Vizyoner Dergisi

Süleyman Demirel Üniversitesi Vizyoner Dergisi, Yıl: 2024, Cilt: 15, Sayı: 42, 711-727.
Süleyman Demirel University Visionary Journal, Year: 2024, Volume: 15, No: 42, 711-727.

ISSN: 1308-9552

DERLEME MAKALESİ / REVIEW ARTICLE

AN INVESTIGATION INTO THE INTERACTION OF SMART CITY GOVERNANCE AND GREEN ECONOMY

AKILLI ŞEHİR YÖNETİŞİMİ VE YEŞİL EKONOMİ ETKİLEŞİMİ ÜZERİNE BİR İNCELEME

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ABSTRACT

Cities can be effectively transformed into smart cities (SCs) to support sustainability, green economy (GE) and sustainable development (SD). Urbanization policies are important for SCs's effectiveness in GE and sustainability. The study aims to propose suggestion on preliminary pillars of the multi-layered conceptual model towards contribution of smart governance (SG) in SCs to GE and sustainability. Therefore, the study reviews the literature in different search engines (e.g., Web-of-Science, Scopus, Sciencedirect) with keyword combinations of SC, GE, SC governance and sustainability. The study examines SC examples and SG strategies to support GE. The findings highlight the contribution of SC and effective SG to the GE and the multi-layered nature of SC that changes strategically through a multi-actor and multi-sectoral approach. The results emphasize that sustainability interacts with the SC, creating a closed loop that supports SC governance to develop GE. Furthermore, the results provide preliminary suggestion on main pillars of the conceptual model as five aspects (technological, governance, environmental, social, economic) and five keys (ICT-led urban-growth, collaboration, integration, transparency & accountability, green performance) that can support GE because of the interactions of SG and SD. The study can be beneficial for municipalities, urban planners, and researchers in the relevant field.

Keywords: Green Economy, Smart City Governance, Sustainable Development, Sustainable Development Policies, Urbanization Policies**.**

JEL Classification Codes: Q01, Q50, Q56, R58.

ÖZ

Sürdürülebilirliği, yeşil ekonomiyi (YE) ve sürdürülebilir kalkınmayı (SK) desteklemek için şehirler etkili bir şekilde akıllı şehirlere (AŞ) dönüştürülebilir. AŞ'in YE ve sürdürülebilirlik açısından etkinliği için kentleşme politikaları (KP) önemlidir. Bu makale, AŞ'lerde akıllı şehir yönetişimi (AŞY) ile şehirlerin YE'ye ve sürdürülebilirliğe katkıları yönünde çok katmanlı kavramsal modele (ÇKKM) yönelik temeller üzerine ön öneri geliştirmeyi amaçlamaktadır. Bu nedenle, bu makale AŞ, YE, AŞ yönetimi ve sürdürülebilirlik anahtar kelime kombinasyonlarıyla farklı arama motorlarındaki (örn. Web-of-Science, Scopus, Sciencedirect) mevcut literatürü gözden geçirmiştir. Bu çalışmada, AŞ örnekleri ve YE'yi desteklemek için akıllı yönetişim (AY) stratejileri incelenmiştir. Bulgular, AŞ'lerin ve etkili AY'nin YE'ye katkısını ve çok aktörlü ve çok sektörlü bir yaklaşımla stratejik olarak değişen AŞ'nin çok katmanlı doğasını vurgulamaktadır. Sonuçlar ayrıca sürdürülebilirliğin AŞ konseptiyle etkileşime girdiğini ve AŞY'yi YE'yi geliştirmek için destekleyen kapalı bir döngü oluşturduğunu vurgulamaktadır. Ek olarak, bulgular AY ve SK arasındaki etkileşimin bir sonucu olarak YE'nin yaratılmasını destekleyebilen çok katmanlı kavramsal beş anahtar (BİT odaklı kentsel büyüme, iş birliği, entegrasyon, şeffaflık ve hesap verebilirlik, yeşil performans) ve beş açı (teknolojik, yönetişim, çevresel, sosyal ve ekonomik) sağlamaktadır. Bu makale ilgili alanda çalışan belediyeler, şehir plancıları ve araştırmacılar için faydalı olabilecektir.

