The Effects of Digital Leadership and ESG Management on Organizational Innovation and Sustainability

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Abstract: Companies around the world have recognized that environmental issues and social values constitute some of the most important management concerns and have actively introduced environmental, social, and governance management (ESG management, ESGM). In the digital age, an attempt is also often made to incorporate digital transformation into ESGM. However, research on the combination of digital leadership, ESGM, and organizational innovation is still in its early stages. Therefore, in this study, a research model was constructed by combining ESGM and organizational innovation (OI) from the perspective of digital leadership (DL). Specifically, for achieving organizational sustainability (OS), the mediating effect of two variables—ESGM and organizational innovation—was also explored, and empirical analysis was conducted on Korean and Chinese companies. We took into consideration the premise that the impact of digital leadership, ESGM, and organizational innovation on organizational sustainability could be different due to the differences in the cultures and systems of the two countries. For empirical analysis, partial least squares structural equation modeling (PLS-SEM) was used. The results showed that digital leadership in both countries had a significant effect on ESGM and organizational innovation. Specifically, both digital leadership and ESGM together with organizational innovation played an important role in organizational sustainability in the entire model. However, between digital leadership and organizational sustainability, the mediating effect of ESGM and organizational innovation was different, viz., Korea had partial mediating effects and China had complete mediating effects. It is expected that this study would fill the research gap in the area of digital leadership in ESGM and contribute to the implementation of corporate ESGM strategies and organizational innovation. Furthermore, valuable implications for organizational sustainability and the sustainable growth of companies are also presented.

Keywords: digital leadership; ESG management (ESGM); organizational innovation; organizational sustainability; Korea and China

1. Introduction

It has become difficult to overlook the significant changes caused by the deepening of a series of major global environmental and social problems such as global warming, economic polarization, ecological pollution, and resource depletion. Above all, the emergence of the coronavirus disease 2019 (COVID-19) pandemic saw the pursuit of new sustainable management practices in businesses in contrast to the existing focus on financial performance-oriented management. With the need for new value systems in corporate management, ESG has spread rapidly. In the end, ESGM, which takes into consideration value creation and the happiness of all stakeholders, has become an important part of business strategies since the outbreak of the COVID-19 pandemic [1], and this has had a great influence on organizational innovations.

What then is ESGM? This refers to a paradigm shift in a company's management towards a desirable direction by innovatively solving important environmental, social, and governance

issues through entrepreneurial thinking. In addition, securing the sustainability of surviving companies by adapting to recent social changes is becoming more important [2,3].

Aouadi and Marsat [4] empirically asserted that ESG significantly affects corporate values and sustainability in the long term. The integration of ESG strategies into management can secure a competitive advantage, increase operational efficiency and reputation, reduce waste, and thus eventually improve the shared value of the stakeholders and the company's sustainability [5]. ESGM seeks to perform activities taking into consideration the interests of the various stakeholders of a company in terms of the environment, society, and governance [6]. Recently, research has been conducted on organizational changes based on ESGM and employee awareness. Predicated on a clear and fundamental understanding of ESG, employees of the company performing their routine tasks should be exposed to a framework that naturally embraces change and engages in innovative activities for environmental change [7].

ESG and CSR have very similar aspects. However, ESG tends to be a more expansive terminology than CSR. Murcia [8] reported that CSR activities catalyze the innovation processes in a company. Broadstock, Matouk, Meyer, and Tzeremes [9] contributed to this debate by revealing the indirect value creation process under which firms' adoption of ESG endeavors initially affects innovation and eventually enhances financial performance through the channel of improved innovation capacity. Most of all, innovation occurs not only with respect to technological changes but also in non-technical fields, including marketing and organization. Additionally, organizational innovation (OI) has evolved into an important factor impacting a company's competitiveness and determining organizational viability [10]. In such a situation, the specific effects of organizational transformation and human resource management based on ESG activities have also been actively studied [11].

Meanwhile, the COVID-19 pandemic is further accelerating the application of digital technology to fields such as the environment. In other words, as the Fourth Industrial Revolution (Industry 4.0) accelerates worldwide, companies are actively promoting digital transformation (DT) to maintain their competitiveness in the digital environment [12]. Such fast-developing digital technologies continue to radiate their potential and are driving innovation in products, services, and business models [13].

Digital transformation facilitates enterprises in delivering diverse and agile responses, thus helping to achieve resource reconstruction [14]. In particular, recent attempts have often been made to combine digital transformation with ESG. For example, the Internet of Things (IoT) is on hand to help provide a cost-effective solution for the collection and reporting of ESG data. Metrics can be measured and collated with precision using IoT sensors, including carbon footprints, energy efficiency, water quality or usage, and waste management. Not only does this technology ensure that the data collected are accurate and streamlined but it also helps track a business's performance across key environmental, social, and governance factors. From helping to provide transparency over carbon emissions to leveraging satellite images, artificial intelligence also allows companies to collect and analyze more information than ever before while accounting for ESG risks and opportunities.

Nevertheless, many organizations fail to achieve digital transformation because they initiate technological changes without holistic planning and coherent digital strategies [15]. Leaders with mindsets towards digital transformation, also known as 'digital leaders', build collaborative network organizations and have higher digital competencies [16]. As such, digital leadership (DL) broadly affects a company's innovative performance through the combination of digital techniques and leadership [17] and thus contributes to its sustainable growth and performance.

Meanwhile, China, which has the largest consumer market among countries close to Korea, is one of the major emerging economies that has recently been paying attention to the implementation of digital technology [18]. Like Korean companies, Chinese companies also continue to show an increased interest in ESG. Despite this interest, it is also true that many Korean and Chinese companies cannot easily respond to these new changes that require

them to engage in ESG activities [19]. In addition, while there has been some research on the impact of digital transformation on ESG, there is still minimal research on the impact of digital leadership on ESGM. In particular, research has been carried out on innovation in ESG performance, but there is not much research on organizational innovation in ESGM.

