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Research Article

The Future of Cities: Integration of Smart and Green Cities as a Step to Achieve SDGs

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Abstract.
The global reliance on scientific and technological progress presents a significant opportunity or promoting sustainable development. a key paradigm in today's globalized world. Concepts such as Smart City and Green City have been widely adopted, particularly by Western countries, as part of the transition toward more sustainable urban living. Striking a balance between environmental sustainability and technological progress is important, especially for ensuring the well-being of future generations. This research seeks to integrate the concepts of Smart City and Green City into a unified framework that supports the sustainable development goals (SDGs). The study highlights that such integration can enhance the efficiency and quality of urban life while maintaining environmental responsibility. Given the current global challenges, including climate change, environmental degradation, natural resource depletion, and pollution, the need for this integration is urgent. In addition, the research emphasizes that public awareness has not been fully able to contribute to the achievement of SDGs.

Keywords: development, smart city, green city

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1. Introduction

In the current era of globalization, the world's dependence on science and technology is increasing. Both have become the main foundation in various aspects of life, ranging from economics, education, health, to communication. Technological advancements have enabled faster, more efficient and scalable growth, while science continues to provide a foundation for innovation that incessantly updates the way humans interact with their environment. In the context of development, awareness of the vital role of science and technology also creates vast opportunities.

An attitude of smart and sustainable use of technology will stimulate countries to drive economic growth, expand access to education and health services, and strengthen human resource capacity to face future challenges. This understanding is important so that development does not rely solely on the exploitation of natural resources, but also

on investment in knowledge and innovation to create a more inclusive and sustainable future.

The concept of sustainable development is commonly adopted by many countries. Developed countries generally view the concept of sustainable development as an effort to achieve a balance between economic growth, social welfare and environmental sustainability [1]. Sustainable development mechanisms in developed countries are often based on scientific principles that emphasize resource efficiency, clean energy use and green technology innovation [2][3]. The importance of the government's role in formulating public policies oriented towards the discipline of research and development (R&D) in order to reduce negative environmental impacts. The philosophy underlying this approach is the realization that natural resources are limited, so they must be managed carefully for the survival of future generations [4].

Achieving the Sustainable Development Goals (SDGs) requires supporting components so that the proportion of sustainable development does not lose its way. The SDGs concept demands that the portrait of future development does not depart from environmentally friendly values and technological progress. This means that the balance between development prospects and environmental quality mutually affects long-term prosperity. Development that only focuses on economic growth without thinking about environmental quality can create resource exploitation [5]. When resource exploitation occurs, the world enters the ecosystem degradation zone and climate change threatens [6].

The concepts of Smart City and Green City have a strong correlation as both aim to create a more efficient, sustainable, and comfortable city for its residents. Smart City refers to the use of information and communication technology to manage city resources more intelligently and efficiently, such as traffic, energy, water and waste management. Green cities, on the other hand, focus on environmental aspects, prioritizing carbon footprint reduction, green space preservation, and the use of renewable energy.

The correlation between the two lies in the technology-based approach that enables the creation of environmentally sound cities. For example, smart technologies in smart cities such as environmental sensors and smart grids can optimize energy use and minimize wastage, in line with green cities' goal of reducing environmental impact. These two concepts complement each other: smart cities provide technological tools and solutions, while green cities ensure that such developments contribute to ecological

sustainability. With this synergy, cities of the future can evolve into spaces that are not only technologically smart, but also healthy and environmentally friendly.

Oslo City as the capital of Norway can be used as a parameter for development with the integration of Smart City and Green City. The world recognizes the City of Oslo as having high discipline and intelligence in implementing a lifestyle in the government and community environment. Oslo's best development began in 2020 with their success in achieving certain targets such as:

a) cutting energy resources,

b) minimizing greenhouse gases,

c) regulating transportation emissions with a 50% saving rate.