Anahtar Kelimeler: Yeşil Ekonomi, Akıllı Şehir Yönetişimi, Sürdürülebilir Kalkınma, Sürdürülebilir Kalkınma Politikaları, Kentleşme Politikaları.

JEL Sınıflandırma Kodları: Q01, Q50, Q56, R58.

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Makale Geliş Tarihi / Received : 15.05.2023
Makale Kabul Tarihi / Accepted : 24.04.2024

https://doi.org/10.21076/vizyoner.1297450

Süleyman Demirel Üniversitesi Vizyoner Dergisi, Yıl: 2024, Cilt: 15, Sayı: 42, 711-727.
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ISSN: 1308-9552

GENİŞLETİLMİŞ ÖZET

Amaç ve Kapsam:

Teknolojinin gelişimi ile önem kazanan AŞ kavramı, şehirlerin dünya genelinde rekabet avantajı elde edebilmesi ve yaşam koşullarında iyileştirme olanağı sunması ile şehir yönetişimi stratejilerinde (ŞYS) önemli bir yer edinmeye devam etmektedir. Yüksek düzeyde üretkenliğe sahip olma ve kalkınma fırsatları sunabilme özellikleriyle şehirler sosyal ve ekonomik kalkınma kapsamında önemli roller üstlenmektedir. Şehirler, yadsınamaz çevresel olumsuz etkileri üzerinde teknoloji odaklı akıllı çözümler geliştirerek yeşil stratejiler oluşturmaktadır. Bu husus sürdürebilir kalkınma hedefleri (SKH) doğrultusunda AŞ oluşumunun önemini vurgulamaktadır. Sürdürebilirlik ilkelerinin (örn: sosyal, ekonomik, çevresel) ve teknoloji odaklı AŞ kavramının ŞYS'ye entegrasyonu KP'nin önemini ortaya koymaktadır. KP'nin kullanıcı odaklı ve teknoloji yoğun gelişmelerle yapılanması, sürdürülebilir, yaşanabilir ve kaynak açısından verimli kentsel alanlar yaratılmasını sağlar, toplumsal ve yaşamsal refahı artırır ve bu stratejiler doğrultusunda da YE'nin oluşumuna ve gelişimine olanak tanır. SKH'nin yerine getirilebilmesi, AŞ oluşumu ile teknoloji odaklı çözüm yollarının geliştirilebilmesi, AŞ uygulamasında şehirlerin yönetişim kalkınma hedeflerinin önemini vurgulamaktadır. Bu makalede, dünya genelinde birçok uygulaması gerçekleştirilen AŞ oluşum örnekleri incelenmiştir. Bu makale, AŞ'lerde YE'nin oluşturulabilmesine ve geliştirilebilmesine olanak tanıyacak, AŞY'nin SKH doğrultusunda gelişimini sağlayabilecek ve YE oluşumunda rol oynayacak ÇKKM geliştirmeyi amaçlamaktadır.

Yöntem:

Bu makalede, amaç doğrultusunda ilk aşamada literatür taraması yöntemi kullanılmıştır. Literatür taramasında son beş yılda ve farklı arama motorlarında (örn. Web-of-Science, Scopus, Sciencedirect) İngilizce dilinde yayımlanmış araştırma makaleleri dikkate alınmıştır. AŞ, YE, sürdürülebilirlik ve AŞY anahtar kelime kombinasyonları kullanılarak başlık, özet ve anahtar kelimelerde tarama yapılmıştır. Toplamda 158 makale elde edilmiştir. Makalelerin içerik analizi yöntemiyle incelenmesi sonucunda elde edilen bilgiler bu makalenin literatür taramasını şekillendirmiştir. İkinci aşamada ilk olarak dünya nüfusu artış verileri ve kentsel nüfus artışı değerlendirilmiştir. İkinci olarak, dünya genelinde bulunan AŞ'leri değerlendiren uluslararası indeksler (örn: IESE Cities Motion Index, JLL's Attraction Index) taranmıştır. Bu indekslerde AŞ kavramının AY'nin temel bileşenlerine bağlı olarak dünya genelinde yapılan sıralamalar incelenmiştir. Son beş yıl içerisinde indekslerde dünya genelinde ilk beş sıralamada yer alan şehirler makalede örnek şehirler olarak incelenmiştir. Belirlenen AŞ örneklerinin, sürdürülebilirlik ve AY kapsamında uyguladıkları stratejiler ile bu stratejilerin YE oluşturma kapsamında etkileri ve gelecek odaklı planlanan stratejik unsurlar incelenmiştir. İncelemeler, literatür kapsamında elde edilen bulgular ışığında değerlendirilmiştir. Elde edilen bulgular ile AŞ uygulamalarının sürdürülebilir gelişime etkisini vurgulayan AY ve YE oluşturabilme kavramları etkileşimi ile şekillenen ÇKKM oluşturulmuştur. Kaynak taraması yöntemiyle elde edilen bulgular ve dünya genelindeki AŞ uygulamalarını inceleyen uluslararası geçerliliği olan indekslerden elde edilen bulgular ÇKKM'nin altyapısını oluşturmuştur.

Bulgular:

İstatiksel verilerin analizi, dünya nüfusunun artış trendinde olduğunu yansıtmakta olup gelir seviyesine bağlı olmaksızın şehirlerde nüfus artışının yaşanacağı beklentisini göstermektedir. Dünya genelinde AŞ sayısının hızla arttığı gözlemlenmiştir. Dünya genelinde, IMD Dünya Rekabet Edebilirlik Merkezi AŞ endeksine göre 2023 yılında 141 AŞ nin, Cities in the Motion endeksine göre ise 181 AŞ nin olduğu gözlemlenmiştir. Bu makale, AŞ'lerin ve sürdürülebilirlik odaklı AY'nin YE'ye katkısına vurgu yapmıştır. Bulgular, AY'nin çok katmanlı yapısı üzerinde sürdürülebilirlik kavramının benimsenmesini ön plana çıkarırken, AŞ'lerin stratejik olarak değişen çok aktörlü ve çok sektörlü olan çok katmanlı doğasını vurgulamaktadır. Bu makale kapsamında AŞ'lerde AŞY ile şehirlerin YE'ye ve sürdürülebilirliğe katkıları yönünde ÇKKM'ye yönelik temeller üzerine şekillenen beş anahtar ve beş açı vurgulanmıştır. AŞ'lerin çok katmanlı yönetimsel yapı ile şekillenmesinin (organizasyonel, stratejik ve taktik seviyeleri), AY, sürdürülebilirlik ve YE kavramlarının birbirleriyle etkileşiminin AŞ oluşumundaki etkisini artırdığı vurgulanmıştır. Literatürde AŞ kavramının kavramsal dört farklı aşamada değişimi (AŞ 1.0, AŞ 2.0, AŞ 3.0, AŞ 4.0) incelemesi sonucunda AY için AŞ'lerin beş anahtarı (teknolojide bilgi işlem teknolojileri (BİT) liderliğinde kentsel büyüme, yönetimde iş birliği, kentsel planlamada entegrasyon, şeffaflık ve hesap verebilirliğe yatırım) olarak belirtilmiştir. Ek olarak, AY'nin SKH'nin etkileşimi ile YE'nin oluşturulmasında teknolojik, yönetişim, çevresel, sosyal ve ekonomik açılar olmak üzere beş açıdan ele alınmasının önemi vurgulanmıştır. Uluslararası AŞ odaklı indekslerde ilk sıralarda yer alan AŞ'lerin bu makalede oluşturulan KM'ye paralellik göstererek, AY'nin sürdürülebilirlik ve YE oluşumuna yönelik stratejiler oluşturduğu gözlemlenmiştir.