We aimed to conduct a comparative study focusing on some issues faced by the two countries (Korea and China). Specifically, we wanted to pay attention to the following points of view: First, we wanted to examine the direct impact of 'DL' on OI, ESGM, and OS. Furthermore, we wanted to consider ways in which DL can be a potential driver of ESGM and corporate strategy. Second, as the importance of ESGM increases, it is believed that 'ESGM' can have a positive (+) mediating effect between 'DL', 'OI', and 'OS', and we wanted to examine these relationships. In addition, we wanted to examine whether 'OI' itself has a positive (+) mediating effect between 'DL', 'ESGM', and 'OS'. Third, a comparison between Korea and China not only provides important insights into future ESG strategies of companies in both countries but also contributes to laying the theoretical foundation for sustainable corporate development through 'OI' in the digital era.

Subsequently, this study progresses as follows: Section 2 examines the theory of major variables related to the research model presented in this study. Section 3 establishes some hypotheses and presents the research model for this study. Section 4 presents empirical analyses of companies in Korea and China. Finally, Sections 5 and 6 present a summary of the research results and implications.

2. Literature Review

2.1. Digital Leadership (DL)

The Fourth Industrial Revolution has made it very important for recent corporate leaders to quickly secure and promote changes [20]. Leaders with a future-oriented perspective have a clear vision and rational strategy and are able to grasp digital trends. A leader's ability to create a clear and meaningful vision for the digitalization process and the ability to build strategies to realize this vision are the core components of digital leadership. Zeike, Bradbury, Lindert, and Pfaff [21] defined digital leadership in their study as 'the ability of corporate leaders to drive digital transformation and find opportunities to use digital business technology to develop business and upgrade value'. Digital leadership is a modern concept that involves the use of digital platforms that dictate and influence employees' behavior to achieve the strategic objectives of the organization [22].

Mihardjo, Sasmoko, Alamsjah, and Elidjen [23] stated that digital leadership consists of an integration of culture and competencies in using digital technologies as part of the leadership style to generate value for the firm. Digital leadership is a blend of leadership skills comprising innovative and disruptive leadership through digital attitudes, including digital awareness and experience [24]. Rudito [25] defined the characteristics of digital leadership as comprising technology leadership, digital visioning, and digital execution. Zhu [26] described a digital leader as follows: 'In other words, the style of a digital leader is (1) creative; (2) a thinker; (3) has a global vision and suggests a willingness to cooperate; (4) an exploratory leader; and (5) a profound leader'. Digital leadership was also measured using a four-dimensional model consisting of digital culture, digital competencies, digital insights, and digital strategy [27]. Based on these earlier studies, this study aimed to consider various factors, such as creativity, deep knowledge, global vision and collaboration, thought, exploration, use of digital technology, digital capabilities, and the establishment of digital strategy, in order to evaluate digital leadership.

2.2. ESG Management (ESGM)

The concept of ESG includes factors related to the environment, society, and governance that may affect the capability of a company to execute its strategy and enhance corporate values [28]. ESG has been recognized as an important factor to consider when investing, especially for institutional investors. However, in recent years, the domain has expanded to encompass overall corporate management goals and activities [1]. There-

fore, companies are trying to introduce ESGM to respond to changes in the new business environment [29]. ESGM can be understood as a key management strategy in which companies pursue sustainability in the context of the environment, society, and governance [30]. A company's ESGM comprises activities that greatly affect its sustainability and long-term values by minimizing any negative impact on the entire society and maximizing the utility in terms of the environment, society, and governance.

Companies should consider all stakeholders who are affected by their performance to create corporate sustainability value in the long run [31]. ESGM internalizes negative external effects such as social polarization and environmental pollution through the realization of stakeholder capitalism and finds the optimal resource allocation between financial and social values to increase its utility to all stakeholders. Therefore, it is largely distinguishable from Corporate Social Responsibility (CSR) management, which aims only at improving long-term shareholder value [32]. Therefore, in this study, 'ESGM' is defined as a corporate strategy that companies carry out in terms of the ecosystem of the environment, society, and governance while considering the interests of all stakeholders to secure corporate sustainability.

2.3. Organizational Innovation (OI)

As competition intensifies in the era of globalization and rapid development of high-tech, the role of organizational innovation in building sustainable competitive advantages has become important for the survival and sustainable growth of companies in both developed and developing countries [33]. Considering all economic factors, organizational innovation is mainly related to four activities: new product development, new production processes, creative strategy, and economic organization [34]. This means that an organization adopts new ideas or actions that can take the form of new services or products, new structures, new production processes, or new administrative systems [35,36]. Organizational innovation involves the application of new and/or improved ideas and processes within the company's workplace, including marketing and management systems that provide cost savings and create value for the company and other external stakeholders, whereas technological innovation deals with the introduction of new products and processes directly for clients or customers [37,38]. It is the fundamental fountainhead of value creation and competitive advantage. If an organization has no intention of adopting innovation in its business, it has a lower probability of internal and external technology advancement compared to innovative organizations, and it is less likely to succeed [34]. Based on these existing studies, this paper defines organizational innovation as the 'integration and utilization of new products and services in technology or management, changes in existing production methods, implementation of new technological processes, or implementation of new management systems'.

2.4. Organizational Sustainability (OS)

Today, the importance of 'sustainability' is accelerating at the global level. Consequently, corporate goals are no longer confined to the traditional approach of financial performance but are instead consistent with social and ecological aspects [39]. Sustainability stems from a business strategy that drives long-term corporate growth and profitability by mandating that environmental and social issues be included in the business model and is 'a forward course' for companies to continue to operate in the new business environment. In terms of business, the foundation of organizational sustainability rests not only on an economic pillar but also on social and environmental pillars. Companies need to grow on these three pillars [40].

