WeGO
SMART CITIES
INDEX
2022

Research on ESG Perspectives in Smart City Assessment

WeGO

World Smart Sustainable Cities Organization

Acknowledgement

About WeGO

The World Smart Sustainable Cities Organization (WeGO), is a membership-based international association of local governments, smart tech solution providers, and institutions committed to the transformation of cities into smart sustainable cities through facilitating public-private partnerships (PPP).

WeGO was founded by 50 member cities in 2010 as the World e-Governments Organization, hence our acronym. In response to the evolving concept of smart cities, WeGO expanded its vision and mandate at the 4th General Assembly (2017) and its name to the World Smart Sustainable Cities Organization.

The President City of WeGO is Seoul while the WeGO's Secretariat is based in Seoul, Korea, and has regional offices in East Asia (Chengdu, China), the Mediterranean (Beyoglu, Turkey), and Africa (Abuja, Nigeria).

As the leading platform on smart city development, WeGO's mission is to share knowledge and good practices in e-Governance; strengthen administrative efficiency and transparency; advance digital capacity; facilitate civic involvement; bridge the digital divide and inequality; and promote cooperation solidarity among cities and local governments around the world.

WeGO serves for its members as their international platform to improve the quality of life, innovate in the delivery of public services, and strengthen regional competitiveness.

Smart Sustainable Cities for All

Preface

According to the United Nations (2019), the urban population has increased from 30 percent in 1950 to 55 percent in 2018, and this figure is expected to expand to almost 70 percent by 2050. As the world witnesses a rapid growth of urban population, it is vital to address challenges or issues in cities in the world and formulate solutions to realize the vision and mission of smart sustainable development.

As an international association of more than 200 members, including cities and local governments, smart tech solution providers, and national and regional institutions, around the world, the World Smart Sustainable Cities Organization (WeGO) has taken an essential initiative to generate the research on the WeGO Smart Cities Index 2022, hoping to further contribute to international community in terms of promoting the concept of smart cities.

With the collected data and information, the WeGO Smart Cities Index 2022 aims at assessing the city performance and development stages based on various indicators that are derived from ESG elements, namely Environmental, Social, and Governance. This research is unique as it emphasizes the concept of "Socially Responsible Cities", inspiring cities to absorb crucial aspects, including digital ethics, sustainability, and resilience, into their policy making and smart city-related initiatives.

The WeGO Smart Cities Index 2022 not only provides preliminary assessment related to smart cities, but also can guide WeGO Members to enhance their smart city initiatives respectively by gaining inspiration from best practices of each other. The research is significant as it aims at serving as a reference for WeGO Members to evaluate their city performance and to improve the standard of living in their cities respectively.

Last but not least, the WeGO Smart Cities Index 2022 aspires to provide pathways for leaders of WeGO Members in fine-tuning their respective public policy related to smart city, allowing cities to be creatively enhanced via smart technologies to attract more flow of investments domestically and internationally.

Jung Sook Park
Secretary General

World Smart Sustainable Cities Organization (WeGO)

TABLE OF CONTENTS

INTRODUCTION

Introduction

Today's cities face significant challenges, such as increasing population, pollution, resource usage, lack of physical and social infrastructure, and sustainable economic growth. In 1950, only 30% of the world's population was living in an urban area, but in 2030, it is expected to increase to about 60% (United Nations, 2019). Based on incurring problems of cities, a critical question arises, "How to make cities smarter, more sustainable, and even more inclusive?"

In the last three decades, many scholars and practitioners have focused on examining the role of modern cities, especially in social and economic aspects. Cities have been located in the center of the rapid growth in the industrial age, and thus have faced significant challenges of rapid urbanization such as increasing population, limited physical and social infrastructure, climate and environmental changes, and unreliable transportation. Indeed, "the future urban scenario is truly alarming as growing inequality and deficiency in basic amenities are likely to create problems of environmental degradation, along with the increase in individual and group violence" (Bhattacharya et al., 2020, p. 180). As an innovative and strategic solution to tackle such challenging issues of cities, recent studies have suggested the concept of "Smart City" to make cities smarter to increase sustainable economic growth and social development through developing more innovative technologies and managerial assessment, so called "information and communication technologies (ICTs)," of a city government (Caird & Hallett, 2018; Zhao et al., 2021).

The conceptual development of "Smart City" has benefited many local governments to find more effective and efficient management tools to be more responsive to citizens and businesses and to enhance a city's competitiveness by providing diagnostic metrics to evaluate a city's smartness. Despite the popularity of developing smart cities index (SCI) as the innovative and strategic form of local management with the specific interest on the sustainable development and growth, the existing concept of "Smart City" has suffered due to the widely balanced distribution of indexes and unclear role of stakeholders in the policy implementation process, and limited assessment of inclusive concept of sustainability including social responsibility and governance of local governments. These limitations of SCI suggest new measures of cities' performance by particularly focusing on developing the government capacity to deal with more socially engaged cities with more parsimonious indicators.

Given to the major concerns of smart cities to deal with sustainable development and growth, cities' "smartness" can be better accessed by using more inclusive and transformative measures that consolidate both the existing conceptual focus of smart city (i.e., information and digitalized technologies) and sustainable practices of local government. Recently, studies in economics and business have actively cited the Environmental, Social, and Governance (ESG) activities that have embedded in corporate firms as the instructional and managerial guidance to promote sustainable growth (e.g., Lagasio & Cucari, 2018; Xie et al., 2019). Since not only ESG activities of rational firms are limited to policies and regulations that a city government has exercised, but smart cities have made a considerable effort to increase the sustainable development as well as the long-term value creation to meet the stakeholders' expectations in a community, it would be more efficient to integrate with multiple information including ESG and ICT issues to measure the smartness of cities.

Based on ESG criteria on a firm level, therefore, we suggest an original and distinct SCI that prioritizes ESG criteria that specify socially responsible governance and sustainable development practice of city government. This paper seeks to suggest and develop the ESG-based smart city

index of cities with a great presence of ICT applied to critical social inclusion and responsibility that contemporary cities should exercise.

The report is structured as follows. A comprehensive literature review on the smart city concept and assessment of major strengths and weaknesses of the existing SCI is presented in the following section. In the third section, the necessity of developing an alternative SCI is discussed, and a new assessment of the smart city with a specific focus on ESG concepts is suggested. The fourth section provides details on the ESG frameworks in the smart city and research methods to create SCI. In addition, the paper provides a survey design to investigate the efficiency of the new index intended primarily for available member cities of World Smart Sustainable Cities Organization (WeGO). Finally, the last section provides potential implications of this paper and concluding remarks.

SMART CITIES INDEX IN EXISTING STUDIES

Smart Cities Index in Existing Studies

Smart City Concept

The concept of a smart city has become popular and widespread as the "more innovative and efficient forms of urban planning and management" is called for to resolve the increasing challenges and demand faced by cities (Caird & Hallett, 2018; Sharifi, 2019). The challenges of cities have evolved to range from social and economic issues to environmental sustainability and digital ethics, while the citizens demand faster and better services that improve quality of life (Albino et al., 2015; Sharifi, 2019, 2020). Facing these challenges and demands, cities increasingly seek solutions from ICTs to provide more efficient and effective services and management, and this trend has led to the rise of smart city projects since the late 2000s.

Despite the proliferated use of the smart city concept for over a decade, there is no universally accepted definition of a smart city (Ahvenniemi et al., 2017; Sharifi, 2019; 2020). As illustrated in Table 1, the definition and concept of a smart city are varied for each institution and country. It is understood that there are two mainstreams in defining the concept of a smart city. One is the ICT and technology approach that highlights the use of modern technology, and the second is the people-oriented approach that focuses on the soft infrastructure and people (i.e., social and human capital, engagement and equity, social innovation, knowledge) (Angelidou, 2014; 2017). Such distinction is also viewed as top-down vs. bottom-up initiatives or supply vs. demand-driven approaches (Calzada & Cobo, 2015; Angelidou, 2015). However, the different dimensions and aspects of the smart city concept seem to be integrated over time, leading to a more comprehensive definition of a smart city embracing both the technology-driven and people-oriented approach (Sharifi, 2019; 2020). Technology is still the cornerstone to developing and advancing smart cities, but the concept of a smart city has become multi-dimensional and holistic, overarching the people, social, economic, and environmental sustainability.

The holistic approach to understanding the smart city concept is well reflected in the definitions supported by the major stakeholders of a recent UN initiative called 'The United for Smart Sustainable Cities (U4SSC).' U4SSC is a global UN initiative coordinated by International Transport Union (ITU), United Nations Economic Commission for Europe (UNECE), and UN-Habitat, and supported by various international organizations, including CBD, ECLAC, FAO, UNDP, UNESCO, to name a few. UNECE, one of the coordination of this initiative, defines a smart sustainable city as "an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (UNECE. Org).

Aligned with such definition of smart city, UN-Habitat promotes 'People-centered smart cities' program calling for "smart city infrastructure and services in commitment to human rights, and maximizing community participation, representation, transparency and control...(providing) digital public goods that are open, transparent, accessible and interoperable" (UN Habitat. Org). ITU also shares the similar concept by defining a smart sustainable city as "an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (ITU.int).

Table 1. Concepts and Definitions of Smart City

	Institution	Smart City Concept/Definitions	Reference
International Organizations	International Telecommunication Union (ITU), United Nations Economic Commission for Europe (UNECE)	*A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, the efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations concerning economic, social, environmental as well as cultural aspects*	"ITU-I, Smart Sustainable Cities at a Glance" https://www.itu.int/en; "Sustainable Smart Cities" https://unece.org/
	OECD	*"initiatives or approaches that effectively leverage digitalization to boost citizen well-being and deliver more efficient, sustainable and inclusive urban services and environments as part of a collaborative, multi-stakeholder process"*	OECD, 2018a
	European Union	*"A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business"*	"Smart Cities" https://ec.europa.eu
	UNDP Global Centre for Technology, Innovation and Sustainable Development	*"Smart cities use technology and innovation to improve the urban environment - leading to improved quality of life, greater prosperity and sustainability, and engaged and empowered citizens"*	"Smart Cities" https://sgtechcentre.undp.org/
	Inter-American Development Bank	*"an innovative city that uses ICT and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental aspects"*	Bouskela et al., 2016
Governments	UK Parliament	*"Smart cities" describes places that incorporate a range of technologies (especially those that collect and use data) to address economic, social, and environmental challenges. Projects usually take place in urban areas, but are also deployed in rural settings.*	"Smart Cities" https://post.parliament.uk/
	Korean Government, Ministry of Land, Infrastructure and Transport	*"A sustainable city wherein various city services are provided based on city infrastructure constructed by converging and integrating construction technologies, information and communication technologies, etc. to enhance its competitiveness and livability"*	https://smartcity.go.kr/en
	Spain Government	*"Smart city is the holistic vision of a city that applies ICTs to improve the quality of life and accessibility of its inhabitants and ensures sustainable economic, social and environmental development in permanent improvement"*	Spanish Association for Standardization and Certification.
	Denmark, the ministry of transport, building and housing.	*Smart city is an evolving concept: "Initially, the concept was only used in a narrow and governmental context especially in relation to environmental, energy and infrastructure issues in terms of how information and communication technologies can improve urban functionality. Subsequently, virtually all other areas of welfare started working with Smart City, for example in business development, innovation, citizen involvement, culture, healthcare and social services, where the use of data and digital platforms helps smart new solutions."*	OECD, 2020.
Private Sector	Smart Cities Council[1]	*"a smart city gathers data from devices and sensors embedded in its roadways, power grids, buildings and other assets. It shares that data via a smart communications system that is typically a combination of wired and wireless. It then uses smart software to create valuable information and digitally enhanced services"*	Smart Cities Council, 2012

---

1 The collective of several major large corporate firms active in smart city technology including Cisco, IBM, Intel and Qualcomm.