Sonuç ve Tartışma:

Dünya nüfusunun hızlı artış göstermesi, şehirlerin akıllı yönetişim ve YE bazlı gelişme gerekliliğini ortaya çıkarmaktadır. Sürdürülebilirlik ve AŞ kavramları etkileşimli olup AŞY YE'yi destekleyen bir döngü oluşturmaktadır. Bu çalışmada ÇKKM'e yönelik önerilen beş anahtardan (teknolojide BİT liderliğinde kentsel büyüme, yönetimde iş birliği, kentsel planlamada entegrasyon, şeffaflık ve hesap verebilirliğe yatırım) ve beş açıdan (teknolojik, yönetişim, çevresel, sosyal ve ekonomik) oluşan ön temeller şehirlerin yeşil ekonomik kalkınmalarında daha sürdürülebilir ve akıllı olmalarında rol oynayabilir. Bu çalışma, AŞ olma yolunda ilerleyen ve/veya ilerleme hedefi olan şehirler için, AY'nin katmanlı yapısı (organizasyonel, stratejik, taktik seviye) ile sürdürülebilirliğin ilişkilendirilmesi, bu etkileşim ile YE oluşturma ve YE büyüme sağlanabilmesi için temel kavramları içeren bir ön rehber niteliği taşımaktadır. Bu makalenin ilgili alanda çalışan belediyeler, şehir plancıları, akademisyenler için ve YE'yi desteklemek üzere şehirlerin AŞ'lere dönüşmesi ile ilgili tüm paydaşlara faydalı olabileceği düşünülmektedir.

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ISSN: 1308-9552

1. INTRODUCTION

Cities have high level of productivity and potential to provide development opportunities (Monzon, 2015). Even if cities have important social and economic roles at the global scale, they have adverse environmental impact (Albino et al., 2015). The potential of cities can play an important role in identifying issues that negatively affect living conditions and enable them to strengthen these weaknesses to achieve better conditions. Cities have significant role in addressing challenges in environmental impact (Organisation for Economic Co-operation and Development [OECD], 2014). Considering interactions among greening public investment and purchasing, raising consumer needs, supporting greener industries, and research and innovative applications, cities have a central role in implementing green growth strategies (OECD, 2013). Smart solutions orientation can minimize the environmental footprint of the city through conserved energy, and efficient resource allocation increased efficiency, and minimized waste and pollution (Barrionuevo et al., 2012).

Even if the smart city (SC) idea was introduced in the 1850s as an advanced technology-driven future social change, economic development, and urban settlement, SC has become a key academic research topic in recent decades (Angelidou, 2014). Gabrys (2014) argues that the emergence of cybernetic planned cities, which form the basis of SC concepts, dates back to the 1960s, and that since the 1980s, the concept of networked cities that constitute and target urban development has been emphasized (Gabrys, 2014, as cited in Bibri & Krogstie, 2017). There are many studies and/or research [e.g., intelligent city (Albino et al., 2015); knowledge city (Anthopoulos, 2015); learning city (Dameri et al., 2019)] in which many different terms, concepts and urban models are used/referenced interchangeably with SCs.