The economic sustainability aspect covers financial health, potential benefits in terms of finance, trading opportunities, and the company's financial performance [41]. In contrast, the social dimension of sustainability focuses on various forms of value related to employees and society, such as health and safety, labor standards, equality, well-being, development, and diversity [42]. Environmental sustainability focuses on a variety of value forms,

including pollution prevention (land, water, and air), renewable resources, low waste, low emissions, and biodiversity [39]. Based on the above studies, this study suggests that business models should not only consider 'economic benefits' but also 'social and environmental benefits' to achieve organizational sustainability.

3. Research Methodology

3.1. Digital Leadership (DL) and Organizational Innovation (OI)

The role of a leader is important in assuring and driving transformation and propelling change in Industry 4.0 [20]. Leadership significantly influences the continuity of innovation management, and this has been revealed in past studies [43,44]. These findings are also relevant in the digital age. In other words, digital leadership is a factor that has an important influence on innovation [45]. Digital leadership is a combination of transformative leadership styles and the use of digital technology [46]. Having a digital leadership style gives leaders unique characteristics that influence their behavior and decisions, thus having an impact on firm-level variables [47]. Sasmoko, Mihardjo, Alamsjah, and Elidjen [48] argued that digital leadership has a positive relationship with innovation capabilities. Wasono and Furinto [45] also emphasized that companies will increase their sustainable competitive advantage in a disruptive era by strengthening digital leadership and innovative management. Digital leadership is also considered a fast, cross-hierarchical, team-oriented, and collaborative leadership style that maintains a strong focus on organizational innovation.

Digitalization is a process of continuous change, and organizations must be more flexible and should have complete coordination at all levels. Organizations are required to produce and deliver high-value-added products and services, gain a competitive advantage over competitors, and optimize their management processes [49]. In this new situation, digital leaders face a variety of demands. Digital leadership, therefore, encourages the effective use of digital tools, which increase opportunities to explore new ways to create value, resulting in significant changes in products and services, organizational frameworks, and business models [50]. Hence, in this study, the following hypothesis is presented:

Hypothesis H1. *Digital leadership will have a positive (+) effect on organizational innovation.*

3.2. Digital Leadership (DL) and ESG Management (ESGM)

Digitalization is quickly becoming an important driver of ESGM. Modern advances in digital technology enable companies to implement and communicate their environmental, social, and good governance practices through digital platforms [51]. Companies are now relying on artificial intelligence, IoT, and big data analytics for carrying out sustainable business practices that involve reduced carbon emissions and minimizing the routing of other waste to the environment [52]. To reduce the consumption of energy and improve operational efficiency, state-of-the-art artificial intelligence-based sensing solutions are providing new opportunities compared to cloud-based alternatives. This can reduce 98% of the energy consumed by the constant monitoring of assets [53]. In response to this trend, Facebook, Amazon, Google, IBM, and Microsoft have formed a new artificial intelligence alliance to improve the living environment of people in society. Digital tools are now beginning to play an important role in improving the well-being of people and the planet. Today, there is a consensus that blockchain has changed the financial, regulatory, and corporate governance processes [54].

Stakeholders are also calling for greater transparency and traceability of ESG data. To address these challenges, the digital twins of advanced manufacturing and the value chain can automate optimal decision making and incorporate environmental and social factors to optimize the supplier landscape and logistics systems. Companies' 'adoption of digital technology' and 'capabilities affecting ESG goals' are increasingly converging. The role of a leader is important in leading an organization in the direction of seeking new opportunities through ESGM and value creation or in transforming the business model of an existing organization [53]. Hogan and Kaiser [55] stated that the leadership competence

of agency heads was one of the most important variables affecting the overall process of ESG activities. The positive effect of ESG activities can increase especially if the head of an agency exerts strong leadership or transformational leadership [56].

The vision of leaders, therefore, is the only route that will lead to the success and growth of an organization through any form of change. Thus, leaders of organizations need to adopt the idea of digital transformation to gain a competitive advantage. From the perspective of the current digital transformation, organizations' success depends more on the learning and operational abilities of digital leaders [57]. In the digital age, digital leaders must play a central role in driving fast decision-making processes and change. Digital leaders play a paramount role in making the transformation happen because they are change-oriented and adaptable and have a 'transformative vision and a forward-looking perspective,' which is key to committing to the transformation and driving a cultural change in turbulent environments [58]. Hence, in this study, based on the above discussion, the following hypothesis is presented:

Hypothesis H2. *Digital leadership will have a positive (+) effect on ESG management.*

3.3. Digital Leadership (DL) and Organizational Sustainability (OS)

Digital leaders play an important role in improving corporate performance [59], which in turn can promote corporate sustainability. Digital leadership requires leaders to strengthen their capabilities and actively participate in sustainability initiatives. Indeed, to become a digitally sustainable organization, companies need to value the role of digital leadership in achieving business success [60]. Artüz and Bayraktar [61] confirmed that digital leadership is an effective means for achieving a sustainable competitive advantage, wherein this leadership style leads to the optimal use of an organization's resources and improves its efficiency. Increasingly serious ecological problems are driving the demand for digital leaders. The ability to gain environmental sustainability demands innovative digital leadership. Many organizations have adopted digital leadership skills and modern technologies to cope with climate change, thus influencing the firms' sustainable performance. Moreover, digital leadership's dependence on technological development and interaction with the business environment can reduce the duration of the production cycle due to the low percentage of defects and the possession of accurate information about the desires of customers [62]. Based on these arguments, this study presents the following hypothesis:

Hypothesis H3. *Digital leadership will have a positive (+) effect on organizational sustainability.*

3.4. Organizational Innovation (OI) and Organizational Sustainability (OS)

Organizational innovation, which is a company's capability to quickly initiate and implement innovations, is pivotal to its survival and growth [63]. The goal of organizational innovation is to reduce organizational and administrative costs, increase satisfaction, and improve sustainability performance. If an organization has a high level of innovation, it is easy to achieve the above by acquiring the capabilities needed to increase performance and solidify sustainable advantage [64,65]. Innovation has a significant positive impact on organizational economic, social, and environmental sustainability. Additionally, organizations can benefit from innovation-oriented practices that improve sustainability performance [66]. Several studies have shown that organizational innovation affects environmental and social sustainability, both of which can be achieved due to this direct and strong relationship [67]. Nidumolu, Prahalad, and Rangaswami [68] argued that sustainable development is the only way to grow, reduce costs, and maximize profits through innovative products or business expansion. In the end, better economic, social, and environmental performance can be achieved by such innovations [69]. Hence, based on such discussions, this study presents the following hypothesis:

