy is a critical foundation for green leadership in the digital era. It helps leaders and employees utilize technology not merely for productivity but also for ecological sustainability, ethical decision-

making, and social accountability. Without strengthening this form of literacy, the full realization of digital green leadership is not possible.

Green transformational leadership is a leadership style inspired by the classical transformational leadership model, aimed at creating fundamental attitudinal and behavioral changes aligned with environmental values, sustainability, and social responsibility. In this approach, the leader not only guides and inspires but also uses green perspectives and digital tools to steer the organization toward innovative environmental goals.

Green technological creativity refers to the organization's and its leaders' ability and willingness to design and implement innovative technological solutions that reduce environmental impact, improve resource efficiency, and create sustainable value for stakeholders. Green technological creativity acts as the innovation arm of digital green leadership, guiding organizations to intelligently design products and processes that fully align with environmental, sustainability, and technological objectives. In fact, without developing this dimension, no model of green leadership in the digital era can be effective or future-oriented.

Table 5

Thematic Analysis Results — Green Synergy

Organizing Themes	Basic Themes	Initial Themes
Green Synergy	Digital Social Responsibility	Virtual green campaigns, Supply chain transparency, Online reporting of green performance
	Cross-Sectoral Environmental Collaboration	Joint collaboration between public and private sectors, University and research center partnership with industry, Digital platforms for facilitating environmental collaboration, Creating collaborative networks for solving environmental problems, Technological collaboration with green start-ups

Green synergy refers to the purposeful and coordinated interaction among various organizational units, stakeholders, technologies, and human resources to achieve environmental and sustainability goals so that the overall outcome exceeds the sum of individual efforts. This approach, by combining technological rationality, sustainability values, and broad participation, enables organizations not only to act more effectively and responsibly but also to tap into hidden capacities for innovation and competitiveness in the future. This dimension is defined through digital social responsibility and cross-sectoral environmental collaboration.

Digital social responsibility refers to the organization's commitment to the conscious, ethical, and sustainable use of digital technologies in pursuit of public good, environmental protection, consumer rights, and community support. Digital social responsibility is an overarching element of green leadership in the technological era. In this framework, organizations are not only accountable to legal and ethical obligations but also actively shape digital transformation toward social and environmental goals.

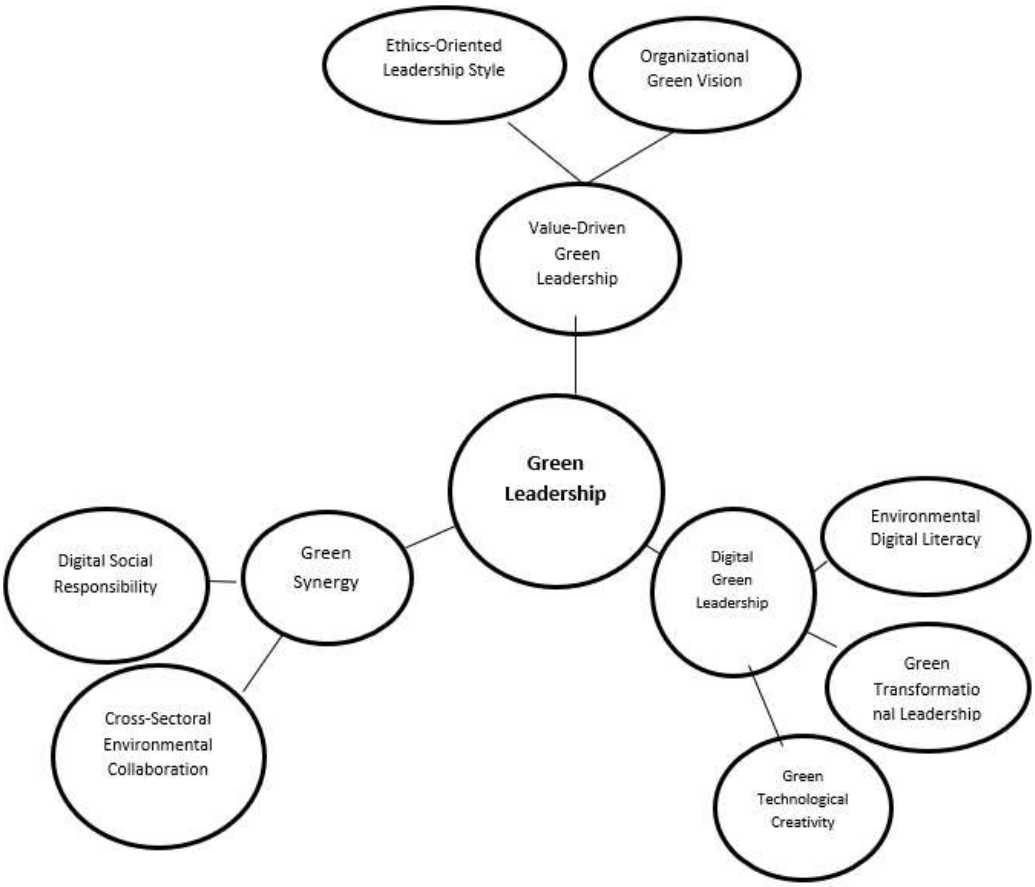
Cross-sectoral environmental collaboration refers to structured, purposeful, and interactive cooperation among different sectors (including governmental, private, academic, civil society, and technological actors) to solve environmental problems. In this form of collaboration, other organizations and institutions are not merely stakeholders but are considered co-creators in the process of developing environmental solutions.