Linking smartness and sustainability into a city can contribute to social cohesion and reduction in adverse impact on the environment, creating a green economy (Girardi & Temporelli, 2017). The European SC Model, created by the Vienna University of Technology, shapes the definition of SC by building on the capabilities and activities of self-determined, independent, and knowledgeable citizens who perform well in 6 key areas (i.e., smart governance, economy, environment, living, mobility, people) of urban development (Figure 1) (Vienna University of Technology, 2022). SC is a conceptual framework representing a comprehensive approach to urban management (Monzon, 2015). SC is built on the development of technological application on urban environment that makes the economy, mobility, environment, people, life and governance smart (Makiela et al., 2022). Having a user centric approach, SC is a technology intensive concept (Albino et al., 2015; Bakıcı et al., 2012) and focuses on enhancing city performance (Barrionuevo et al., 2012). SC aims to enhance well-being through creating sustainable, habitable and resource efficient urban areas (Yigitcanlar & Lee, 2014). SC focuses on effective resource management, and reduction in energy consumption and pollutant emissions (Girardi & Temporelli, 2017).

The New York Proposal for Inclusive Growth in Cities, which points out urgent economic and political obligations addressing inequalities in societies, and which centralizes well-being and social inclusion on economic growth, has been signed by 47 mayors around the world (OECD, 2016a). Furthermore, the Paris Proposal for Inclusive Growth in Cities, which has been taken as a next step, and which has been signed by 50 mayors in 2016, aims to take actions in four areas which are the same as the New York Proposal is focusing on preventing rising inequalities (OECD, 2016b). Enhancing growth inclusively and sustainably, the Paris Proposal addresses the inequality and climate change, which is adopted with the aim of implementing and enhancing growth of cities inclusively and sustainably (OECD, 2016b).

Governance of smart cities (SCs) can support cities to grow in socioeconomic and socioenvironmental capabilities that can support development in green economy (Kinelski, et al., 2022). In the literature, there are many SC definitions shaped by SC's effects on sustainable development (SD) (e.g., Makiela et al., 2022; Ruhlandt, 2018; Mutiara et al., 2018; Scholl & AlAwadhi, 2016; Kourtit et al., 2012). SC is the progression of technology and creation of sustainable economic growth for the communities through effective resource management and renewable energy consumption (Caragliu et al., 2011). Cooperation of different economic actors through information technologies can support creation of a business infrastructure that can provide interconnected business models with advanced economic capital (Komninos, 2011; Kourtit et al., 2012).

Various studies have focused on different aspects of SCs. For example, Boiler (1998) focused mainly on smart growth (Boiler, 1998, as cited in Van Bastelaer, 1998), while Van Bastelaer (1998) focused on multimedia technology application in digital cities. The University of Ottawa has advocated a governance-oriented SC approach highlighting social capital's role and relations in development (Albino et al., 2015). Moreover, the

European Union (EU) has a significant endeavour to develop a strategy to achieve SC understanding in growing urban areas and improving its applications (Caragliu et al., 2011). There are many studies (e.g., Han & Kim, 2021; Tarek & Nasreldin, 2022; Šurdonja et al., 2020) in the literature on smart mobility, living, and environment. However, there is a literature gap in the link between SC governance and green economy. Based on the literature review, examining contribution of SCs to green economy, and the SC governance and green economy relationship, this paper aims to propose a preliminary suggestion on main pillars of the multi-layered conceptual model towards contribution of smart governance in SCs to green economy and sustainability.

2. SMART CITY AND ITS SMART GOVERNANCE

Originating in the 1850s with a high-tech focus on future social change, SC was shaped by cybernetic planned cities in the 1960s and shifted to urban development concepts in the 1980s (Angelidou, 2014; Bibri & Krogstie, 2017). Implementing and integrating ICT into urban infrastructure by global companies (Praharaj & Han, 2019) have enhanced the technological vision of SC and enabled cities to evolve in all kinds of innovation, development, planning, and management (Yigitcanlar et al., 2018; Praharaj & Han, 2019).