Smart City Assessment

With increasing attention to the concept of smart city, there has been a growing effort to evaluate and assess the performance or quality of smart cities (Caird et al., 2016; Caird & Hallett, 2018). Assessment of a smart city can serve multiple objectives: monitoring the performance, information sharing with relevant stakeholders including the general public, reporting to the funding bodies, generating evidence and guidelines for policy decision making, business purposes, achieving the Sustainable Development Goals, etc. (Sharifi, 2019; Caird et al., 2016; Caird & Hallett, 2018; Sharifi, 2020). Assessment criteria are also divergent: some of the existing smart city assessment systems focus on measuring the technological advancement while others target overarching themes, including social and environmental aspects (Caird & Hallet, 2018; Sharifi, 2019, 2020; Patrão et al., 2020; Bhattacharya et al., 2020).

Table 2 below illustrates the existing smart city assessment schemes and tools categorized by the primary evaluation criteria since 2015. The list of schemes is developed referring to the previous systematic reviews of smart city assessment frameworks, including Sharifi (2020) and Patrão et al (2020), and additional research. The list is also refined based on the research relevance (i.e., whether the assessment target is the city or not (community, project, etc.), the measurement cycle, and developer (i.e., frameworks developed by individual researchers without assessment result or one-time assessment are excluded). As illustrated, various developers assess diverse criteria of smart cities with different standards and methodologies.

Table 2. List of the Smart City Assessment Schemes/Indices

Assessment Framework/ Tools	Year*	Main Assessment Criteria	Developer
IMD-SUTD Smart City Index	2021	Infrastructure and technology evaluated over health and safety, mobility, activities, opportunities and governance	IMD World Competitiveness Center and Singapore University of Technology and Design (SUTD)
Global Cities Index	2021	Business, Human Capital, Information Exchange, Cultural Experience, Political Engagement	Kearney
United 4 Smart Sustainable Cities KPIs	2021	SDGs (especially SDG 11)	ITU, UNECE, UN-Habitat
What Works Cities	2021	Data-driven governance	Bloomberg Philanthropies
Global Power City Index	2021	Multiple dimension	The Mori Memorial Foundation's Institute for Urban Strategies
Smart City Government	2021	Smart City Governance and readiness	Eden Strategy Institute and ONG&ONG Pte Ltd.
Innovation Cities Index	2021	Emphasis on innovative economy	2thinknow with various partners
Juniper Research Smart City Frameworks	2021	Smart Solutions related to mobility, healthcare, public safety, productivity	Juniper Research

Cities in Motion Index (CIMI)	2020	Multiple dimensions	Center for Globalization and Strategy and IESE Business School, Univ. of Navarra
EasyPark	2020	Emphasis on mobility	Easy Park Group
Austrian Digital Cities Index	2019	Draws on European Digital Cities Index	Center for Innovative Industry Economic Research Inc.
Smart Cities Council's tools and frameworks	2018	Multiple dimensions of smartness	Smart Cities Council, Australia and New Zealand
Smart Cities Index-India	2017	Multiple Dimension	Indian School of Business
CityKeys	2017	Multiple Dimensions	Netherlands Organization for Applied Scientific Research (TNO), Austrian Institute of Technology (AIT), VTT Technical Research Centre of Finland
European Digital Cities Index	2016	Digital Entrepreneurship	Nesta

* Year of the most recent measurement

Strengths and Weaknesses of Existing Index

Various smart city performance measurements provide an essential guide to citizens and policymakers in making decisions in the increasingly complicated and complex urban lives (OECD, 2020). The diverse range of measurements with different topics and criteria allows the users to choose the most appropriate scheme based on their purposes. However, such diversified measures also lead to criticisms regarding the comprehensiveness, consistency of quality, and flexibility based on the target measurement topic and criteria, choice of indicators, and applied methodology.

After exploring five international frameworks, Stratigea et al. (2017) discovered how the indicators are focused on the 'living' and 'environment' themes while lacking indicators under the 'governance' and 'people' themes. Wu et al. (2016) and Liao et al. (2017) reviewed Chinese-oriented smart city indicator sets and criticized how they fail to provide policy guidelines for smart city planning because of the limited dimensions being assessed and the expert-oriented approach lacking objectivity. Huovila et al. (2019) reviewed seven smart city measurement frameworks and pointed out a lack of balance between sustainability and smartness where indicators are mainly focused on 'sustainability' after reviewing seven indicator frameworks. Some frameworks are identified to be mainly focused on social and economic factors, missing the environmental sustainability themes, while the sustainability indices have been separately operated/utilized (Ahvenniemi et al., 2017; Mofaredzadeh & Beradi, 2015).

Compared to the analysis targeting the limited number of frameworks, Sharifi (2019) identifies the strengths and weaknesses of the 34 smart city evaluation schemes. Sharifi (2019) reviews how indicators demonstrated comprehensive measurement for innovation and ICT, whereas some indicators lacked to deal with the theme related to 'people,' and many schemes lacked balanced distribution of thematic indicators. Another issue identified is that local context or needs are rarely taken accounted for in the measurement models. The financial and technical feasibility of using the assessment schemes are also not considered in most cases. Among others, Sharifi (2019) emphasizes the need for modeling and scenario-making technique (by utilizing big data analytics and IoTs) in smart city performance measurements to deal with future uncertainties.

The suggestions made from the OECD's "Smart Cities and Inclusive Growth" report (2020) regarding the aspects to be considered when building a measurement framework for smart cities also resemble the implications drawn from Sharifi (2019. Among the three aspects suggested, the first is to enhance the comprehensiveness. The report points out the lack of "harmonized and comparable framework…to measure the extent to which digital innovation in cities is delivering better multi-sectoral outcomes for residents," and suggests the building of a framework that can assess "how digital innovation affects cities and urban policies" therefore offering policy solutions to overcome various urban challenges (p. 36). The second is to align such a comprehensive framework to a country of a city's strategies while providing a time-variant effect of smart cities on society. The third aspect suggested is flexibility and adaptability to different circumstances. The report shares an example of Bristol, UK, with around 150 key performance indicators to measure and release, apart from the potential smarty city measurement framework.

DEVELOPING NEW INDEX FOR SUSTAINABLE SMART CITY

Developing New Index for Sustainable Smart City

In general, many scholars and professionals have dealt with "Smart City" as a technological innovation. Thus, the development challenges of Smart City Assessment (SCA) have attracted many interdisciplinary fields of study, but the index development has been actively pursued in science and engineering fields. Overall, it is important to approach Smart Cities Index by combining multiple issues across the fields that access the social changes of the Fourth Industrial Revolution effectively. Although having a clear index to measure performance of the smart city is still limited due to the existing unclear and multi-faceted definition of the smart city, many studies characterize a smart city that advances qualities of citizens and communities as well as ICTs, and thus the indexes have been developed accordingly (Albino et al., 2015).

Existing SCA has received much attention in both academia and practitioners due to several advantages of its applicability including schemes available for a wide range of target audiences, various applied methods, a wide range of indicators reflecting different aspects of city environment, and usefulness of index for benchmarking purposes. Despite its strengths, however, the major weaknesses still remain. These include a lack of balanced distribution of indicators, static assessments of SCA tools, limited assessment to the local specifics, unclear role of stakeholders in the policy implementation process, and the feasibility of issues across the tools. Results indicate that a new index needs to account for the ability of cities to manage the government efficiently, to deal with digital ethics, and to increase citizen co-production and engagement. In this sense, we suggest the existing Environmental, Social, and Governance (ESG) criteria that emphasize the role as "socially responsible city."

As firms continue to increase the strategic investment based on sustainability and ESG, it is important for cities to transform themselves into sustainable cities by investing in ESG issues. Smart cities with ESG-based practices promote the economic development of a municipality, region, or country through sustainable management of cities, which is basically focused on developing healthy ecological cities, incorporating citizens, and strengthening social and environmental engagement. However, this does not mean that the existing indicators for SCA are wrong, and thus the ESG values should replace SCA. Rather, this paper suggests that it is important to reframe ESG issues aimed at business practices to socially profitable values that combine ICT with greater social inclusion and greater access to services of a city to meet the needs of governments, citizens, and businesses. Despite a wider definition and focus of "Smart City", it is imperative to consolidate the key feature of "Smart City" that specifies "digital technologies and communication technologies (ICT) to enhance quality and performance of urban services, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens" (Bhattacharya et al., 2020, p. 181). In this regard, we seek to advance the smart cities index by reframing the existing index of smart cities by characterizing elements and dimensions of ESG indices integrating the digital technology that specify the existing SCI in common.

Environmental, Social, and Governance Performance

Key Words and Concept of ESG

ESG criteria create a framework for helping investors who want to incorporate personal values into their investment approach. The ESG screening process identifies companies that have built sound environmental practices, strong social responsibility tenets, and ethical governance initiatives into their corporate policies and everyday operations regarding its sustainability actions. In recent years, ESG adoption has been growing rapidly resulting in a secular market shift and is estimated that in the next 20 to 30 years, the millennial generation could put between $15 trillion and $30 trillion into US-based ESG investments. Given the growing importance of ESG, SCI studies paid little attention to the necessity to use the ESG frameworks as the assessment tools for Smart City implementation evaluation.

Literature Review on ESG

According to the report of Chartered Alternative Investment Analyst (CAIA) Association, Systemic Impact and ESG Investing in Smart Cities (2021), ESG and its impact frameworks are two side of the same coin; both are necessary to not only create smart cities but also a sustainable future in which all of Earth' inhabitants thrives. ESG mainly focuses on limiting risks and negative effects of corporate processes as it is related to environmental, social and business governance issues, while impact identifies positive evidence-based priorities and intentionally works to measure and quantify the positive effects. A few of the key considerations as part of ESG are the following diagram.