Accordingly, in the era of digital transformation, organizations face complex challenges regarding environmental sustainability and social responsibility. In this context, green leadership as an innovative managerial approach plays a pivotal role in guiding organizations toward sustainable development. The findings of this section, by focusing on the interaction between emerging technologies and environmental values, examine the dimensions, components, and impacts of green

leadership within digital organizations—where digital literacy, technological innovation, and professional ethics are intertwined to create a forward-looking and sustainable vision. Therefore, the components of the green leadership model in digital-age organizations are presented in Figure 1.

Figure 1

Green Leadership Model in Digital-Age Organizations



Discussion and Conclusion

The present study aimed to design an integrative model of green leadership for organizations in the digital age, drawing on qualitative insights from experts in management and sustainability. The thematic analysis yielded three overarching dimensions—value-driven green leadership, digital green leadership, and green synergy—supported by seven organizing themes and twenty-seven basic themes. This conceptual structure highlights how contemporary leaders can align environmental stewardship with technological innovation to respond to complex sustainability challenges while remaining competitive and adaptive in a rapidly evolving digital economy.

One of the key findings is the centrality of value-driven green leadership, which emphasizes an organizational green vision and an ethics-oriented leadership style. The study shows that leaders who cultivate a future-oriented environmental vision and embed ethical values such as transparency, fairness, accountability, and employee well-being create a moral foundation for sustainable transformation. These findings align with the work of [1] and [2], who argue that environmental leadership requires deep consciousness development and moral commitment, not merely technical adaptation. In the Iranian context,

the emphasis on ethical, value-based leadership resonates with prior models of sustainable management proposed for governmental and educational organizations [16, 17]. By articulating a green vision and embedding moral integrity in decision-making, leaders can align daily operations with long-term sustainability and social responsibility [11].

Another significant outcome is the identification of digital green leadership as a distinct but interdependent dimension of sustainable leadership. This category integrates environmental digital literacy, green transformational leadership, and green technological creativity. The results show that leaders who are digitally literate in environmental contexts can analyze resource use, deploy AI and big data to monitor sustainability metrics, and encourage innovative solutions to ecological problems. This finding aligns with the emerging literature on green digital transformational leadership [5], which posits that the fusion of digital tools and green culture accelerates sustainable innovation. Similarly, [3] describes how digital empowerment drives the evolution of enterprise green strategies by enabling real-time data-driven environmental decision-making. The ability to integrate digital competencies with environmental responsibility is also emphasized by [4], who notes that digital leadership can improve sustainable performance when it is grounded in ethical and ecological awareness.

Furthermore, the notion of green transformational leadership within digital settings builds on existing scholarship that links transformational leadership to pro-environmental behavior [9, 10]. Our findings suggest that green transformational leaders use digital tools to inspire, empower, and instill a sense of belonging to a sustainable future. This aligns with [7], who identified creative self-efficacy and knowledge sharing as mechanisms through which transformational leaders drive innovation and commitment. Similarly, [14] found that green organizational identity and knowledge sharing reinforce sustainable behavior among employees. By fusing these elements with digital capabilities such as AI-driven decision support and IoT-enabled monitoring, leaders can amplify their transformative influence and ensure environmental objectives are embedded into organizational culture.

Another critical insight is the strategic importance of green technological creativity. The participants highlighted that organizations must not only adopt digital tools but also innovate in ways that reduce environmental impact and create long-term value. This result corroborates [13], who frames entrepreneurial leadership in the digital age as inherently linked to sustainability-oriented innovation. The capacity for green technological creativity also resonates with [19], who found that green leadership fosters supportive policies for environmental practices. [3] further emphasizes that technological empowerment provides organizations with the agility to respond to environmental pressures through adaptive and innovative strategies.