Hypothesis H4. *Organizational innovation will have a positive (+) effect on organizational sustainability.*

3.5. The Mediating Effect of ESG Management (ESGM) and Organizational Innovation (OI)

The argument that strategy is a key factor influencing the sustainable growth of a company is irrefutable [19]. Nowadays, more companies are seeking ESG strategies to improve sustainability. Incorporating ESG strategies and policies within a company can result in improved accountability and enhanced stakeholder trust (social reputation) that improves the said company's economic performance [5]. ESGM pays more attention to and examines the contribution of companies to environmental protection and social responsibility while promoting sustainable economic development [70]. Furthermore, companies participating in ESG activities can improve their social and environmental sustainability while boosting their long-term value by fulfilling social obligations and environmental responsibilities, thus enhancing their reputation [71]. Aouadi and Marsat [4] argued that ESG has a great influence on corporate value and sustainability in the long run and verified this empirically.

Additionally, some studies have examined the relationship between ESG and innovation. For example, an environmental information disclosure policy can significantly promote enterprise-wide innovation [72]. The fulfillment of CSR contributes to the improvement in patent quality and the level of green innovation [73]. According to the existing literature, CSR practices lead to innovation through certain social or environmental drivers that stimulate new product development, new processes, and possible environmental and managerial capabilities to handle new markets and improve financial performance [74,75]. The two terms, ESG and CSR, are somewhat similar. However, one important difference is that ESG explicitly includes governance, and CSR indirectly includes governance issues with respect to environmental and social considerations. Thus, ESG tends to be a more expansive terminology than CSR [76]. In the case of China, with the practice of ESG, the innovation of state-owned listed companies was greatly promoted through the pilot operation of the board of directors [77].

However, organizational innovation is an organization's tendency to adopt a series of different types of innovations within the organization [78]. ESGM activities are essential for improving the financial and social value of a company and can further induce change and innovation within the organization [79]. According to the 'stakeholder capitalism' theory, companies that actively practice ESGM can gain support from various stakeholders for future development, secure external resources for development, improve corporate efficiency, and create a suitable environment for innovative activities [80].

Good ESG performance can transmit positive messages to the capital markets, increase the transparency of enterprises, and enable them to win the favor of all stakeholders, especially the trust of external investors, which in turn eases corporate financing constraints [81]. Enterprises may also actively increase research and development (R&D) investment to promote organizational innovation to help them maintain sustainable development. Using the supply and demand theory as a framework, McWilliams and Siegel [82] showed that the adoption of environmental practices, going beyond legal requirements, may promote R&D investments, which in turn can produce both process and product innovations. Activities for the betterment of society can increase the operating cost of the firms, and the corporate innovation capacity can perform a mediating role to overcome obstacles, such as hiding ESG issues instead of solving them. Innovation in management, product development, and operations with the help of R&D investments can reduce operating costs. Innovations can include new services or products, new structures, new production processes, or new administrative systems and can be affected by ESGM activities. Companies can coordinate ESGM and organizational innovation initiatives to achieve strategic synergies [83]. By setting the drivers and goals for the ESGM agenda, organizations can ultimately generate revenue by accessing potential new markets, customers, products, innovations, and goodwill.

If an organization wants to gain a competitive advantage and have higher profitability than its competitors, it must acquire capabilities that are difficult for others to emulate.

Today, the intensity and severity of competition bring both risks and opportunities, which also ensure the need for continuous innovation. Businesses that are successful in innovation have a sustainable competitive edge [84]. Indeed, it is widely recognized in the literature that there is a positive relationship between innovation and the sustainability of performance [85]. Fan, Liu, Luh, and Deng [86] argued that Taiwan's efforts to promote the sustainability of its companies are often accomplished through organizational innovation.

Meanwhile, digitalization has become the major determinant of innovation in recent years. Due to the rapidly increasing market changes in the digital era, the innovation-based capabilities of companies have resulted in them significantly seizing market opportunities, highlighting the importance of digital leadership. Kohli and Johnson [87] reported that the role of digital leaders is central to driving rapid decision making and change when implementing digital transformation and innovation. A digital leader needs to not only always master the latest technical knowledge and set an example for employees to learn continuously but also create an atmosphere supporting innovation for the team [88]. Malakyan [89] showed that digital leadership positively affects corporate innovation, leading to sustainable performance. Similarly, Benitez, Arenas, Castillo, and Esteves [17] also showed that digital leadership broadly influences a company's innovative performance through digital means, thus ensuring a company's sustainable performance.

Over the years, digital start-ups have been prominent but have often led to environmental degradation. Thus, the role of digital leadership in influencing green product innovation and sustainable performance has become increasingly important [60]. This role not only contributes to the creation of new products and services but may also be extended to enhance the organization's ability to achieve its competitive and strategic goals. The importance of ESG strategies for companies is gradually increasing, and it is becoming an essential and not an optional element for survival. In the case of China, good ESG performance can encourage companies to carry out eco-friendly technological innovations [90]. Tan and Zhu [76] showed that ESG ratings play an important role in promoting the quantity and quality of green innovation in enterprises. Therefore, as the influence of ESGM and organizational innovation increases in the digital era, it is believed that they would have a positive mediating effect. Therefore, the hypothesis presented based on the above premise is as follows:

Hypothesis H5. *ESGM will have a positive mediating effect between digital leadership and organizational sustainability.*

Hypothesis H6. *ESGM will have a positive mediating effect between digital leadership and organizational innovation.*

Hypothesis H7. *Organizational innovation will have a positive mediating effect between ESGM and organizational sustainability.*