The prospect of integrating Smart City and Green City concepts is a concrete step by Norway, which does not exclude technological advances [7]. Smart City and Green City complement each other as a concept to improve the quality of development and environmental sustainability. There are not many examples of cities and regions that can be categorized as smart cities and green cities, because in general both concepts are still developing. Therefore, it is important to examine the future of cities because several threats have been predicted in advance such as:

a) climate change,

b) pollution,

c) waste management,

d) congestion,

e) health risks,

f) environmental degradation and so on

The integration of Smart City and Green City concepts in developed countries such as Sweden and Germany is now a priority. For example, local governments are collaborating with the private sector to develop smart transportation networks that can encourage the accumulation of clean energy. In Berlin, resource optimization is done on a risk-based basis, resulting in savings in energy consumption. Other countries such as Singapore accommodate Smart City ecosystems using advanced technology with sensory motors that function to monitor air quality, smart waste management and green energy infrastructure monitoring.

Smart City is a concept that has been widely developed in the world. The concept of Smart City can be learned, examined, and understood by everyone by looking for international literacy that has been widely discussed by most Europeans and Americans.

Researchers need to emphasize the standard understanding of Smart City and its true nature, if most people still feel unfamiliar.

Showing the literacy of Smart City as presented by the world policy watchdog European Commission, defines that Smart City is a place where traditional networks and services are converted to be more efficient with digital support in order to improve the interests of residents and business progress. Secondly, smart cities are not just about the advancement and development of digital technology, but about the efficient use of resources in a better way with low emissions. Third, smart cities should have a ready network of smart facilities, especially water supply, waste disposal, and more efficient ways of lighting and physical development. Fourth, a Smart City should have a city government that is responsive in touching public spaces, especially in meeting the needs of the aging population [8].

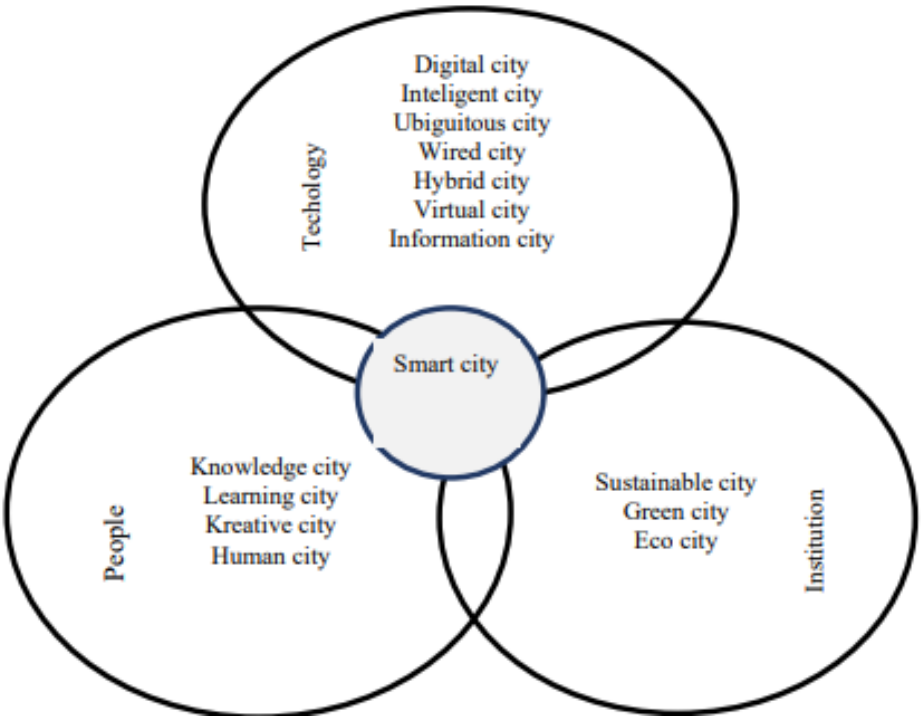

Figure 1: Smart City Concept.