Diagram 1. Key Considerations of ESG

ENVIRONMENTAL

Climate Change

Pollution and Waste

Natural Resources

SOCIAL

Labor Management

Equal Access/ Opportunity

Product Safety

GOVERNANCE

Financial Transparency

Board Diversity

Business Ethics
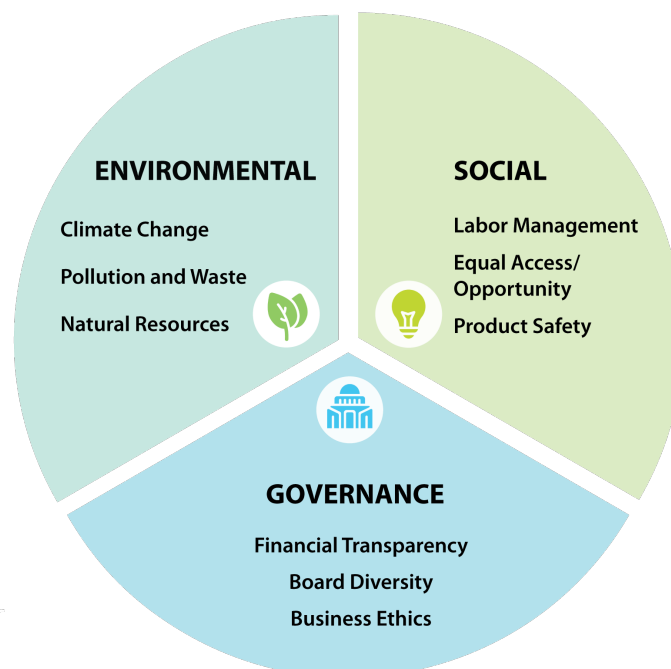
Source: CAIA Association (2022) Systemic Impact and ESG Investing in Smart Cities. p.4.

Assessment of ESG Initiatives for the Smart City

Building a sustainable smart city enhances the quality of civic life and preserves environmental, social values as well as democratic governance. However, existing smart sustainable city projects have concentrated on the technological dimensions of smart cities such as developing digital infrastructure and using big data or smart devices to follow sustainability goals. Currently, there is no comprehensive category of smart sustainable city indicators in the literature. This study aims to discover these indicators by considering the common features of sustainability and smart city concepts. The content analysis technique was employed to investigate semantic, lexical, and conceptual relationships between smart city and sustainability indicators as well as citizen centric and democratic governance. This research employed the Sustainable Development Indicators suggested by OECD and the Smart City Index Master by Cohen as the two main groups of indicators and a number of other indices such as the World Bank and S&P and so on.

Developing New Themes of ESG

Environmental Values in ESG

Environmental Values are the most important value in the ESG concept. It includes natural resource conservation, climate change policies, waste and pollution management, renewable energy polices and so on. The notion of environmental risks is crucial for understanding the birth of ESG. Considerations on those risks are related to diverse environmental issues such as greenhouse gas emissions, increase of wastes, lack of water etc. These risks are directly linked on the development of smart city. Rapid increase of urbanization caused tremendous challenges. Among them, the Environmental issues are important than any other problems. Thus, the new SCI should align with the ESG and especially the environmental values are at the most.

Environmental Performance

First of all, the new indexes for measuring environmental dimension of smart city should focus on 1) green technologies, 2) resources and energies as well as 3) managerial efforts. To understand the three pillars of environmental performance of smart city, we need to look back on the development of smart city is the major trend of the 21st century of urbanization. Since 1994, the notion of smart city as cybernetically planned cities has become a popular term among public policy makers, urban industries and civic society. Due to the advancement of digital technologies, the trend has become more strong initiatives and proliferations for built city environments which is heavily relied on information and communication technology (ICT) for providing public services and improving citizens' lives. However, the novelty of smart cities is not in its inclusiveness and sustainability toward civic engagement, equity, and even innovation (Clark, 2020).

Also, up to date, a number of smart city initiatives have focused on how to maximize the level of utilization on technologies such as digital infrastructure, data and online services. However, those efforts created unexpected results such as supplier-centric approach and government driven policies which are mainly connected on urban developing and constructing strategies. There was less attention on environmental-friendly as well as in-depth approaches to green policies on the smart city assessments and indicators. In addition, more and more the progress of smart city efforts asks socially responsible, ethical as well as sustainable ways for success of those improvement. Meanwhile, there is no consensus for assessing these efforts such as changing from traditional 'cities' to 'smart cities' which the crucial than ever before now. As a consequence, the substantial critique of smart city research community is how to evaluate the smart city project

in terms of sound economic development, urban technologies as well as urban renewals at the same time environmental, social and governance factors. Thus, this research aims to provide a meaningful new smart cities index in terms of environmental social and governance (ESG) criteria.

Environmental Indicators for Smart City

Originally, the notion of ESG came from the corporate management and investment. Especially, the environmental criteria refer to actions related to emission reduction processes or polices aiming at reducing the environmental impact of our daily life. Solutions that will be needed in the future will help to consider fossil fuel divestment policies, resource efficiency actions, such as in the case of water or energies. Moreover, environmental actions have to target waste and processes or polices aiming at reducing water or increase circularity in a responsible organization. Thus, the keywords include the independence of energy, green remodeling for reducing energies, green consumer goods, environmental consulting, recycling, waste management, water purification, battery, clean energy, energy efficiency, power grid and renewable energy. The following descriptions are the gatherings of commonly discussed in school of ESG for understanding the environmental values. After combining all the indicators and categories as three pillars. According to the Future City ESG Innovation Index (2021) and Smart City Index Master (2014), green technologies, resources and energies and managerial efforts on environmental performances are crucial to develop the new SCI for enhancing the sustainable smart city for the future generation.

Table 3. Descriptions of Environmental Values in ESG

Indicators	Descriptions
Green technologies	1. Sustainability-certified buildings (Number of LEED or BREEAM sustainability-certified buildings in the city (note: if your city uses another standard please indicate), 2. % of commercial and industrial buildings with smart meters, 3. % of commercial building with a building automation system) & Smart homes (% of homes (multifamily & single family) w/smart meters, 4. Number of Electronic and Hybrid Buses
Resources and Energies	1. Energy (% of total energy derived from renewable sources (ISO 37120:7.4), Total residential energy uses per capita (in kWh/year) (ISO 37120:7.1), 2. % of municipal grid meeting all of following requirement for smart grid: (1) 2-way communication; (2) Automated control systems for addressing system outages; (3) Real-time information for consumers; (4) Permits distributed generation; (5) Supports net metering), Carbon footprint (Greenhouse gas emission measured in tons per capita (ISO 37120:8.3), Air quality (Fine particulate matter 2.5 concentration (mg/m3) (ISO 37120:8.1), 3. Waste generation (% of city's solid waste that is recycled (ISO 37120:16.2), 4. Total collected municipal solid waste in city per capita (in kg) (ISO 37120: 16.3), 5. Water consumption (% of commercial buildings with smart water meters, Total water consumption per capita (liters/day) (ISO 37120:21.5),
Managerial efforts	1. Climate resilience planning (Does your city have a public climate resilience strategy/plan in place? (Y/N) If yes provide link, Density (Population-weighted density (average densities of the separate census tracts that make up a metro), 2. Green space per capita (Green area per 100,000 (in m2) (ISO 37129:19.1), 3. Environment Acquisitions, Environmental Investment, Average Seed Environment Investment, Environment Crowd-funding Projects

Source: Adapted to the Smart City Index Master Indicators Survey (2014) & Future City ESG Innovation Index (2021)

Social Performance

While social activities refer to equitable treatment of close stakeholders and protection of the social ecosystem in which the firm operates (Limkriangkrai et al., 2017), social terms of smart cities incorporate building and developing a greater role for the citizens in decision-making processes (Machado et al., 2021). Thus, social performance in the smart city model should allow the incorporation of knowledge, cultures, and people's desires, which open perspectives for greater convergence in plans, programs, projects, and activities to promote the sustainability-centered urban development. Given to the role of city governments as the entities of urban intelligence, Machado et al. (2021) suggest that it is essential for cities to promote social inclusion and social equality such as accessible public spaces, affordable healthcare, better quality of life for the senior population, mass online education, open spaces for culture, and participatory democracy. Given to the fundamental role of the city to be more inclusive, safe, resilient, and sustainable, city administrators make efforts to increase social inclusion and to build collective identity by promoting an urban ethic of mutual respect and social trust, which help citizens feel confident and safe when using public spaces (Iversen, 2019; Risdiana & Susanto, 2019). All these social aspects emphasize cities as platforms for social interaction. Thus, it is important to suggest new social dimensions as the inclusive tools to measure what a smart city is that emphasize social responsibility and social inclusion of a city based on ICT-based solutions.

Social Values in ESG

Cervo et al. (2019) suggest that social performance refers to the concept of social capital, which means "an accumulation of resources collectively built through a relational network and involving various actors" (p. 9). Thus, social values prioritize the new relationships created within organizations or local communities that are designed to promote people's well-being and initiation of innovative strategies (Cervo et al., 2019). "The corporate culture of the organization and the nature of the sector highly influence the way they manage their social accountability and stakeholder relations, which determine the corporate approach to documenting and disclosing the ESG performance" (De Silva Lokuwaduge & Heenetigala, 2016, p. 439). Thus, the ethical conduct and the effective managerial tool can be critical determinants of measuring social performance of ESG. The achievement of organizational goals depends on how well an organization has behaved in socially responsible ways (Campbell, 2007). Matthews (1993) also defines that social value is the concept of legitimacy that organizations not only satisfy societal expectations, but regulates socially acceptable behavior. Therefore, when two values, the social values associated with organizational activities and the norms of behavior, are not congruent, organizations do not gain legitimacy (Matthews, 1993).

According to the corporate social responsibility model, organization is driven to increase social performance by meeting the expectations of various stakeholders such as customers, employees, the government, and community, which are the critical issue of ESG reporting (De Silva Lokuwaduge & Heenetigala, 2016; Geva, 2008). A stakeholder is an individual or any group of individuals who can affect the corporations' activities, and takes the role in an ethical and socially responsible value in furthering sustainable development (Reddy, 2019). As a result, the role of both internal and external stakeholders can increase organizational performance through the socially responsible practices that generate social value and ethical behavior (Khuong et al., 2021).

A theoretical approach of ESG concept based on corporations could apply to the city governments that are driven to increase strategic and innovative management tools to create the smart urban environments for governments, citizens, and businesses. Like a company, a city management system attempts to maximize profits and values by associating with all levels of stakeholder including

government employees, citizens, interest group members. Thus, the social value indicators in the concept of ESG need to be developed by ensuring social responsibility of cities towards all stakeholders who work in the city's growth and development.