Hypothesis H8. *Organizational innovation will have a positive mediating effect between digital leadership and organizational sustainability.*

The research model of this study, which combines the above hypotheses, is shown in Figure 1.
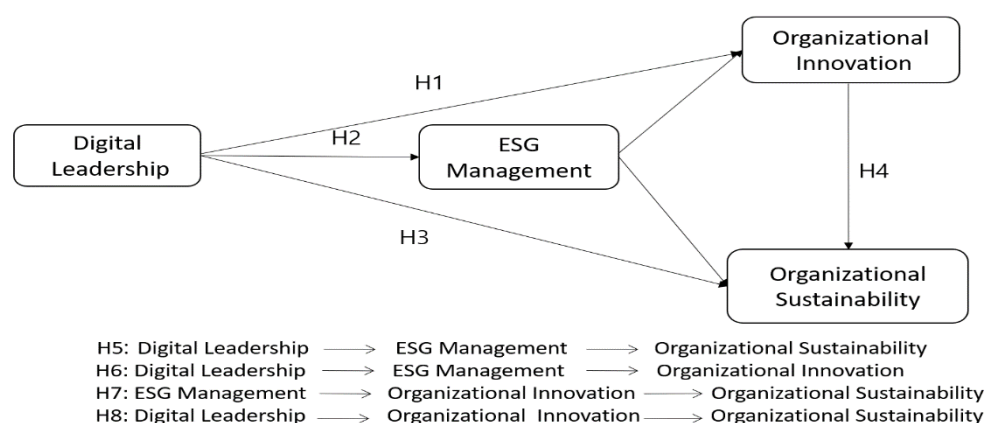
Figure 1. Conceptual model.

4. Empirical Analysis

4.1. Data Collection and Analysis Method

In this study, questionnaires based on the research model were distributed to general companies in Korea and China that were interested in ESGM. Subsequently, the completed questionnaires were collected. In Korea, 150 copies were collected mainly in Chungcheongbuk-do, and of these, 135 copies were used for the final analysis after excluding inappropriately filled questionnaires. In China, 175 questionnaires were collected mainly from Shandong Province, and 153 were used for the final statistical analysis after excluding inappropriately filled questionnaires. The Chungcheongbuk-do region of Korea and Shandong Province of China were selected for the survey because, in our estimate, the living standards and economic conditions in the two regions were moderate and comparable. The survey period was from 5 June 2022 to 5 July 2022, and responses were received by email or collected through direct visits. The characteristics of the sample are shown in Table 1. The questionnaire for this study was appropriately adjusted and prepared based on the formats used in previous studies. Feedback was taken from various academic and management experts during its drafting. We conducted the surveys primarily through email and direct access. Emails were sent to enterprise mailboxes. Each company was surveyed based on a broad understanding of its capabilities and ESG strategies. Interviews were also conducted directly with employees who had a deep understanding of the company's ESGM. They confirmed that most of the questions were easy to understand but suggested that we replace some words with better terms.

Partial least squares structural equation modeling (PLS-SEM) was used to test the proposed hypotheses [91]. The measurements in the questionnaire were generated using a five-point Likert scale. The fact that the data had a non-normal distribution was one of the reasons for choosing PLS-SEM. This is because PLS-SEM does not require a normality assumption and can handle non-normal distributions [92]. Typically, PLS-SEM is very suitable for use in theoretical construction applications to develop new models or concepts. This study focused on companies' organizational innovation and sustainability from a comprehensive perspective including digital leadership and ESG strategies. To achieve this purpose, we intended to use PLS-SEM to estimate parameters and check the comprehensive causal relationship.

Table 1. Characteristics of the sample.

	Characteristics	No. (Korea)	% (Korea)	No. (China)	% (China)
Firm size	Large	32	23.7	50	32.7
	Medium-sized	48	35.6	70	45.7
	Small	55	40.7	33	21.6
Firm age	Less than 5 years	32	23.7	27	17.6
	5–10 years	26	19.2	35	22.9
	10–15 years	24	17.8	31	20.3
	15–20 years	24	17.8	25	16.3
	More than 20 years	29	21.5	35	22.9
Firm sales (Korean Won)	Less than a billion	34	25.2	15	9.8
	Between a billion and 10 billion	31	23.0	43	28.1
	Between 10 and 100 billion	36	26.7	36	23.5
	Between 100 and 1000 billion	11	8.1	14	9.2
	More than 1000 billion	23	17.0	45	29.4
Firm type	Machinery	4	3.0	7	4.6
	Clothing/fiber trade	9	6.7	23	15.1
	Electrical/electronic trade	11	8.2	17	11.1
	Semiconductor	6	4.4	6	3.9
	Automobile	7	5.2	7	4.6
	Pharmaceutical/biopharmaceutical	4	3.0	6	3.9
	Other manufacturing	33	24.4	11	7.2
	Financial/insurance	1	0.7	8	5.2
	Wholesale and retail trade	8	5.9	12	7.8
	Logistics	1	0.7	4	2.6
	Other services	40	29.6	20	13.1
	Other	11	8.2	32	20.9
Your position	General staff	61	45.2	99	64.7
	Middle-level management	47	34.8	38	24.8
	High-level management	17	12.6	6	3.9
	CEO	10	7.4	10	6.6
Length of service	Less than 1 year	15	11.1	30	19.6
	1–5 years	38	28.2	63	41.2
	6–10 years	33	24.4	31	20.3
	10–15 years	25	18.5	16	10.4
	More than 15 years	24	17.8	13	8.5
	total	135		153	

4.2. Measurement and Source of Variables

The dependent variable in this study was the firms' OS combining economic, environmental, and social sustainability [93]. To measure this, we inquired about (1) financial performance; (2) social performance; and (3) environmental performance. Each item was rated on a five-point Likert scale ranging from one (completely disagree) to five (completely agree) by comparing each firm's performance to its competitors over the previous 5 years.

The independent variable was DL. This study adopted the item scale of Benitez et al. [17]. Moreover, this study referred to items used to measure DL as defined by Artüz and Bayraktar [61].