Smart City is a modern concept offered by many world thinkers to answer the problems of life in urban areas. Overcrowding is the main trigger for the birth of non-conducive life in urban areas, so that it is oriented towards guaranteeing a sustainable life that is less feasible in the future [9]. The Smart City concept needs to be supported in a common consensus that human capital is essential to integrate technological advances and intense communication. The dynamics of public life in economic, social, cultural and environmental development in the future need to be supported by smart

investments such as smart cities [10]. Cities with advanced economies and population competencies serve to maintain the quality of urban space, so the discipline of education administration is one of the steps to build a Smart City. Human resource awareness determines the durability of a city every day, so it is rational if the element of education is included in the shaping factors of a Smart City [11].

This research aims to examine the concept of Smart City and Green City integration in the transformation to support SDGs in the future. This research departs from the many studies on the urban environmental crisis if the lifestyle and development continue to be carried out in the old way. So, the concept of integration between Smart City and Green City can be used as the main theory to parse the research findings and effective recommendations for global life.

This research seeks to integrate various concepts and literature on Smart City and Green City as a standardized whole. When linked to the Sustainable Development Goals (SDGs), the integration of Smart City and Green City concepts can be used as a supporting element in the future. The SDGs largely aim to ensure the well-being of humanity in the present without compromising the needs of future generations. The integration of the Smart City and Green City concepts is very relevant to the big goals of the SDGs, which envision livable, just and sustainable cities, so it is important to further research as a scientific contribution to the world.

2. Material and Methods

2.1. Materials

The researcher used a laptop as the main tool to search for scientific references on the internet. The references found served as sources to be studied, analyzed, and compared with other similar references. The analysis was carried out based on the researcher's thoroughness in exploring the research topic and supporting literature, so, in other words, the researcher maintained a high level of focus throughout the research period. The researcher selected and evaluated all stages of the research continuously.

The concepts of Smart City and Green City are currently being initiated by many cities around the world. The researcher found many references from institutional reports and studies, professional groups and supporting scientific journals mainly in Europe and America. The function of the Smart City and Green City concepts that the researcher found is to build the main framework of understanding, namely an understanding of

how the benefits offered by the integration of Smart City and Green City concepts in supporting global consensus related to SDGs, especially in the future.

2.2. Methods

The research used the literature study method as an approach that relied on the ability of the researcher. The skills that researchers needed were in terms of collecting, analyzing, reducing information, and mastering literature sources from the internet. Although various secondary reference sources were available, such as scientific journals, articles, research reports, government documents, and other relevant publications, researchers needed to improve literacy to avoid research gaps. The researcher acted as a subject to identify in-depth information related to the research topic because the researcher did not gather field data [12].

The advantages of the literature study method lay in efficiency and effectiveness, especially cost. The literature used in this study related to how to develop the concept of developed cities, as exemplified by several cities around the world. The scientific literature in this study was deliberately designed with the main focus on understanding the concepts of a Smart City and a Green City. In addition, literature on the positive aspects of the development of Smart City and Green City concepts in supporting environmental quality was also included in this research as an introduction to concrete understanding, showing that the integration of the two concepts was able to address the challenges of sustainable life in the future.

Secondly, there was unlimited exploration of broad knowledge because researchers could utilize various concepts, theories, research results, and other published documents to help strengthen research construction. The researcher was able to organize the theoretical framework well, which could be refined over time. Finally, the researcher had great opportunities to verify and revalidate the results of previous research or the theories used.

3. Research ad Discussion

3.1. Philosophy of Building Smart City and Green City

The philosophy of good urban development focuses on the principles of sustainability, balance and community well-being. This approach involves careful planning to create

spaces that are environmentally friendly, functional and inclusive for all. Every element, from infrastructure, building layout, public spaces, to green areas, is designed to support each other, strengthen the local economy, and reduce negative impacts on the environment. By taking into account social, economic, and ecological aspects, good urban development aims to create places that are safe, comfortable, and meet the needs of the present without compromising the rights of future generations.

The philosophy of undertaking development activities is not complex, as it requires a fundamental understanding of high-level discipline as world cities have exemplified. These cities have gone global and solved small problems such as blackouts, potholes, traffic jams or access to clean water for citizens. Another example is disciplining the characteristics and behavior of citizens in matters of consumption culture. The culture of consumption is prevalent in almost all countries and international regions. The philosophy is that when a consumptive culture is not accompanied by efforts to maintain waste substances or residues, such conditions will hamper the government's task in developing.