Although the conceptual focus of ESG has been given to the firms' responsible activities for society, studies in ESG indicate that the issues of social values including ethical conduct, human capital management, and workplace safety are being observed in societies in general (e.g., Azapagic and Perdan, 2000; Lokuwaduge & Heenetigala, 2016; de Bem Machado, 2021). The common social value indicators that the ESG studies suggest include "subjects related to the well-being, rights and interests of people and communities, mainly including workplace health and safety; human rights; slave, child, and bonded labor; labor standards in the supply chain; diversity; freedom of expression and freedom of association; health and access to medicine; employee relations and human capital management; relations with local communities; controversial weapons and consumer protection; and activities in conflict zones" (Sultana, et al., 2018, p. 4). Given the growing responsibility of city governments to deal with the large-scale human and social challenges of cities becoming smarter, it makes sense to expect that a smart city is required to comply with social values that firms actively pursue to effectively manage perceptions of their stakeholders. Table 4 shows the descriptions for main social value indicators in ESG dimensions that recent ESG research suggests.

Table 4. Descriptions of Social Values in ESG

Indicators	Descriptions
Actor governing type	Indicators the stakeholder typology governing the synergy creation process
Stakeholders	The number of actors (person/organization) managing, leading, coordinating social activates
Stakeholders' links	The whole number of additional structured links created in the territory through the corporate social activities
Informal links	Formal links that are purely professional while informal are outside of the professional sphere. They might be intra- or inter-company.
Trust and cooperation	Indicators to assess if benefits, risks, and changes are performed in a transparent way for all relevant stakeholders
Employees' interdependencies	An average of the inter-organizational links created for each of the stakeholders directly involved in the cooperative initiative
Interconnections	Variation of the organizations' resources interconnectivity in the territory
Relations' frequency	Indicators that clarify exchanges frequency or intensity between partners involved in corporate social performance
Employees social engagement	The level of social engagement of employees.
Employee training	Indicators to access whether the company has implemented any initiatives to train new and existing employees on career development, education, or skills. Training initiatives should apply to all employee levels, not just to those employees at management level.
Equal opportunity	Indicators to assess whether the company has made a proactive commitment to ensure nondiscrimination against any type of demographic group.

Human rights	Indicators to assess whether the company has implemented any initiatives to ensure the protection of the rights of all people it works with.
Health and safety	Indicators to assess whether the company has recognized its health and safety risks and responsibilities and is making any effort to improve the management of employee health and/or employee safety.
Fair remuneration	Indicators to assess if the company has demonstrated a group wide commitment to ensure payment of a fair wage to all group employees, even in those countries that do not legally require a minimum wage.

Source: Cervo, H. et al. (2019). A Case Study of Industrial Symbiosis in the Humber; Region Using the EPOS Methodology. Sustainability; Xie, J. et al. (2019). Do environmental, social, and governance activities improve corporate financial performance? *Business Strategy and the Environment.*

Social Values in Smart City

The smart city has a strong governance-oriented approach which emphasizes the role of social capital and relations in urban development (Albino et al., 2015). While many definitions of smart cities exist, conceptual dimensions of social value of smart cities can be explained in several terms. First, a smart city is based on human and social capital (e.g., intense and open network linkages) that would fuel sustainable economic growth and a high quality of life (e.g., Caragliu et al., 2011; Kourtit et al., 2012). Second, a smart city seeks to make a conscious decision to aggressively deploy technology as a catalyst to solving its social and business needs (e.g., Eger, 2009; Guan, 2012). Third, a smart city attempts to connect the social infrastructure to leverage the collective intelligence of the city (e.g., Alawadhi et al., 2012; Harrison et al., 2010). The social infrastructure, such as intellectual and social capital, is an indispensable endowment to smart cities as it allows "connecting people and creating relationships" (Alawadhi et al., 2012). Smart people generate and benefit from the social capital of a city, so the smart city concept acquires the meaning of a mix of education/training, culture/arts, and business/commerce with hybrid social, cultural, and economic enterprises (Winters, 2011). A dimension of a smart city has also been applied to "soft domains" such as social inclusion, human and social capital, and social and ethnic plurality (Nam & Pardo, 2011). The most common characteristics of smart cities emerging from recent studies is social inclusion of various urban residents and social capital in urban development.

Gil-Garcia et al. (2010) suggest that the use of ICT infrastructure and the potential of bringing various information streams together are clearly affected by acts of governance and institutional structures. They support the emergence and persistence of stable and trusted social networks (players having confidence in each other and collaborating), and facilitate information-sharing and the building of a platform for smart governance. High quality of life is one of the ultimate goals of all human advancement and not exclusive to the smart city. Access to high-quality healthcare services (including e-health or remote healthcare monitoring), electronic health records management, home automation, smart home and smart building services, and easier access—via the Internet— to social services of all kinds are evidence of smart city commitments for a high quality of life.

Overall, social values were not much taken into consideration for the measurement of a smart city performance. Despite the limited access to social value in smart cities, the existing studies in smart cities commonly suggest social indicators in the three main domains of well-being criteria, quality of life, and social inclusion (Berardi, 2015). These social indicators are shown in Table 5.

Table 5. Descriptions of Social Values in a Smart City

Indicators	Descriptions
Health	Health status of citizens; Conditions for a healthy community
Education	The level of quality education and access to education
Transportation	Investment and supply of reliable transport facilities and smart transport system
ICT	The ability to use digital technologies and communication technologies
Demography	Characteristics of urban population
Economy	Economic dimension of a city; the level of income inequality at city level

Source: Bhattacharya, T. R. et al. (2020). Sustainable smart city development framework for developing countries. *Urban Research & Practice.*

ESG-Driven New Social Value Indices

It is important to note that new measures of social value should be built on the emphasis of more comprehensive roles of a city that promotes social inclusion and social responsibility for governments, citizens, and businesses in the ICT-based environment. While typical social values in ESG dimensions are measured by focusing on increasing firms' performance, social values in the smart city concept need to be reframed by considering indicators that represent the performance of a city. We suggest new social indices by factoring social spheres in both the ESG and the smart city concepts in seven categories—human rights, workforce opportunity, society and community interconnection, human resources (HR) training and development, social inclusion and responsibility, quality of life, and health and safety—based on the ICT function of a city.

New social value dimensions include indicators that measure whether a city has implemented any ICT-based initiatives to ensure the protection of the rights of all citizens; indicators that measure whether a city has implemented any ICT-based workforce system to ensure the opportunities to access employment, education and training programs, and support services to be successful in the labor market; indicators that measure whether a city has implemented any ICT infrastructure and digital platform of interconnected communities to ensure that citizens and all levels of stakeholders are engaged in a competitive ecosystem; indicators that measure whether a city has implemented any ICT-based initiatives to establish higher level of work engagement and to train new and existing employees on career development, education, or skills; indicators that measure whether a city has implemented any ICT infrastructure to ensure that all individuals and communities, including socially disadvantaged groups and individuals, not only have access to information needs, but have no social and emotional discrimination to information; indicators that measure whether a city has implemented any affordable and widespread ICT infrastructure to ensure that all levels of citizens have better access to service information of higher-quality products and public services; and indicators that measure whether a city has established any integrated digital management system not only to reduce health and safety risks, but to increase any efforts to improve the management of citizens' health and safety.

Overall, based on the main stream of the existing ESG studies, we suggest the social dimension of "Smart City" in seven categories—human rights, workforce opportunity, society and community interconnections, human resource management, social responsibility, employment quality, and health and safety. The descriptive new social value dimensions are shown in Table 6 below.

Table 6. Descriptions of New Social Value Measures

Indicators	Descriptions
Human rights	1. Institutionalization of digital ethics policy 2. Institutionalization of comprehensive and human-centered development policy 3. Institutionalization of participatory human right process 4. Institutionalization of social justice in development
Workforce opportunity	1. Availability of workforce ICT system to access employment, education and training programs, and support services 2. Financial support to access employment, education and training programs, and support services 3. Government support to access employment, education and training programs, and support services
Society and community interconnections	1. Penetration rate of household with computer, net connectivity, and per capita mobile phone 2. Availability of programs to participate in social activities, volunteering, and charitable giving
HR training & development	1. Availability of digital platforms or programs to establish higher level of work engagement and to train new and existing employees on career development, education, and skills 2. Government spending for the purpose of employee training and career development
Social Inclusion & responsibility	1. Availability of digital platform for knowledge sharing on social innovation 2. Level of social equality 3. Level of social protection for disadvantaged citizens
Quality of life	1. Government investment on healthcare, transportation, energy, environment, and public safety 2. Availability of ICT infrastructure to solve social problems 3. Availability of telework or friendly-work environment system
Health & safety	1. Level of digital security 2. Level of police department performance 3. Integrated disaster/emergency management system 4. Level of health security (access to healthcare, number of doctors per 1,000, water and air quality etc.)

Governance Performance

Firstly, this session reviews governance in ESG and Smart City. Governance in ESG and governance in smart cities have different characteristics and sub-components. It is a necessary process to incorporate governance of ESG into governance attributes of smart cities.

Governance Value in ESG

According to the 'K-ESG Guidelines V 1.0' jointly issued by related ministries of the central government, governance is the area of rights and responsibilities of executive teams of corporations, board of directors, stockholders, and various stakeholders of corporations, focusing on diversity of the board of directors, executive salaries, ethical management and auditing bodies, and emphasizing their rational and fair management (Ministry of Trade, Industry and Energy, 2021: 6). In addition, the "Governance" in ESG means the governance factors of decision-making, from sovereigns' policymaking to the distribution of rights and responsibilities among different participants in corporations, including the board of directors, managers, shareholders and stakeholders (S&P Global, 2022). Governance factors can include a variety of indicators and indicate the management and administrative rules or procedures for countries, corporations, and public agencies. A corporation's purpose, the role and makeup of boards of directors, shareholder rights, and how corporate performance is measured are core elements of corporate governance structures, and governance factors allow investors to screen for appropriate governance practices. (S&P Global, 2022). Governance performance is assessed by evaluating structure and oversight, code and values, transparency and reporting, and cyber risk and systems. The detailed items presented by the government to guide self-diagnosis of "G" of ESG are as follows.

Table 7. Indicators for self-diagnosis of Governance of ESG (Joint Ministries of The Central Government)

Indicators	Descriptions
Board Composition	1. Proposal of ESG agenda within the Board of Directors (BOD) 2. The Ratio of Outside Directors 3. Separation of the Chairman of the BOD 4. Gender Diversity of BOD 5. Expertise of Outside Directors
Activities of BOD	1. Activities of BOD 2. Ratio of Executive Director Attendance 3. Committees under the BOD 4. Agenda Handling of BOD 5. Announcement of Convocation of General meeting of shareholders 6. Date of general meeting of shareholders 7. Intensive/ Electronic/ Written voting system 8. Policy Implementation
Ethical Management	1. Disclosure of Violations of Code of Ethics
Audit Body	1. Establishment of internal audit department 2. Expertise of Audit Body
Violation of Laws and Regulations related to Governance	1. Violation of Laws and Regulations related to Governance

Source: Ministry of Trade, Industry and Energy (2021). Guideline v 1.0 for K-ESG. Joint Ministries of Government. p. 28.