As ICT application supports innovative solutions to urban management related problems, SC is based on ICT implementation-based strategies and depends on human and social capital involvement (Dameri et al., 2019). Although SC is claimed to be a completely techno centric city (Praharaj & Han, 2019), the multidimensional feature of SC shows its multidimensional focus rather than being just a technology-centred interpretation (Ruhtlandt, 2018). Human-centred approaches to urban environment's problems are required for SC development and therefore, SCs leverage technology to provide a better life for their residents (Angelidou, 2014, p.4). Having a multi-dimensional characteristic, SCs involve human, infrastructural, social, and entrepreneurial capitals, collaboration and well-being and sustainability (Appio, et al., 2019; Ruhlandt, 2018; Dameri et al., 2019; Ismagilova et al., 2019; Yigitcanlar et al., 2019), which are integrated and coordinated, and linked to innovative solutions through the cooperation and participation of different actors and different sectors (Ruhtlandt, 2018). Komninos (2019) defined the SC, where innovation and urban life cooperate, as the value of socioeconomic, sociotechnological, and techno environmental growth. While innovation is compatible with technology, Komninos (2019) has determined SC's conceptual development in 4 stages (i.e., SC 1.0, SC 2.0, SC 3.0, SC 4.0) according to the social, environmental, and economic effects of these technologies on urban life (Komninos, 2019).

In the literature, SC is shaped by different components (Figure 1), where smart governance (SG) is the core component (Appio et al., 2019; Lopes, 2017; Mutiara et al., 2018; Ruhlandt, 2018; Vienna University of Technology, 2022). SC has a multi-level perspective (organizational, strategic, and technical), which supports achievement of goals in SC applications despite difficulties (Ruhlandt, 2018) (Figure 1). SG plays important role in supporting management and organization of SC to reach its purposes (Lopes, 2017). The definition of SG in the literature includes: involvement of multiple actors (Appio et al., 2019; Mutiara et al., 2018); interaction of different sectors for decision making (Batty et al., 2012; Kourtit et al., 2012; Lombardi et al., 2012; Nam & Pardo, 2011); providing investment promotion (Mutiara et al., 2018); creating services for citizens (Ruhlandt, 2018; Lopes, 2017); improvement of efficiency through innovations (Barrionuevo et al., 2012); e-governance service (Barns, 2018); urban infrastructure management (Razaghi & Finger, 2018); improvement in the socio-economic and environmental performances (Ruhlandt, 2018; Kourtit et al., 2012); sustainability oriented ICT management (Scholl & AlAwadhi, 2016). Figure 1 highlights multi-level perspective of SG (Figure 1). Contrary to the technocentric definition of SG (Ruhlandt, 2018), there is interaction in terms of sustainability's social, environmental, and economic pillars at each stage from Ruhlandt (2018)'s perspectives of organizational, strategic, and technical levels. Therefore, technology-oriented SG implementation at each stage can contribute to and enhance the socioeconomic, socio-technological, and technological developments. Participation of multiple actors and multiple sectors at all levels can support social capital development, as well as can minimize environmental impact (Ruhlandt, 2018). Cooperation of multiple actors and multiple sectors can support creation and development of sustainable green economy. SG can influence sustainability and green economy. SG can be enabled/supported by the technologies and smart infrastructure of SCs. SG can integrate Komninos (2019)'s four stages of SC. Furthermore, SG can integrate and be enabled by Anthopoulos (2015)'s hard and soft infrastructure of SCs. Based on information exchanges, SC provides information flow to commercial service, which can enable more resource efficient and sustainable ecosystem creation (Hammer et al., 2011).

SCs can be defined as technology and data-driven sustainably managed economy engines (Barns, 2018). Enhancing the socio-economic performance, SC is a consequence of knowledge intensive strategies (Kourtit et al., 2012). Integrating skilled labour force as human capital with open network linkages as social capital, SCs have business opportunities as entrepreneurial capital and job opportunities (Kourtit et al., 2012). SCs can enhance innovation based on high educated people knowledge and creativity as human capital (Zygiaris, 2013). Innovation capacity and potential of SCs can influence green economy, GDP of their countries and their SD. SCs can be called as sustainable cities considering influence of their smartness on resource efficiency, green economy and SD.