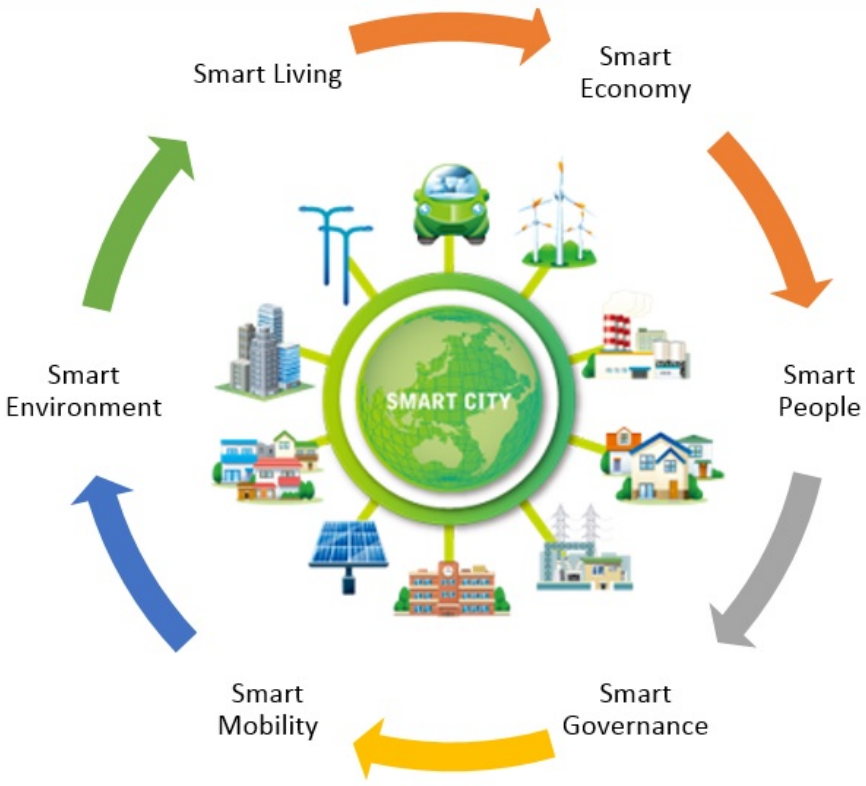

Figure 2: Smart City Concept

Referring to the figure above as developed by several researchers [13], [14], & [15], it is stated that the Smart City concept essentially supports many fields. The urgency of

Smart City does not have a single function when associated with people's lives, but there are several other supporting aspects. Based on the picture above, human existence functions as the main controller to carry out sector management. The existence of humans covered by the power of authority is certainly in the government, so the government plays an important role in creating a sustainable living climate.

1) Smart Living

The term refers to the presence of technology and innovation as a buffer for an improved quality of life. An enabling environment where people have broad access to basic services is a prerequisite for physical and psychological well-being. Technological advancements such as in health and education are examples of standardized concepts that should be nurtured.

2) Smart Economy

This sector is oriented towards increasing the productivity of urban areas in order to increase competitiveness with other regions. Smart economy cannot be separated from technological support in supporting business prospects, labor distribution, and inter-regional interactions so that it can be said that technology plays an economic acceleration.

3) Smart People

Istilah ini berkaitan dengan kondisi serta kompetensi sumber daya manusia terutama di era kemajuan digital seperti sekarang ini. Manusia dituntut untuk mahir mengembangkan kepribadian dan meningkatkan literasi teknologi, literasi bacaan, hingga membentuk budaya terampil digital agar dapat berkontribusi terhadap proses penciptaan kota pintar.

4) Smart Governance

This term refers to governance that has a high response to public needs. Fast and accurate public services need to be supported by information technology in order to increase efficiency, participation, accelerate administration, and monitor problems quickly.

5) Smart Mobility

This term refers to the mobility of every individual, especially when it comes to transportation every day. Fast and organized mobility in the midst of congestion challenges, of course, requires serious management. On the other hand, fast mobility and the development of transportation facilities must not override environmental aspects.