The World Bank also introduces key components for G of ESG. The World Bank suggests indicators for G in ESG at national level. This category, called Governance Pillar, encompasses essential factors to design sustainability of a country's economic performance by suggesting institutional capacity to support long-term stability, growth and poverty reduction, the strength of a country's political, financial and legal systems, and capacity to address environmental and social risks. The World Bank categorizes the composition into human rights, government effectiveness, stability & rule of law, economic environment, gender, and innovation.

Table 8. Indicators for Governance of ESG

Indicators	Descriptions
Human Rights	1. Strength of legal rights index 2. Voice and Accountability
Government Effectiveness	1. Government Effectiveness 2. Regulatory Quality
Stability & Rule of Law	1. Control of Corruption 2. Net migration 3. Political Stability and Absence of Violence/Terrorism 4. Rule of Law
Economic Environment	1. Ease of doing business index (1=most business-friendly regulations) 2. GDP growth (annual %) 3. Individuals using the Internet (% of population)
Gender	1. Proportion of seats held by women in national parliaments (%) 2. Ratio of female to male labor force participation rate (%) (modeled ILO estimate) 3. School enrollment, primary and secondary (gross), gender parity index (GPI) 4. Unmet need for contraception (% of married women ages 15-49)
Innovation	1. Patent applications, residents 2. Research and development expenditure (% of GDP) 3. Scientific and technical journal articles

Source: The World Bank (https://datatopics.worldbank.org/esg/framework.html)(2022. 06. 07)

In addition, S&P Global defines the governance of ESG as the economic dimension score (EDS) because it evaluates the corporate governance performance. However, it includes additional critical factors that evaluate the quality of a corporate's management systems as well as its ability to control long-term risks and opportunities.

Diagram 2. Indicators for Governance of ESG

Corporate Governance	Codes of Business Conduct	Risk and Crisis Management
1. Board Structure, Diversity, Effectiveness, Experience, Tenure	1. Codes of Conduct	1. Risk Governance and Culture
2. Executive Compensation	2. Corruption and Bribery	2. Sensitivity Analysis and Stress Testing
3. Management Ownership Requirement	3. Systems/Procedures	3. Emerging Risks
	4. Reporting on Breaches	

Supply Chain Management	Tax Strategy	Materiality, Political Influence, Impact Measurement
1. Supply Chain Awareness and Risk Exposure	1. Tax Strategy	1. Materiality
2. Supplier Code of Conduct	2. Tax Reporting	2. Contributions
3. ESG Integration in Supply Chain	3. Tax Governance	3. Impact Valuation and Disclosure

Source: S&P Global (2022) (https://www.spglobal.com/)(2022. 06. 8)

As seen, the indicator set for G of ESG has a variety of components depending on what it wants to focus on. They usually try to explain the G of corporations and the country in terms of economic dimension. However, this study should focus on a city's G in city scale and have to measure governance that reflects the concept and characteristics of a smart city. Therefore, this study reviews how governance is being discussed and utilized in smart cities.

Governance Value in Smart City

Smart city is a process of making a city smart rather than a compound meaning of smart and city (Lee & Leem, 2016). Recently, smart cities in developed countries are building a smart governance system by supporting and developing various smart communities. This means that the public is no longer centered on outcomes such as cutting-edge ICT technology or equipment, but rather centered on the process of creating an ecosystem where smart urban activities can thrive in various fields, including the private sector (Nam et al., 2017). A smart city was defined as a city in which the integration of a traditional city, a low-carbon green city, and an ICT-based U-city is advanced. In terms of city form, it is a city where ICTs-Eco Ts technologies and information systems are connected and integrated, and ICT-Eco Ts embedded urbanization is advanced. The linkage and integration between traditional urban planning and u-city and low-carbon green city technology is a key success factor. In order to realize such connection and integration, it is necessary to establish the governance called platform governance (Lee & Leem, 2016). Therefore, a smart city functions as a platform.

Platform governance of a smart city is characterized by flexibility, connectivity, creativity, self-organization, people-oriented, and data-based, and these characteristics are recognized as the most important factors that distinguish a smart city from a general city (Hwang & Jang, 2016). Governance can be viewed as a set of rules governing who will participate in the platform ecosystem, how to distribute value, and how to resolve conflicts (Parker et al., 2016).

Such a platform is a multi-faceted platform, and the multi-faceted platform always involves various interests. Parker et al. (2016) presented governance tools, among which laws, norms, and markets were already existing tools of governance. On the other hand, information architecture is attracting attention as a new tool that enables a platform of decentralized governance as an information and communication-based platform where centralized authority does not exist (Nam &Choi, 2019).

Lee & Leem (2016) defines governance of smart city as three categories: Administrative, Technological, Global Governance. Administrative governance takes place between the central government and local governments to achieve the goals of the smart city, or in the form of local governance centered on the central and local governments and citizens and businesses for the construction and operation of smart cities. It also appears as regional governance between metropolitan cities that seeks civic participation and regional development through networks between adjacent cities. Next, technology governance is governance to promote information production, processing, linkage and integration, and utilization, especially, linkage and integration between information. The American IT Governance Institute (ITGI) presented an IT governance architecture with five elements: strategic linkage, IT resource management, risk management, performance measurement, and value delivery. Technology governance focuses on performance management and quality control through information utilization. Third, global governance is a series of processes to preempt the standards and exports of smart cities. Unlike local governance, it is formed in the form of cooperation between companies and countries internationally to pursue common interests between countries. Global governance is sometimes created as a governance to lead the standardization of IT technologies, or it is led by international companies such as ISO/IEC 38500. Also, cities are the main actors, such as the World Smart Sustainable Cities Organization (WeGO). Sometimes, like the Paris Agreement for greenhouse gas reduction, global governance is organized around the country.

Diagram 3. Indicators for Governance of Smart City

Administrative Governance

1. Central Government, Comprehensive Planning, Committee
2. Local Government, Ubiquitous Strategic Planning
3. Private Companies
4. Civil Service Center

Technological Governance

1. Central Government, Comprehensive Planning, Committee
2. Local Government, Ubiquitous Strategic Planning
3. Private Companies
4. Integrated Operation Center, Cloud Data Center, CCTV Integrated Control Center

Global Governance

1. Oversea Export Platform, Forum, Road Show
2. Export Items Development, Information System
3. Technology Standards, Participation of International Organization
4. Global Governance between Companies

Source: Lee & Leem (2016). Analyzing Characteristics of the Smart City Governance. pp. 90-95.

Castelnovo, et al. (2015), who studied the evaluation system of smart governance through a holistic approach, found that from the perspective of smart governance, sustainable growth of a city is first, policy decision-making. It is evaluated that it depends on whether or not there is a clear strategic vision of stakeholders, second, active participation of city leaders such as communities, and third, an effective organizational system that can form and manage public values. He suggested five evaluation factors from the perspective of regional innovation on the relationship between the services provided by the city and the role of governance (Nam et al., 2017).

Table 9. Indicators for Governance of Smart City

Indicators	Descriptions
Community Management	1. Are stakeholders participating in the smart city governance and decision-making process by field? 2. Is the community created and managed smartly?
Vision and Strategy	1. Does the regional vision and strategy go through a rationally derived process? 2. Does the city have the ability to determine the basis for suitability as a stroke by monitoring and evaluating the ability to use the strategic plan or alternatives derived from the future strategic plan of cities?
Reflection of Public Value	1. What is the performance of the action plan and what is the long-term impact on the city from the perspective of deriving public values, including general social goals such as economic growth, employment, social inclusion and welfare?
Collective Intelligence	1. Do you have the collective intelligence to compare and review city performance in terms of city asset management and the empirical level of execution ability to develop future plans?
Economic and Financial Sustainability	1. Does the city create long-term sustainability, investment attraction and change in smart cities as a criterion for economic and financial sustainability? 2. Are the city's financial and economic resources available and efficient and effective?

Nam, Park, Park, & Ji (2017). The Organizational Structure and Role of Smart City Governance, Local Studies, pp. 71-72.

ESG-Driven New Governance Indices in Smart City

As we have seen above, ESG can vary depending on what you focus on. Various types of governance can be implemented, such as governance for sustainable and successful management of corporations, governance for creating economic performance of corporations, and governance for sustainable development of a country at the national level. Governance in ESG is mainly concerned with how fair and transparent the composition and operation of corporate management is done. It also focuses on whether institutional mechanisms and activities are in place to prevent, monitor and audit various violations and corruption. Another ESG governance approach from the corporate level is concerned with how well the corporate organizational system for smooth management is reasonably well-organized, and how well the corruption prevention and risk management system are in place. In addition, it includes political influences and administrative regulations including corporate logistics procurement system and taxation. Governance of ESG at the national level is also very interesting in terms of whether the government has an ecosystem for fairness in the composition of government policy makers, an efficient operating system, and government innovation. In addition, it is emphasized that human rights protection, control devices to prevent and respond to corruption, and an environment for economic development are in place. In sum, Overall, regardless of a country or a corporation, how fair and transparent

the composition of the management and operating system is structured and institutionalized is judged to be a very important condition. In addition, institutional devices to prevent and respond to corporate and national corruption and to guarantee the human rights of members are being considered as important. And if there are political and administrative factors externally affecting corporate and state operation, these factors need to be considered as important.

Smart city governance is one of the city management techniques for smart city development, and there is a view that it is a process of making and executing decisions on important issues in the city using network technology. On the other hand, it also defines smart digital service governance and the use of sophisticated information technologies to interconnect and integrate information, processes, institutions and physical infrastructure to better serve citizens and communities. From the point of view of organizational management, it also meant community-based governance in which various actors in the city create a smart urban cooperation system and expand the connectivity between city elements through the use of new technologies. Therefore, a smart city can be defined as an urban living community that smartly implements sustainable development by utilizing smart technology in the holistic relationship of a fair and transparent administrative and legal system, human and organizational structure and engagement, and urban economic and financial condition. In addition, smart cities should pertain the capacity to solve urban problems with collective intelligence and realize and expand public values. Therefore, a smart city needs to have the process and results of rationally establishing the city's vision and development strategies, and has a management system to guarantee the quality of life of citizens, it is necessary to have an ecosystem in which economic and financial resources can be used sufficiently and efficiently. It is necessary to create governance indicators that reflect the characteristics of smart city while reflecting the governance elements of ESG. This study aims to develop a governance index that reflects the governance elements of ESG in the governance structure of a smart city, and thus categorizes its dimension to administrative/legal, organizational/human, and economic/financial governance.