The mediating variable in this study was ESG management. This study included questions based on the K-ESG index developed by the Ministry of Trade, Industry and Energy in 2021. It asked about the establishment of environmental management strategies and action plans, management of environmental business performance, and support for stakeholders' environmental protection activities. Regarding social strategy, the survey asked about consumer protection, improvement of the working environment, and win–win activities with partner firms (or competitors). Regarding governance strategy, the survey asked about process design to guarantee shareholder rights, continuous monitoring through an independent audit team, and reflecting stakeholders' opinions [19].

Another mediating variable in this study was OI. OI was measured through questionnaires from Ngoc-Tan and Gregar [94] and Waheed, Miheed, Waheed, Ahmad, and Majeed [95].

4.3. Validity and Reliability Analysis

Measurement models must be evaluated for reliability and validity to ensure that all constructs are appropriately measured through the indicators. Results showed that in the samples from China and Korea, both factor loading values were 0.7 or higher. The reliability of the constructs was assessed using Cronbach's alpha and composite reliability tests, and all calculations showed good reliability, as all the values for each construct were above 0.7 [96]. The average variance extracted (AVE) was found to be 0.5 or higher, so it was judged that there was no problem with internal consistency. The results of the validity and reliability analyses are shown in Table 2.

The discriminant validity was verified by whether the square root value of the AVE displayed on the diagonal axis was greater than the correlation coefficient value between other constituent concepts [97]. This method for assessing discriminant validity is also known as the Fornell and Larcker method. Per the Fornell and Larcker criterion, there was no problem in terms of discriminant validity because the smallest value (0.729) in the Korean sample was higher than the largest correlation coefficient value (0.545) (Table 3) and the smallest value (0.834) in the Chinese sample (0.682) (Table 4).

Table 2. Validity and reliability analysis.

Variable	Indicator	Korea				China			
		Loadings	α	CR	AVE	Loadings	α	CR	AVE
LD	Our company's leadership has technical leadership capabilities	0.716				0.858			
	Our company's leadership has the ability to build digital governance.	0.707				0.913			
	Our company's leadership considers digitalization a key factor in achieving a competitive advantage.	0.768	0.787	0.861	0.608	0.880	0.914	0.939	0.794
	Our company's leadership can accurately evaluate the level of digital capabilities or digital technologies to implement digital transformation.	0.724				0.912			
ESG	Our company carries out business that values eco-friendly ecosystems.	/				0.827			
	Our company carries out a business that aims for a win-win supply chain.	0.770				0.796			
	Our company carries out business while placing importance on the welfare of workers.	0.720	0.708	0.819	0.532	/	0.855	0.901	0.696
	Our company conducts business while pursuing sound governance.	0.833				0.873			
	Our company conducts business based on ethical management.	0.791				0.839			
OI	In our company, employees are always looking for new ways of working.	/				0.844			
	Our company strives to develop and implement a new organizational structure.	0.811				/			
	Our company is innovative in the operation of the organization.	0.817	0.804	0.872	0.630	0.865	0.805	0.885	0.719
	In our company, it is easy to introduce new technology, products, and services.	0.800				/			
	It is easy for our enterprise to introduce new regulations.	0.745				/			
	Our company is active in entering new markets and creating niche markets in existing markets.	/				0.834			

Table 2. *Cont.*

Variable	Indicator	Korea				China			
		Loadings	α	CR	AVE	Loadings	α	CR	AVE
OS	Our company's sales growth rate (over the past five years) is good compared to the average of major industries.	/				0.819			
	Our company (over the past five years) is striving to improve the welfare and safety and health of employees compared to the industry average.	/				0.814			
	Compared to the industry average, our company has tried to strengthen its relationship with the community and stakeholders over the past five years.	0.834	0.746	0.854	0.661	/	0.859	0.904	0.703
	Our company (over the past five years) has made efforts to reduce carbon footprint and waste emissions compared to the industrial average.	0.785				0.825			
	Our company (over the past five years) has made efforts to increase the use of renewable energy and recycled materials compared to the industrial average.	0.820				0.894			

α: Cronbach's alpha; CR: composite reliability; AVE: average variance extracted.

Table 3. Discriminant validity results (Korea).

	ESG	LD	OI	OS
ESG	0.779			
LD	0.403	0.729		
OI	0.460	0.513	0.794	
OS	0.534	0.470	0.545	0.813

Table 4. Discriminant validity results (China).

	ESG	LD	OI	OS
ESG	0.834			
LD	0.483	0.891		
OI	0.448	0.405	0.848	
OS	0.608	0.408	0.682	0.838

4.4. Testing the Hypotheses of Direct Effects

The structural relationships were tested at a 0.05 significance level by running a nonparametric bootstrapping technique that allows for the generation of 5000 subsamples from the original sampling size with replacement, which also yields approximate t-values for testing the significance of the structural path [98]. If the t-value exceeded 1.96, the path was considered significant at the 0.05 level of significance.

In Table 5, the results of the structural equation model of the Korean sample showed significant relationships between digital leadership ($\beta = 0.392$, $p < 0.001$) and organizational innovation, digital leadership ($\beta = 0.403$, $p < 0.001$) and ESG, digital leadership ($\beta = 0.186$, $p < 0.05$) and organizational sustainability, and organizational innovation ($\beta = 0.302$, $p < 0.01$) and organizational sustainability. Therefore, hypotheses 1, 2, 3, and 4 were all supported.

Looking at the results of the structural equation model of the Chinese sample in Table 6, the relationships between digital leadership ($\beta = 0.247$, $p < 0.05$) and organizational innovation, digital leadership ($\beta = 0.483$, $p < 0.001$) and ESG, and organizational innovation ($\beta = 0.507$, $p < 0.001$) and organizational sustainability were all statistically significant. On the other hand, the relationship between digital leadership ($\beta = 0.024$, $p > 0.05$) and organizational sustainability did not show significance. Therefore, hypotheses 1, 2, and 4 were supported, and hypothesis 3 was rejected.