6) Smart Environment

This term is very important to maintain in the midst of technological advances that often threaten human civilization. The point is, that the progress of the times often converts a green land to be used as a new function such as: the establishment of factories, the establishment of the business sector, the establishment of toll roads, the establishment of hospitals, the establishment of rental buildings and so on.

As the theory that the existence of the government must be several steps ahead of the community. The will of the community cannot be realized without the actualization of the program, which is a program or policy that requires finance. The only party that can ensure the creation of change and development is the government. Meanwhile, other parties such as the private sector and the community only have the status of second-tier supporters.

Sustainable development designs such as Smart City and Green City are the most ideal approach to driving SDGs. The vision to create more livable lives and human well-being focuses on resource control, waste reduction and maintenance of natural ecosystems [16]. Principles such as Smart City and Green City are inseparable as long as there is balance at the implementation level [17]. In addition to implementation, it is important to pay attention to high public awareness as the public has great potential to create global movements such as:

a) Reduction of fuel consumption

b) Reduction of electricity consumption

c) Reduction of plastic consumption

d) Household-level waste management

e) Reduction in the use of private vehicles that trigger pollution

f) Household-level waste recycling patterns

g) Other active contributions in the context of saving the earth

h) Cultivating a culture of discipline in accordance with the vision of SDGs

3.2. Implementation of SDGs Supporting Policies Across Countries

Policies supporting the SDGs should be designed to create a balance between economic development, social welfare and environmental sustainability. For example, policies that encourage the use of renewable energy and energy efficiency can support economic growth while reducing environmental impacts. In addition, policies related to

sustainable management of natural resources, such as ecosystem protection and pollution control, will help maintain environmental quality while still allowing for necessary infrastructure development [18]. Inclusive policies that take into account the rights of vulnerable groups and encourage community participation in the development process also play an important role in ensuring that the benefits of development are felt by all levels of society, without compromising the needs of future generations. By combining social, economic and environmental aspects, these policies support the sustainable achievement of the SDGs.

Some countries that implement SDGs through the Smart City and Green City concepts/approaches are as follows:

a) South Korea: Songdo City is an example of a Smart City developed with sustainability in mind. The city utilizes technology to optimize energy use, waste management, and transportation, and has extensive green spaces and an efficient water management system.

b) Sweden: Sweden is well recognized as a trendsetter in sustainability and has embedded the elements of Smart City and Green City in its systems with major emphasis on the Stockholm city. Smart technologies are implemented in cities for purposes of energy and transport management, while a sustainable environment is ensured through the sourcing of renewable energy as well as effective waste management systems.

c) Singapore: Singapore has embarked on the Smart Nation initiatives which seeks to foster the application of technology in building more efficient and sustainable cities. They prioritize smart resource management, enhanced quality of life, and environmental policies that promote renewable energy and green spaces that are embedded in urban planning.

d) Denmark: The city of Copenhagen stands as an ideal case of Green City which also deploys Smart City technologies. This city focus is on reduction of carbon emissions by deploying renewable energy, green commuting, and efficient public transport networks. Copenhagen is aiming to have the status of a carbon-neutral city by 2025.

e) Germany: In Berlin and other metropolitan centers, Germany is also using smart technologies for energy conservation and efficiency, waste management, and transport logistics, while increasing large scale greenery and renewable energy policies integration.

4. Conclusion

The conclusion of this research confirms that the integration of the Smart City and Green City concepts is a crucial step in achieving sustainable development goals (SDGs). The application of both concepts allows for a balance between technological advancement and environmental sustainability, which is an important foundation in dealing with global challenges such as climate change, environmental degradation, natural resource pressure and pollution. Developed countries have begun to adopt this concept in their urban transformation, disciplining society through regulation and smart technology to improve efficiency, quality of life and environmental sustainability.

However, a major challenge that remains is the low level of awareness among the global community of their role in realizing sustainable development. Although developed countries have succeeded in building infrastructure that supports citizen discipline in protecting the environment, the level of individual awareness in supporting the achievement of SDGs has not been fully optimized. This shows that in addition to the implementation of technology and strong policies, education and raising public awareness remain important components in the successful integration of Smart City and Green City in the future.