Table 10. Indicators for Governance in Smart City

Dimension	Descriptions
Administrative/ Legal Governance	1. Administrative Application of Information and Network Technologies 2. Ratio of Information Disclosure of City Gov. (per year) 3. Integrated Digital Operation Platform for Administrative System 4. Expertise and Institutionalization of Internal Audit 5. Level of Ethical management 6. Government's Support for Smart City Development and Maintenance 7. Number of Ordinance Amendments of City Council (per year)
Organizational/ Human Governance	1. Activation of Information and Network Technologies for Organizational/Human Resource Management and Networking 2. Diversity of Stakeholders' Participation for Smart City Policy 3. Number of NPOs in City (enrolment) 4. Level of Human Rights Protection 5. Ratio of LGBT + to City Population 6. Activation of Collective Intelligence
Economic/ Financial Governance	1. Efficiency of Economic Organizations (Corporations, Small Businesses et al) and Sufficiency of Economic Resources 2. Ratio of Small & Medium Business to Total Business 3. Sustainability of Investment Attraction 4. Availability of Financial Resources 5. Ratio of Increase of Total Taxes

ESG-DRIVEN INTEGRATED SUSTAINABLE SMART CITIES INDEX

ESG-Driven Integrated Sustainable Smart Cities Index

Taken as a whole, then, we suggest new ICT-based ESG indicators with detailed measures in smart cities. As noted earlier, the new measure integrates the key feature of "Smart City" that specifies digital technologies and the main ESG indicators that can be applied to local governments' managerial assessment to lead to sustainable economic growth and development. We collected 52 ESG performances including 16 environmental performance, 20 social performance, and 16 governance performance for city governments. The variables are the combination of both dummy and discrete variables. If any policy that a city government implemented is available, it is coded as 1 and otherwise 0. Each dimension (E, S, G) score is calculated as a composite score combining the values that represent a group of indicators for each E, S, and G performance. After a number of consensus building processes among the research team and experts on smart city, 36 indicators are selected. Those composite indicators are shown in Table 11 below.

Table 11 . Integrated ESG Indicator Assessment Models of Smart Cities

Dimension	Indicator	Description
Environmental Performance	Green Technologies	1. Number of LEED or BREAM sustainability-certified buildings in the city 2. Percentage of commercial and industrial buildings with smart meters or automation system 3. Percentage of electronic and hybrid cars
	Resources and Energies	4. Percentage of total energy derived from renewable sources 5. Greenhouse gas emission measured in tons per capita 6. Percentage of city's solid waste that is recycled
	Managerial Efforts	7. Availability of climate resilience planning 8. Green space per capita (Green area per 100,000) 9. Environment Acquisitions, Environmental Investment 10. Average seed environment investment 11. Local government spending on ICT-based environmental education as percentage of total education spending
Social Performance	Human Rights	12. Availability of any initiatives to educate citizens on career development, education, or skills. 13. Availability of laws and policies to protect about digital privacy
	Workforce Opportunity	14. Availability of digital platforms or programs to access employment, education and training programs 15. Availability of financial support to access employment, education and training programs, and support services in ICT sector
	Social Inclusion & Responsibility	16. Availability of programs to participate in social activities, volunteering, and charitable giving 17. Proportion of schools with access to the internet for pedagogical purposes 18. Fixed-broadband subscriptions per 100 inhabitants
	Quality of Life	19. Availability of ICT infrastructure to solve social problems 20. Availability of telework or friendly-work environment system
	Health & Safety	21. Availability of community policing polices related to digital security 22. The rate of law enforcement officers who work on digital crime (including cyber-enabled fraud and data theft) 23. Availability of integrated disaster/emergency management system 24. The rate of the use of telehealth access to primary physician/general practitioner services

Governance Performance	Administrative/ Legal Governance	25. Availability of administrative services and process of AI 26. Availability of integrated digital operation platform for administrative system 27. Availability internal audit manual of ICT management 28. Number of ordinances related to ICT management
	Organizational/ Human Governance	29. Availability of ICT system in the hiring process 30. Number of NPOs related to ICT in city 31. Availability of institutionalized digital ethics guideline 32. Availability of ICT-based collective intelligence platforms
	Economic/ Financial Governance	33. Ratio of ICT-related small and medium business to total businesses 34. Local government spending on ICT sectors as percentage of total government expenditure 35. Local government spending on R&D as percentage of total government expenditure 36. Number of startups from ICT related sectors in a city

As a part of the development of the new smart cities index (SCI), this study conducted a pilot survey. As mentioned earlier, the survey is designed to investigate the efficiency of the new index intended primarily for member cities of the World Smart Sustainable Cities Organization (WeGO). To advance the SCI by reframing the existing index of smart cities by characterizing elements and dimensions of ESG, each value included the following sub-contents (see Diagram 4).

Diagram 4. Integrated SCI sub-contents

- Green Technologies
- Resources & Energies
- Managerial Efforts

ENVIRONMENTAL

- Human Rights
- Workforce Opportunity
- Social Inclusion & Responsibility
- Quality of Life
- Health & Safety

SOCIAL

GOVERNANCE

- Administrative & Legal Governance
- Organizational & Human Governance
- Economic & Human Governance

In 2022, the WeGO Secretariat and the research team conducted the preliminary survey to finalize the SCI for building more inclusiveness and sustainability-driven smart city assessment (SCA) in order to introduce the new themes in environmental, social, and governance in smart cities index (SCI). Among the member cities, 13 cities responded to the survey and the heat-map for checking up the level of relevancy of the newly introduced SCI by the research team.

The analytical methodology is to draw the heat map which represents the level of performance of the sub-contests of three ESG values. Among the participant cities, the higher level or same level of the performance in a leading city[1] is categorized as the high performer, 'H,' the lowest or zero performance is considered as the low performer, 'L' and the middle performer between the H and the L is categorized as the middle performer, 'M.'

Results of Environment Performance of the New SCI

In Table 12, the survey results of the environment performance indicators were shown. The level of performance is illustrated with letters and shades. H means that relatively a higher performer than other cities. M means middle level and L means lower level of performance. In order to visually understand the level of performance in relation to other member cities, the level of performance is also illustrated with shades, where the darker shade represents lower performance. Thus, as we can see, the three sub-content of environment performance indicators is shown in the following table.

Table 12. Environment Performance of the new SCI

		1	2	3	4	5	6	7	8	9	10	11
		Green Techonologies			Resources & Energies			Managerial Efforts				
Middle East	A	M	H	M	M	H	M	H	H	H	H	H
Asia-Pacific	B	M	L	L	L	M	M	H	L	H	H	L
	C	M	H	L	H	L	L	L	H	L	L	H
	D	L	M	M	H	M	M	H	L	H	H	L
	E	L	L	L	L	H	H	H	M	H	H	L
	F	H	H	H	H	H	H	H	H	H	H	H
	G	M	M	L	H	H	H	H	M	H	H	M
	H	L	L	H	L	L	L	H	M	H	H	L
	I	M	H	M	H	H	H	H	L	H	H	L
Eastern Europe	J	L	L	L	L	L	M	L	M	H	H	L
	K	M	H	M	H	M	H	H	L	H	H	H
Americas	L	L	L	L	H	L	M	H	M	H	H	L
	M	L	L	H	H	M	L	H	L	H	H	L

_____
2 The leading city is selected as the top performer among the participants of the pilot survey.

As described in the heat-map of three pillars of environment performance, green technologies, resources & energies and managerial efforts, the overall color of green technologies is darker than the other two pillars. It means that the green technologies of environment performance in the new SCI is weak and it could say that member cities should work hard on increasing the level of this dimension of environmental performance. Per green technologies, only 23% is high level while most of them are low or middle. The resources and energies (R&E) pillar have 46% of high, which means that the performance of R&E is better than green technologies. In other words, still the level of utilization on green technologies needs to be investigated more than the others. Comparatively, per managerial efforts of environment performance is a little bit brighter (52% is high levels). Thus, as the SCI, three pillars of environment performance indicators are still lower level among member cities but are relevant to SCI and SCA as solid measures.

Results of Social Performance of the New SCI

Next, in Table 13, the social performance (SP) of the new SCI is shown. The five sub contents are all much lighter than the other two performances. It means that, at least among the respondent member cities, the SP is comparatively higher performing area than the others. Specifically, human right (H=76%[1]) and workforce opportunity (H=69%) is well provided and managed in their smart cities. Quality of life, health & safety and lastly, social inclusion & responsibility have 65%, 61% and 53% respectively. All sub-contents are over 50% so that it is much lighter than the other two performances. It also could be argued that this SP is a right measure for the new SCI.

Table 13. Social Performance of the new SCI

		12	13	14	15	16	17	18	19	20	21	22	23	24
		Human Rights		Workforce Opportunity		Social Inclusion & Responsibility			Quality of Life		Health & Safety			
Middle East	A	H	H	H	H	H	H	L	H	L	H	L	H	H
Asia-Pacific	B	H	H	H	H	H	H	L	H	H	H	L	H	H
	C	L	L	L	L	L	M	M	L	L	L	L	L	L
	D	H	H	H	L	H	L	L	H	H	H	H	L	H
	E	H	H	H	H	L	L	H	L	L	L	M	H	H
	F	H	H	H	H	H	H	M	H	H	H	H	H	H
	G	H	H	H	H	H	H	H	H	L	H	M	H	H
	H	H	H	H	H	H	H	L	H	H	L	L	L	L
	I	H	H	L	H	H	H	H	H	H	H	H	H	H
Eastern Europe	J	L	L	L	L	L	L	L	L	L	L	L	L	L
	K	H	H	H	H	H	H	M	H	H	H	H	H	H
Americas	L	L	L	L	L	H	M	M	L	H	L	H	H	H
	M	H	H	H	H	H	H	M	H	H	H	L	H	H

3 H is measuring the percentage of the high-level over the all cells of that sub-contents. For instance, human rights have total 26 cells and 20 cells have 'H' so that the percentage is 76% (20/26).

Results of Governance Performance of the New SCI

The following Table 14 shows the results of governance performance in the new SCI, as it is noticeable that there is a different level of performance among the respondents. Comparatively, the administrative and legal governance performance is better than the other two (H=52%). However, the economic and human governance is the weak area (H=23%). Organizational and Human governance is 44% thus it is less than 50% so that it should be increased if the member cities would like to increase their capability of governance to develop the more inclusive and sustainable smart city. Therefore, these measures also are well fitted in and could be included in the new SCI.