Beyond the organizational level, the emergence of green synergy as a dimension highlights the importance of digital social responsibility and cross-sectoral environmental collaboration. The study demonstrates that organizations must leverage digital platforms to ensure transparency in green performance, run virtual environmental campaigns, and build partnerships that transcend traditional sectoral boundaries. These findings support the arguments of [6], who suggests that green leadership in policymaking depends on systemic collaboration and shared responsibility for sustainability. Similarly, [18] shows that green servant leadership improves organizational green performance by fostering voluntary pro-environmental behavior and a supportive psychological climate. In the Iranian setting, where fragmented environmental governance is a challenge, digital infrastructures can provide transparency and foster cross-sector collaboration [16, 21].

The concept of digital social responsibility identified in this study goes beyond conventional corporate social responsibility by emphasizing the ethical use of digital technologies for ecological and social impact. This aligns with [5], who highlights that

organizations adopting a green digital culture actively shape their digital transformation toward sustainable goals. The use of blockchain for supply chain transparency, digital platforms for environmental reporting, and online environmental campaigns reflects the emerging practice of embedding social and ecological accountability within digital infrastructures [3, 20].

Additionally, the study's focus on cross-sectoral collaboration addresses a well-documented gap in sustainability research. Complex environmental issues require partnerships between governments, businesses, academia, and civil society, enabled by digital platforms for data sharing and co-creation of solutions [6, 10]. This resonates with the insights of [17] and [16], who advocate collaborative frameworks in Iranian public institutions to promote sustainability. The integration of digital ecosystems, such as cloud-based innovation hubs and AI-enabled environmental monitoring networks, facilitates such collaboration, supporting the dynamic interplay of technological rationality and ecological values [13].

Our results further reinforce that digital green leadership offers not only environmental benefits but also competitive and reputational advantages. Organizations that embed sustainability into their digital transformation strategies can differentiate themselves, attract environmentally conscious stakeholders, and maintain resilience in uncertain markets [1, 2]. According to [15], green transformational leadership and innovation are directly linked to sustainable business performance, while [12] warns that digital transformation without ethical and environmental grounding risks reputational and operational failure. The present model integrates these insights by providing a framework where ethical values, digital literacy, and innovative collaboration reinforce each other to create long-term impact.

In sum, this research advances the theoretical and practical understanding of green leadership by bridging the domains of sustainability and digital transformation. It confirms and extends earlier findings on environmental leadership [1], transformational leadership [7, 9, 10], and digital leadership [4, 5], while contextualizing them in a holistic model relevant for emerging economies such as Iran. By demonstrating how value orientation, technological competence, and collaborative ecosystems can be integrated, the study provides a roadmap for leaders seeking to navigate ecological and digital complexity simultaneously.

This study, while offering valuable conceptual contributions, has certain limitations that should be acknowledged. First, the research is qualitative and based on a purposive sample of 15 experts from specific Iranian organizations, which may limit the generalizability of the findings to other sectors or cultural contexts. Second, although thematic analysis provided deep insight into expert perspectives, the model has not yet been quantitatively validated; thus, the strength of relationships between the identified dimensions and organizational outcomes remains to be tested. Third, because the study focused primarily on leaders with experience in governmental and academic settings, private sector perspectives, especially from technology-driven industries, may be underrepresented. Finally, the rapid pace of digital innovation means that some technological aspects discussed (e.g., AI, blockchain, IoT) may evolve quickly, requiring continuous refinement of the model to remain relevant.

Future studies can build on this work by employing mixed-methods or quantitative designs to validate the proposed model statistically across diverse organizational contexts. Researchers could explore causal relationships between digital green leadership and measurable outcomes such as organizational resilience, environmental performance, and employee green engagement. Comparative cross-cultural studies would also help examine how cultural and institutional differences shape the adoption of digital green leadership. Additionally, longitudinal research could track the evolution of digital and sustainability integration over time, offering insight into how leaders adapt to technological disruptions and changing

environmental regulations. Expanding the scope to include small and medium-sized enterprises and technology startups could further enrich the understanding of green technological creativity and collaborative digital ecosystems.

Leaders and policymakers can use the findings of this study as a strategic guide for fostering digital green transformation. Organizations should invest in developing environmental digital literacy among managers and employees to ensure technology is used ethically and effectively for sustainability goals. Leadership development programs can integrate green transformational principles with digital skill-building to prepare future leaders for ecological and technological challenges. Furthermore, establishing digital platforms for transparency, environmental reporting, and cross-sector collaboration can enhance trust and accelerate collective sustainability initiatives. Finally, embedding a value-driven culture anchored in ethical responsibility and long-term ecological vision can help organizations remain both competitive and socially accountable in the digital age.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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