3. EXAMPLES FOR SMART CITIES AND GREEN ECONOMY

SD refers to a long-term vision that analyzes the main priorities to be developed for the future in economic, social and environmental terms, ensuring that the current situation is addressed and the functionality that meets the needs is achieved (United Nations Economic Commission for Europe [UNECE], 2020). The UN 2030 SD agenda provides 17 sustainable development goals (SDGs) as an action plan for the future, which can enable policymakers to focus on the SDGs and create government policies and strategies with an understanding of economic growth, social equity, and environmental protection (United Nations, [UN], 2023). Cities play an important role as being the center of high productivity, providing potentials for the development (e.g., entrepreneurships, technology centers, new business models and interactions) with economic growth and social capital manner (Monzon, 2015), besides having adverse environmental impact (Albino et al., 2015). Cities therefore play an important role in addressing and managing sustainability. UNECE (2020) argues that innovation, which provides innovative opportunities for creating a circular economy, increasing human capital through different job opportunities, minimizing waste, air pollution, energy, and resource depletion, is the key factor for the transition to sustainability in cities. Moreover, SDG 11 refers to the creation of cities focused on SD and includes: adequate and affordable housing for all (11.1), sustainable and green transport (11.2), sustainable urban planning and sustainable governance with participation of all (11.3), reducing economic loss and green creating a circular economy (11.5), reducing the negative environmental impacts of cities, creating waste management policies and improving air quality (11.6), creating a sustainable pillars-oriented connection between urban and rural areas by implementing sustainability oriented governance policies nationally or regionally (11.A), and supporting underdeveloped countries with technical, financial and sustainable governance models (11.C) (UN, 2023).

The world population is increasing rapidly. The world population is estimated to reach 8.6 billion in 2030 and projected to reach 9,8 billion in 2050 (United Nations Department of Economic and Social Affairs [UNDESA], 2024). As cities are the economic and social assets of countries (Monzon, 2015; Albino et al., 2015), urbanization in the face of an ever-increasing population has become an urgent management problem for city governance, which should provide solutions to challenges such as ensuring continuity in economic growth, ensuring the effectiveness of resource management, minimizing the damage to the environment and citizens' accessibility to daily resources/services (UNECE, 2020).

The rapid increase in the world population accelerates the increase in the urbanized population. The projected urbanized population worldwide and on all continents is expected to increase continuously between 2024 and 2050 (UNDESA, 2024). Approximately 70% of the world population, which is estimated to be 9.8 billion in 2050 (United Nations Department of Economic and Social Affairs, 2024), is expected to live in cities (OWD, 2024). Furthermore, more than half of the population in each continent is expected to live in cities in 2050, and that the fastest increase between 2024 and 2050 is expected to be seen in Asia and Africa followed by Europe (OWD, 2024). When statistical predictions are examined, in 2050, the population in cities in more developed regions is expected to have a higher percentage, whereas a faster increase in the urbanized population is expected between 2024 and 2050 in underdeveloped regions (OWD, 2024). When urban population estimates are evaluated at an economic scale, it is predicted that more than half of the population in countries at all income levels will live in cities in 2050, whereas in high-income countries, almost the entire population (88.39%) will live in cities, while in low-income and middle-lower income countries, there will be a faster increase in the urbanized population (OWD, 2024).

The formation of SCs that integrate sustainability, innovation and technology is paving the way for the establishment of new SCs globally. The IMD World Competitiveness Center publishes an annual SC index that evaluates the technological and structural dimensions of smart cities according to the country-level human

development index. According to the IMD Smart City Index (IMD SCI) 2023, there are 141 smart cities worldwide; the majority of these are located on the European continent (41%), followed by Asia (31%), with a minority in Africa (6%) and Australia (4%) (IMD, 2023). Additionally, the IESE Cities in the Motion index (IESE CMI) evaluates cities in 10 different categories (e.g., economy, governance, urban planning) to rank cities according to their sustainable and smart performance (IESE, 2017). Similar to the IMD SCI, the IESE CMI evaluates 180 cities worldwide; the majority of cities (40%) are located in Europe, followed by Asia (27%), and a minority of cities are located in Africa (6%) (IESE, 2017). As a continent, Europe is home to most of the world's smart cities, and its urbanized population is expected to experience the fastest growth between 2024 and 2050 (OWD, 2024).