Table 14. Governance Performance of the new SCI

		25	26	27	28	29	30	31	32	33	34	35	36
		Administrative & Legal Governance				Organizational & Human Governance				Economic & Human Governance			
Middle East	A	L	H	H	H	H	M	L	H	M	M	M	M
Asia-Pacific	B	H	H	H	H	H	L	H	H	L	H	L	L
	C	M	H	H	L	H	M	L	L	M	H	M	L
	D	H	H	H	L	L	M	H	L	H	H	L	M
	E	H	L	H	L	H	L	L	L	L	L	M	L
	F	H	H	H	H	H	H	H	H	H	H	H	H
	G	H	H	H	H	H	M	H	L	M	M	M	M
	H	L	H	L	L	H	L	L	L	L	M	L	L
	I	M	H	H	H	H	M	H	H	M	L	M	H
Eastern Europe	J	L	L	L	L	L	L	L	L	L	L	L	L
	K	L	H	H	M	H	L	H	L	M	H	M	H
Americas	L	L	L	L	L	L	L	L	L	M	L	L	L
	M	L	H	H	H	H	L	H	L	L	H	L	L

Overall Conclusion

Through the pilot survey, it is aimed at checking the validity of the newly introduced index system which shows the values of ESG. Thus, the ranking based on scores are not meaningful as well as not appropriate in terms of numbers of cases for the pilot. In that context, our findings could contribute to improving the current smart city research in terms of the values of ESG for seeking more valid index systems which include those values. In sum, the E and G of ESG are still lower than S, however, S is also not satisfied in all cities. In conjunction with this, the new index could show the need for enhancing these values to achieve a sustainable and inclusive model for the new smart cities index system.

IMPLICATIONS AND CONCLUDING REMARK

Implications and Concluding Remark

The development of the new index system is not an easy process and mandate to have right amount of consensus among experts who seriously investigated this matter as well as the practitioners who work every day in the field of smart city. Thus, the findings of this study are the beginning of the new steps that make us close to a better future and help facilitate and sustain implementation of the smart city.

Throughout this pilot study, three important lessons have been found. First, the new goals and direction of smart cities should be citizen-centric, environmental-friendly and focused on democratic governance. Second, all the indicators should be managed in terms of change management because of their speed of changing nature and globally connected diffusion of rapid digital transformation. Finally, the new SCI system should be assessed openly and in participatory ways. As a globally accepted SCI, the participant cities know their level and be admired their efforts equally.

Despite a certain degree of progress and success as an initial effort, the ESG-driven SCI has faced two sets of challenges. The first deals with the concretization of the technical aspects of the digital transformation (DX) process itself while the second deals with the presence of enabling conditions that support the DX process. The new SCI has different focuses, we call it, ESG. However, it cannot degrade the importance of DX and the other changes of science and technologies. Thus capacity-building and knowledge sharing efforts should be conceived of as a crucial, multi-step process for creating the better outcome of smart city initiatives towards the next generation.

In conclusion, the new concept of smart cities index which emphasizes the ESG values is vastly crucial to the new normal world as well as it is meaningful to be incorporated into the weight of sustainability and inclusiveness. By exploring these new efforts on creating SCI, the ESG-driven smart cities index system could consolidate the future expansion of smart cities in the imminent page for the next step. It is just the beginning, and the better version of SCI could be seen to continue to grow.

WeGO's PERSPECTIVE

WeGO's Perspective

The COVID-19 and the Fourth Industrial Revolution both have made a significant impact on hanging balance of economic power. In the meantime, resource scarcity and climate change, societal transformation, and technological advancement along with the rapid urbanization undoubtedly have an effect on both people and the world as a whole. As we are passing through a turbulent time of rapid changes, consideration of the ESG concept is essential for the future development of cities as well as citizens in the world, including the cities from the WeGO's network. The pandemic has led us to a new reality where people have become more vulnerable, and where economic and geopolitical situations are exposed to the higher risk of instability. In line with this, many international organizations have already adapted their agenda for a new call of actions both in mid- and long-term strategies for sustainability and improved resilience.

WeGO has identified one of its main core missions as taking a people-centric approach by adding the element of "People" to the public-private partnership. This approach provides a shared blueprint for peace and prosperity for people and incorporates with the United Nations (UN)'s Sustainable Development Goals (SDGs) that "Leave No One Behind". WeGO emphasizes a city's ultimate goal to improve the efficiency of urban operation and services, quality of life, and economic prosperity and services for their communities. A smart city is no longer a "nice to have", but a "must have" in today's world. It is the foundation that underlies the lives of citizens where the implementation of policies from economy, education, infrastructure, governance, welfare, environment, tourism, media to arts is not possible without smart city people, processes, and technology. Development of a smart city, therefore, should be sustainable and inclusive to realize the vision of leaving no one behind.

Under this backdrop, the implementation of new technologies such as Big Data or Artificial Intelligence should be carefully planned and decided for a smart city as they can jeopardize some of the basic rights of citizens. Cybersecurity was not much emphasized as an essential element of ESG in the beginning. However, with the rising culture of remote working and the growing numbers of digital economy since the occurrence of the COVID-19 pandemic, it is noticeable that cybersecurity plays a crucial aspect in safeguarding users against any kind of cyber threats.

Leading institutions, such as J.P.Morgan (2021), claimed that considering cybersecurity as an ESG indicator is a relatively new model, yet all available data indicates that organizational stakeholders continue to be interested in this new model. For instance, according to a 2019 investment poll by RBC Asset Management, 67% of investor respondents from the U.S., Europe, Asia, and Canada identified cybersecurity as their top concern. The core cost of cybersecurity, which includes infrastructure protection, network security gear, integrated risk management, and application security, reached $68 billion in 2020. According to the Bloomberg research as highlighted by Nasdaq (2021), the spending on cybersecurity will top $200 billion yearly by 2024. Given its growing significance for a company's operational and financial performance, cybersecurity has emerged as a major ESG concern that has to be integrated into business operations.

As the leading platform on smart city development, WeGO aims at raising awareness on cybersecurity and digital ethics to ensure citizens' rights remain always protected. Increased cybercrimes due to rapid digitalization call for close attention as well as actions regarding Digital Security. In line with this, WeGO has launched its own youth program in 2022, which is known as the 'WeGO Smart City Champions'. The main objective of this program is to develop and empower the capacity of young people around the world as the future leaders in the fields of urban development and smart cities that are aware of sustainability and ESG values embracing digital security.

The ESG in Cyber World

The idea behind the ESG is to achieve sustainable growth through the careful management of these categories of environmental, social, and governance. These days, building the software or content of smart cities is receiving more attention in the field of smart city development. A smart city is no longer just the use of technology to address urban problems. The ethos of smart cities has permeated every aspect of citizen life. In a similar spirit, ESG has also been establishing the new standard for corporate responsibility and culture.

The management of data, well protected from cyber threats, can be understood and emphasized in pursuit of ESG values as well. In connecting the "Environmental (E)" aspect with the cyber world, it has been emphasized that entities with robust cybersecurity initiatives perform much better in terms of improving "their environmental footprints, without interruptions and cyber threats to their environmental efforts" (Everhart, 2022). In terms of the "Social (S)" aspect of ESG, it is critical to safeguard individual personal data and privacy. As much as the users of the cyber world and smart technologies are increasing with the rising digital transformation taking place around the world, cyberattacks, cyber threats, and other forms of cybercrimes are also on the rise. For example, it has been pointed out that "Data breaches can have a huge impact on people. Hackers have increasingly targeted healthcare data and institutions, with an impact on the quality of care for the community as a whole. A disruption to the utility industry, such as the attack on Colonial Pipeline in the United States, can also lead to temporary income loss, further affecting the community" (Sarnek & Dolan, 2022).

The term "Internet Governance" can be understood in relation to the "Governance (G)" of ESG. It refers to "the rules, policies, standards and practices that coordinate and shape global cyberspace" (School of Public Policy at Georgia Institute of Technology, 2022). In addition, the United Nations (n.d.) elaborated that "Internet governance is the development and application by governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet". The values of "G" in the cyber world involve a wide range of stakeholders. The renowned Tunis Agenda for the Information Society (2005) specifically highlights the following dimensions:

> "(i) Policy authority for Internet-related public policy issues is the sovereign right of States. They have rights and responsibilities for international Internet-related public policy issues.
>
> (ii) The private sector has had, and should continue to have, an important role in the development of the Internet, both in the technical and economic fields.
>
> (iii) Civil society has also played an important role on Internet matters, especially at community level, and should continue to play such a role.
>
> (iv) Intergovernmental organizations have had, and should continue to have, a facilitating role in the coordination of Internet-related public policy issues.
>
> (v) International organizations have also had and should continue to have an important role in the development of Internet-related technical standards and relevant policies."

The Tunis Agenda for the Information Society (2005) further emphasizes that such governance should cover the significant aspects of the security and safety of the Internet while at the same time incorporating inclusive and responsive aspects. In accordance with this, WeGO upholds the approach that can promote a risk- and threat-free cyber world be where everyone is able to utilize the advantages of technology in their daily lives while the public sector is able to leverage

the smart technologies to improve the livelihood for the people via the development of smart city incorporated with the ESG values.

42

Way Forward

Pursuit of ESG values and adoption of digital technology have been and will even more be mutually influential to each other. In terms of employing and utilizing digital technology, better data gathering, reporting, and analysis will lead to the most significant and immediate effect on the pursuit of ESG that is advantageous to every aspect of the lives of citizens. At the same time, it is time to envisage how to incorporate and pursue the ESG values into the cyber world where the problems of reality, such as gender issues, e-commerce and social problems are equally prevailing.

Hence, WeGO is bringing a new agenda of building a new digital ecosystem in the cyber world that will rectify these challenges in the cyber world through the ESG concept. The ESG concept is highly relevant to the cyber world, and it is important to be incorporated into the development of smart cities. By launching this WeGO Smart Cities Index 2022, the WeGO Secretariat looks forward to further bridging the ESG concept and cyber world for strengthening the future development of smart cities.

REFERENCES

References

Ahvenniemi, H., Huovila, A., Pinto-Seppa, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities? Cities, 60(A), 234-245.

Alawadhi, S et al. (2012). Building Understanding of Smart City Initiatives. Electronic Government (7443), 40-53.

Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. Journal of urban technology, 22(1), 3-21.

Angelidou, M. (2014). Smart city policies: a spatial approach. Cities, 41, S3-S11.

Angelidou, M. (2017). The role of smart city characteristics in the plans of fifteen cities. Journal of Urban Technology, 24(4), 3-28.

Alawadhi, S et al. (2012). Building Understanding of Smart City Initiatives. Electronic Government (7443), 40-53.

Azapagic, A., Perdan, S. (2000). Indicators of Sustainable Development for Industry: A General Framework. Process Safety and Environmental Protection, 78(4), 243-261.

Bhattacharya, T. R., Bhattacharya, A., Mclellan, B., & Tezuka, T. (2020). Sustainable smart city development framework for developing countries. Urban Research & Practice, 13(2), 180-212.