Table 5. Hypothesis verification results (Korea).

	Hypothesis	**O**	**M**	**SD**	**T-Statistics**	***p*-Values**	**Result**
H1	LD → OI	0.392	0.397	0.084	4.676	0.000 ***	Supported
H2	LD → ESG	0.403	0.413	0.086	4.711	0.000 ***	Supported
H3	LD → OS	0.186	0.186	0.092	2.011	0.044 *	Supported
H4	OI → OS	0.302	0.305	0.097	3.112	0.002 **	Supported
	ESG → OI	0.302	0.299	0.081	30708	0.000 ***	
	ESG → OS	0.321	0.299	0.081	3.909	0.000 ***	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 6. Hypothesis verification results (China).

	Hypothesis	**O**	**M**	**SD**	**T**	***p*-Values**	**Result**
H1	LD → OI	0.247	0.239	0.097	2.548	0.011 *	Supported
H2	LD → ESG	0.483	0.491	0.083	5.833	0.000 ***	Supported
H3	LD → OS	0.024	0.025	0.080	0.292	0.770	Not supported
H4	OI → OS	0.507	0.507	0.080	6.359	0.000 ***	Supported
	ESG → OI	0.329	0.343	0.109	3.012	0.003 **	
	ESG → OS	0.370	0.368	0.104	3.547	0.000 ***	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

4.5. Testing the Mediation Effects

Based on studies by Preacher and Hayes [99] and Zhao et al. [100], this paper analyzed the mediating effects through a nonparametric bootstrapping approach, testing the significance of the proposed indirect effects. The percentile bootstrap and deflection correction bootstrap were calculated using 5000 re-samples to test specific indirect effects. Results showed that the mediation was significant (*p*-value < 0.05). We also calculated the variance accounted for (VAF) to evaluate the intensity of adjustments to quantify the scope of indirect effects on the total effect. The range of VAF was 0–100%, and a value greater than 80% indicated complete mediation, 20–80% indicated partial mediation, and less than 20% indicated no mediating effect.

In Table 7, all the results showed statistical significance in the Korean samples. In detail, ESG (40.95%) as a mediating variable between digital leadership and organizational sustainability, ESG (23.74%) as a mediating variable between digital leadership and organizational innovation, organizational innovation (22.09%) as a mediating variable between ESG and organizational sustainability, and organizational innovation (38.82%) as a mediating variable between digital leadership and organizational sustainability all showed statistical significance. In other words, a partial mediating effect appeared in all relationships.

Table 7. Testing the mediation effects (Korea).

	Hypothesis	***p*-Value**	**Total Effect**	**Direct Effect**	**Indirect Effect**	**VAF**	**Mediation**
H5	LD → ESG → OS	0.001 ***	0.315	0.186	0.129	40.95%	Partial mediation
H6	LD → ESG → OI	0.003 **	0.514	0.392	0.122	23.74%	Partial mediation
H7	ESG → OI → OS	0.042 *	0.412	0.321	0.091	22.09%	Partial mediation
H8	LD → OI → OS	0.049 *	0.304	0.186	0.118	38.82%	Partial mediation

*** $p < 0.001$; ** $p < 0.01$. * $p < 0.05$.

In Table 8 covering the Chinese samples, all the results showed significant mediating effects, but there was a slight difference depending on the route. In detail, ESG (88.12%) as a mediating variable between digital leadership and organizational sustainability and organizational innovation (83.89%) as a mediating variable between digital leadership and organizational sustainability all showed complete mediating effects. On the other

hand, ESG (39.12%) as a mediating variable between digital leadership and organizational innovation and organizational innovation (31.10%) as a mediating variable between ESG and organizational sustainability all showed partial mediating effects.

Table 8. Testing the mediation effect (China).

	Hypothesis	*p*-Value	Total Effect	Direct Effect	Indirect Effect	VAF	Mediation
H5	LD → ESG → OS	0.001 ***	0.202	0.024	0.178	88.12%	Complete mediation
H6	LD → ESG → OI	0.021 *	0.406	0.247	0.159	39.12%	Partial mediation
H7	ESG → OI → OS	0.007 **	0.537	0.370	0.167	31.10%	Partial mediation
H8	LD → OI → OS	0.013 *	0.149	0.024	0.125	83.89%	Complete mediation

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

5. Suggestions and Conclusions

Due to serious social problems and the outbreak of international crises such as climate change, companies are increasingly becoming ESG-oriented. These companies are seeking sustainable development of their organizations by introducing ESG strategies into corporate management. Most of all, ESGM can also cause change and innovation within organizations. At the same time, digital transformation has become an important factor exerting influence on companies to practice responsible environmental, social, and governance management. Accordingly, the importance of a leader's ability to promote digital transformation by demonstrating digital leadership is emphasized. Moreover, as Korea and China are countries based on capitalism and socialism, respectively [101], it was anticipated that the research results may vary between the two countries. Specifically, we postulated that it was likely that this differentiation would have an impact on digital leadership, ESGM, and organizational innovation. In that sense, we believe that this study, which empirically compared the two countries, has great significance. The summary of the research results is as follows.

First, the Korean and Chinese results showed that digital leadership had positive effects on organizational innovation and ESGM and that organizational innovation had a positive effect on organizational sustainability. Research shows that digital leadership is important for enhancing organizational innovation and ESGM. As a result, digital leadership could be expected to promote digital upgrades and innovation in the entire industry. It could also accelerate corporate digital transformation and organizational innovation, create a beneficial industrial environment for corporate development, and contribute to organizational improvement and long-term development [102]. Both in Korea and China, the response to ESGM has been very positive. For example, in September 2020, China's 'double-carbon' policy proposal—carbon neutralization and carbon peak—was a major driver of ESG development, and theoretically, the ESG concept is internally consistent with the high-quality development of the Chinese economy at a macro level [103]. This concept also utilizes digital transformation to drive the digital synergy between the corporate environment and social and governance systems and to help companies actively conduct ESGM. That is, as digital transformation accelerates and becomes more prevalent, ESGM may be promoted more. Greater consideration of digitalization strategies can make it easier for corporate leaders to analyze and solve the strategic problems of ESGM using digitalization. The results of this study, which showed that organizational innovation influenced organizational sustainability, are consistent with those of the preceding studies of Xiao and Su [104].