References

[1] Haqqi MM. PENERAPAN KONSEP PEMBANGUNAN BERKELANJUTAN DALAM SISTEM PERENCANAAN PEMBANGUNAN NASIONAL. Supremasi Hukum. Jurnal Penelitian Hukum. 2022;31(1):11–28.

[2] Widodo M, Watapri P. KTT Dunia Pembangunan Berkelanjutan 2002 Peluang dan Tantangan Bagi Indonesia Baru. Paper Tidak Dipublikasikan; 2001.

[3] Wiryananda NGAK, Andika PIGA. Kajian Strategi Penerapan Pembangunan Berkelanjutan. Jurnal Lingkungan Almuslim 2022;1:009–15. https://doi.org/10.51179/jla.v1i2.1252.

[4] Burhanuddin SH. Integrasi ekonomi dan lingkungan hidup dalam pembangunan yang berkelanjutan. EduTech: Jurnal Ilmu Pendidikan Dan Ilmu Sosial 2016;2.

[5] Binter AF. Budaya Sasi: Perlawanan Negara dan Masyarakat terhadap Eksploitasi dan Kerusakan Sumber Daya Alam. PhD Thesis. Magister Studi Pembangunan Program Pascasarjana UKSW, 2015.

[6] Hasid HZ, SE S, Akhmad Noor SE, Se M, Kurniawan E. Ekonomi sumber daya alam dalam lensa pembangunan ekonomi. Cipta Media Nusantara; 2022.

[7] The Agility. Oslo leads the way in green and inclusive smart cities. The Agility Effect 2019. https://www.theagilityeffect.com/en/case/oslo-leads-the-way-in-green-and-inclusive-smart-cities/ (accessed November 13, 2024).

[8] Europan Commision. Smart cities - European Commission 2024. https://commission.europa.eu/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en (accessed January 18, 2025).

[9] Kozlowski W, Suwar K. Smart City: Definitions, Dimensions, and Initiatives. Eur Res Stud. 2021;XXIV(Special Issue 3):509–20.

[10] Anthopoulos L, Janssen M, Weerakkody V. A Unified Smart City Model (USCM) for Smart City conceptualization and benchmarking. Smart Cities and Smart Spaces: Concepts. Methodologies, Tools, and Applications; 2019. pp. 247–64.

[11] Tham JC, Verhulsdonck G. Smart education in smart cities: layered implications for networked and ubiquitous learning. IEEE Trans Technol Soc. 2023;4(1):87–95.

[12] Adlini MN, Dinda AH, Yulinda S, Chotimah O, Merliyana SJ. Metode penelitian kualitatif studi pustaka. Jurnal Edumaspul. 2022;6(1):974–80.

[13] Winkowska J, Szpilko D, Pejić S. Smart City concept in the light of the literature review. Engineering Management in Production and Services. 2019;11(2):70–86.

[14] Zubizarreta I, Seravalli A, Arrizabalaga S. Smart City Concept: What It Is and What It Should Be. J Urban Plann Dev. 2016;142(1):04015005.

[15] Vishnivetskaya A, Alexandrova E. “Smart City” concept. Implementation practice. IOP conference series: materials science and engineering. Volume 497. IOP Publishing; 2019. p. 012019.

[16] Axios. Mendesain Masa Depan Berkelanjutan: Konsep Smart City untuk Lingkungan Hijau - Leading Smart Living & Environment 2024. https://axios.id/mendesain-masa-depan-berkelanjutan-konsep-smart-city-untuk-lingkungan-hijau/ (accessed November 13, 2024).

[17] Kim YG, Song YM, Cho S. Design and management direction of smart park for smart Green City. Journal of the Korean Institute of Landscape Architecture. 2020;48(6):1–15.

[18] Delitheou V, Meleti V, Athanassopoulos CG. Green economy and Smart City. J Reliab Intell Environ. 2019;5(4):235–40.