Bouskela et al. (2016). The Road toward Smart Cities: Migrating from Traditional City Management to the Smart City. Inter-American Development Bank. https://publications.iadb.org/en/road-toward-smart- cities- migrating-traditional-city-management-smart-city

Caragliu, A., Del Bo, C. (2011). Smartness and European urban performance: assessing the local impacts of smart urban attributes. Innovation: The European Journal of Social Science Research, 25(2), 97-113.

Caird, S. P., & Hallett, S. H. (2018). Towards evaluation design for smart city development, Journal of Urban Design, 24(2), 188-209.

Caird, S., Hudson, L. & Kortuem, G. (2016). A Tale of Evaluation and Reporting in UK Smart Cities. UK: The Open University. 51. (http://oro.open.ac.uk/46008/).

Calzada, I. & Cobo, C. (2015). Unplugging: Deconstructing the smart city. Journal of Urban Technology, 22(1), 23-43.

Campbell, J. L. (2007). Why would corporation behave in socially responsible ways? An institutional theory of corporate social responsibility. Academy of Management Review, 32(3), 946-967.

Castelnovo, W. & Simonetta, M. (2015). Engaging with complexity in a public programme implementation. Public Management Review,20(7): 1013-1031.

CAIA Association. (February 2, 2021). Systemic impact and ESG investing in smart cities. (https://caia.org/blog/2021/02/02/systemic-impact-and-esg-investing-in-smart-cities).

Cervo, H. et al. (2019). A Case Study of Industrial Symbiosis in the Humber; Region Using the EPOS Methodology. Sustainability 2019, 11(24), 6940. (https://doi.org/10.3390/su11246940).

Clark, J. S. (2020), Models of Ecological Data. Princeton University Press.

Eger, J. (2009). Smart growth, Smart Cities and the Crisis at the Pump A Worldwide Phenomenon.

ESG investing in Smart Cities (2021). (https://www.ftserussell.com/).

EU. Definition of Smart City. https://commission.europa.eu/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

Everhart, J. R. (2022). Cybersecurity + ESG for the Global Capital Markets. Harvard Law School Forum on Corporate Governance. (https://corpgov.law.harvard.edu/2022/09/15/cybersecurity-

esg-for-the-global-capital-markets/#more-149443)

Future City ESG Innovation Index (2021). (https://startupsandplaces.com/).

Garcia, J. R., Zhang, J. & Cid, G. P. (2016). Conceptualizing smartness in government: An integrative and multi-dimensional view. Government Information Quarterly, 33(3), 524-534.

Geva, A. (2008). Three models of corporate social responsibility: Interrelationships between theory, research, and practice. Business and Society Review, 113(1), 1-41.

Guan, L. (2012). Smart steps to a better city. Government News.

Harrison, C., Eckman, B. & Hamilton, R. (2010). Foundations for Smart Cities. International Business Machines Corporation, 54(4), Paper 1.

Huovila, A., Bosch, P. & Airaksinen, M. (2019). Comparative analysis of standardized indicators for Smart sustainable cities: what indicators and standards to use and when? Cities, 89, 141-153.

Hwang, J.S. & Jang, J.H. (2016). Development prospects of smart cities and competitiveness of Korea. IT & Future Strategy.

ITU.int (https://www.itu.int/en/Pages/default.aspx).

ITGI. American IT Governance Institute (https://www.isaca.org/).

Iversen, L. L. (2018). From safe spaces to communities of disagreement. British Journal of Religious Education, 41(3), 315-326.

J.P.Morgan (2021, August 19). Why is Cybersecurity Important to ESG Frameworks? (https://www.jpmorgan.com/insights/research/why-is-cybersecurity-important-to-esg)

Khuong, M. N., Truong an, N. K., & Hang, T. T. T (2021). Stakeholders and Corporate Social Responsibility (CSR) programme as key sustainable development strategies to promote corporate reputation—evidence from vietnam, Cogent Business & Management 8(1), 1-21.

Kourtit, K., Nijkamp, P. & Arribas, D. (2012). Smart cities in the innovation age. Innovation: The European Journal Social Science Research, 25(2), 93-95.

Lagasio, V. & Cucari, N. (2019). Corporate governance and environmental social governance disclosure: A meta-analytical review. Corporate Social Responsibility and Environmental Management, 26(4):701-711.

Lee, S. H. & Leem, Y. T. (2016). Analyzing Characteristics of the Smart City Governance. Journal of the Korean Association of Geographic Information Studies. 19(2), 86-97.

Liao S.J., Chen, X., Qian, Y. & Shen, L.Y. (2017). Comparative analysis of the indicator system for guiding smart city development. In: Proceedings of the 20th International Symposium on Advancement of Construction Management and Real Estate, 575-594.

Limkriangkrai, M., Koh, S. & Durand, R. B. (2017). Environmental, Social, and Governance (ESG) Profiles, Stock Returns, and Financial Policy: Australian Evidence.. International Review of Finance, 17(3), 461-471.

Lydia Harris, Philippa Kearny. (2021). Research Briefing: Smart Cities. UK Parliament. https://post.parliament.uk/research-briefings/post-pn-0656

Nam, T. & Choi, H. (2019). Platform governance for smart cities: lessons from the examples of Barcelona, Stockholm and Copenhagen. Journal of the Korean Urban Management Association, 32(4): 21-39.

Nam, T. & Pardo, TA. (2011). Conceptualizing smart city with dimensions of technology, people, and institutions. Digital Government Innovation in Challenging Times, 282-291.

Nam, K. W., Park, J. W., Park J.H., & Ji, S.T. (2017). The Organizational Structure and Role of Smart City Governance, Local Studies, 33(1): 69-85.

Nasdaq (2021). Cybersecurity: Industry Report & Investment Case-HUR. (https://indexes.nasdaqomx.com/docs/HUR_Research.pd).

Machado, A. B., Santos, J. R., Richte, M. F. & Sousa, M. J. (2021). Green Technological Innovation for Sustainable Smart Societies. 1-19.

Matthews, M. R. (1993). Socially Responsible Accounting. Chapman and Hall. London.

Ministry of Trade. & Industry and Energy. (2021). Guideline v 1.0 for K-ESG. Joint Ministries of Government.

Monfaredzadeh, T. & Berardi, U. (2015). Beneath the smart city: dichotomy between sustainability and competitiveness. Int. J. Sustain. Build. Technol. Urban Dev. 6 (3), 140-156.

Nasdaq (2021). Cybersecurity: Industry Report & Investment Case – HUR. (https://indexes. nasdaqomx.com/docs/HUR_Research.pdf)

OECD (2020). Smart Cities and Inclusive Growth (https://www.oecd.org/cfe/cities/OECD_Policy_ Paper_Smart_Cities_and_Inclusive_Growth.pdf).

Parker, G. G., Alstyne, M. V., & Choudary, S. P. (2016). Platform revolution: How networked markets are transforming the economy and how to make them work for you. 266.

Patrão, C., Moura, P., & Almeida, A. T. D. (2020). Review of smart city assessment tools. Smart Cities, 3(4), 1117-1132.

Reddy, M. S. (2019). Corporate social responsibility practices by the multinational corporations. India: Archers and Elevators Publishing House.

Risdianam, D. M., & Susanto, T. D. (2019). The safe city: Conceptual model development-A systematic literature review. Procedia Computer Science, 161, 291-299.

RBC Global Asset Management (2019). 2019 Responsible Investing Survey Key Findings. (https:// global.rbcgam.com/sitefiles/live/documents/pdf/rbc-gam-responsible-investing-survey-key-findings-2019.pdf).

Sarnek, A. & Dolan, C. (2022, March 1). Cybersecurity is an environmental, social and governance issue. Here's why. World Economic Forum. (https://www.weforum.org/agenda/2022/03/three-reasons-why-cybersecurity-is-a-critical-component-of-esg/)

School of Public Policy at Georgia Institute of Technology (2022). What is Internet Governance? (https://www.internetgovernance.org/what-is-internet-governance/).

Sultana, S., Zainal, D. & Zulkifli, N. (2018). Environmental, Social and Governance (ESG) and Investment Decision in Bangladesh. Sustainability, 10(6).

Sharifi, A. (2019). A critical review of selected smart city assessment tools and indicator sets. Journal of cleaner production, 233, 1269-1283.

Sharifi, A. (2020). A typology of smart city assessment tools and indicator sets. Sustainable cities and society, 53, 101936.

S&P Global. (2022). (www.spglobal.com/).

Smart City Index Master (2014) (https://www.smartcitiescouncil.com/).

Smart Cities Council. (2012). definition of smart city from "Our Vision" submitted by jdekeles on April 10, 2012. https://www.smartcitiescouncil.com/article/our-vision-0

Spanish Smart City Model. (2017). Definition from AENOR Standardisation Technical Group 178 (AEN/CTN 178/SC2/GT1N 003). Citudades Inteligentes: Agenda Digital para Espana. https://plantl. mineco.gob.es/digital-agenda/Documents/Spanish-Smart-Cities-Model.pdf

Silva Lokuwaduge, C. S. & Heenetigala, K. (2016). Integrating Environmental, Social and Governance (ESG) Disclosure for a Sustainable Development: An Australian Study. Business Strategy and the Environment, 26(4), 438-450.

Stratigea, A., Leka, A. & Panagiotopoulou, M. (2017). In search of indicators for assessing smart and sustainable cities and communities' performance. International Journal of E-Planning Research 6(1): 43-73.

Systemic Impact (2021) (https://www.communitylegalsocal.org/).

The World Bank (https://datatopics.worldbank.org).

Tunis Agenda for the Information Society (2005). World Summit on the Information Society. (https://www.itu.int/net/wsis/docs2/tunis/off/6rev1.html).

UNECE.ORG (https://unece.org/).

UN HABITAT (https://unhabitat.org/).

UNDP. Definition of Smart City. https://www.undp.org/sgtechcentre/smart-cities-1.

United Nations, Department of Economic and Social Affairs, Public Institutions (n.d.). Internet Governance. (https://publicadministration.un.org/en/internetgovernance).

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations. (https://population.un.org/wup/publications/Files/WUP2018-Report.pdf).

Winters, J. V. (2011). Why are smart cities growing? Who moves and who stays. Journal of regional science, 51(2), 253-270.

Wu Z., Pan Y., Ye Q. & Kong L. (2016). The city intelligence quotient (city IQ) evaluation system: conception and evaluation. Engineering 2(2): 196-211.

Xie, X., Huo, J. & Zou, H. (2019). Green process innovation, green product innovation, and corporate financial performance: A content analysis method. Journal of Business Research, 101, 697– 706.

Zhao, X., Askari, H. &Chen. J. (2021). Nanogenerators for smart cities in the era of 5G and Internet of Things. Joule 5(6), 1391-1431.