Second, in the Korean sample, digital leadership was found to have a positive effect on organizational sustainability. However, the Chinese sample showed different results. As a country with advanced digital technology, Korea has a cutting-edge and complete semiconductor industry base and ecosystem. In addition, the government is active in enhancing digital policies and educating leaders on corporate digital transformation. It is believed that these policies have contributed to organizational sustainability. In contrast

to Korea, in the Chinese sample, digital leadership did not show a statistically significant positive effect on organizational sustainability. This could be due to the rapid digital transformation in China. However, in a digital era where organizational boundaries are becoming increasingly blurred and competitive relationships and recruitment methods are becoming more diverse, a key outcome of the implementation of digital leadership is the ability of leaders to achieve co-creation through cooperation and thus create business value. Therefore, improving digital leadership and creating the advantages of a company's 'moat' are urgent issues facing corporate leaders. Accordingly, follow-up research is needed to ensure the continuous development of organizations' digital leadership [105].

Third, looking at the results of the analysis of the mediating effects, ESGM and organizational innovation showed a positive partial mediating effect in the Korean sample. This means that digital leadership (which is a combination of corporate leader capabilities and digital capabilities) promotes organizational sustainability performance through ESGM and organizational innovation. Our study specifically suggests that firms can improve organizational sustainability by actively responding to changing environments through the implementation of ESGM strategies by digital leadership. The stronger the digital leadership, the more likely a firm is to make informed decisions and drive organizational innovations, thereby achieving organizational sustainability. Additionally, firms performing ESG tend to invest more in R&D and thus gain innovative capabilities in delivering products and customer services, thereby creating value for their customers.

On the other hand, in the case of China, ESGM and organizational innovation showed a complete mediating effect between digital leadership and organizational sustainability. This means that digital leadership is only possible through ESGM or organizational innovation to realize a company's organizational sustainability. It is necessary to actively explore why this phenomenon occurred and whether it is desirable. For example, there may be a problem with the digital leadership policies of Chinese companies.

6. Implications and Limitations

This study has the following academic implications. First, this study is expected to theoretically contribute to the ESGM and organizational innovations of companies. In this study, digital leadership was found to be an important factor affecting ESGM and organizational innovation, and this view has recently become very important and presents significant academic implications in the digital era. Second, ESGM and organizational innovations are becoming more important to companies. Specifically, in the digital age, the importance of the effective implementation of ESG strategies through digital technology must be recognized. This study empirically presented the important fact that ESGM strategies can actively innovate in a changing environment, and these innovations can improve organizational sustainability. This study also included a comparison between Korea and China. The fact mentioned above has important implications not only for academics but also for companies and policymakers. Third, it is necessary to pay attention to the differences between Korea and China. In the Korean samples, the direct route between digital leadership and organizational sustainability was recognized as important, but in the case of the Chinese samples, no statistical significance was observed for the same variables. In other words, organizational innovation and ESGM in China showed a complete mediating effect between digital leadership and organizational sustainability. An in-depth follow-up study of the differences between the two countries would be meaningful.

This study also provided some practical implications as follows: First, the empirical results of this study showed that digital leadership was an important factor in improving ESGM and organizational innovation, and finally, in improving organizational sustainability, specifically in Korean companies. Second, it is important to combine digital transformation and ESGM. Embedded digital technology at each stage of ESG responsibilities and digital transformation drive the digital synergy in ESG systems, which in turn drives aggressive enterprise ESG responsibilities [106]. ESGM can be promoted by utilizing various innovative technologies such as collecting and evaluating ESG data based

on digital technology, monitoring using blockchain technology, and establishing a platform. We also need to pay attention to the role of digital leadership in the process of digital transformation, which can help achieve organizational sustainability. Third, a mid- to long-term strategy for ESGM is needed. Many companies in China and Korea implement ESGM, but it is still in the nascent stages. Hence, it is required to establish a step-by-step strategy from a mid- to long-term perspective. In addition, managers can promote ESG endeavors through an innovation that is adopted in ESG policies, the development of reward, incentive, and capacity-enhancing programs, and can also achieve organizational innovation through the company's own ESGM [107]. In the end, it should be recognized that organizational sustainability can be improved through various strategies. Finally, it is necessary to analyze the differences between Korea and China and devise differentiated strategies. Specifically, digital leaders of Chinese companies should not only be skilled in digital technology but also strive to improve the digital leadership and sustainability of their corporate organizations while fostering the vision to transform digital thinking and assist companies in improving their competitive advantages. In this process, the utilization of ESGM and organizational innovation is most necessary.

This study has many valuable implications. However, it also has limitations, some of which could be major and can be addressed in future research. First, the subjects of this empirical study were general companies in Shandong Province in China and Chungcheongbuk-do in Korea. Therefore, for generalization, empirical research over a wider geographical area is needed. Second, in the model used in the study, research was conducted from the perspective of digital leadership as a leading variable. There may be other variables that affect a company's ESGM strategy and organizational innovation and sustainability. Third, in ESGM and organizational innovation, research on the interaction between the two variables is possible, and integrated research through convergence would be also possible. Furthermore, if innovations are achieved while managing ESG, there is a possibility of improving organizational sustainability more efficiently. Fourth, since this study was conducted using a quantitative research method, it is necessary to employ other research methods such as qualitative research in the future so that the role of digital leadership in organizational innovation can be investigated in more detail given the fact that it is a social science study.

Author Contributions: Methodology, S.N.; writing—review & editing, J.S.J. and B.I.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

DL	Digital Leadership
ESGM	ESG Management
OI	Organizational Innovation
OS	Organizational Sustainability
DT	Digital Transformation

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