The rapid increase in the world population (it is estimated to reach 8.6 billion in 2030 and 9.8 billion in 2050) (UNDESA, 2024) also causes the urban population to increase rapidly (approximately 70% of the world's population will be urban population in 2050) (OWD, 2024). Regardless of the development level of countries and the income level of people, more than half of the world's population is expected to live in urban areas in 2050 (OWD, 2024). For this reason, the increasing world and urbanizing population is becoming a serious management problem for city governance that needs to be solved in economic, social, and environmental terms. Within the scope of ensuring economic growth (economic pillar), ensuring citizens' access to daily resources/services, and increasing job opportunities (affecting social pillar), and minimizing environmental impacts and ensuring energy efficiency, resource management and minimizing waste management (environmental pillar), it is essential for city governance to develop innovative and technological strategies, providing green economy (UNECE, 2020). It is important to ensure SC pillars to create a sustainable and SC. The smart city, which addresses this sustainability in all its dimensions, should be supported by smart city governance that enables the formation of a green economy with the contribution of other SC pillars.

Green economy has become one of the priority issues that attract the attention of countries. Green economy, which is an important supporter of SD, focuses mainly on green public and private investments that create a balance between environmental and ecological protection (e.g., reduction in carbon emissions, preventing the decrease in biodiversity), ensure social inclusive equality, focus on resource efficiency, and increase income and employment (United Nations Environment Programme [UNEP], 2011). Rio+20 has inspired SD and fostered further future SD policies and green economy. According to Rio+20, the UN SD conference held in Rio de Janeiro, The United Nations (UN) contextualizes success in achieving the three-bottom line (TBL) of SD (Rio+ 20's visions 3, 4 and 6) and recognizes the progress of SD at all geographical levels, namely at the regional, national, subnational, and local levels (Rio+ 20's vision 22) (UN, 2012). Moreover, the UN confirms the influence of various actors (e.g., governments, nationally based private and public sectors) in the implementation of SD (Rio+ 20's visions 19 and 46) and affirms the need for active participation of all countries in the global decision-making process for SD (Rio+ 20's vision 19) (UN, 2012). Moreover, the UN confirms that the implementation of the green economy provides different country-based approaches (e.g., strategies, plans and priorities) for the transition to SD (Rio+ 20's visions 56-59) (UN, 2012). While the UN recognizes that green economy strategies vary from country to country (Rio+ 20's vision 59), the UN also confirms that these strategies should support: minimizing environmental impacts and waste (Rio+ 20's vision 60); improving resource efficiency (Rio+ 20's vision 61); creating inclusive and equal employment opportunities (Rio+ 20's visions 62-64); application of ICT to build capacity in open and transparent information sharing in different areas supporting SD (Rio+ 20's vision 65) (UN,2012). In addition, the UN, aware of the importance of the intersection of finance, technology use and capacity building in line with country needs in the implementation of the green economy and achieving the SD Goals (Rio+ 20's vision 66), encourages the creation of models and/or best practices that will guide countries in their green economy strategies (Rio+ 20's vision 66(c)) (UN, 2012). In addition to green economy strategies, the UN encourages the determination of methodologies for policy making that will enable the creation of a green economy (Rio+ 20's vision 66(d)) (UN, 2012). The UN emphasizes the role of governance in developing policies for the implementation of the green economy through an inclusive and transparent process (Rio+ 20's vision 67) (UN, 2012). Additionally, the UN encourages public and private sector collaboration in green economy initiatives, where private sector's contribution can support green economy policies (Rio+ 20's visions 68-71) (UN, 2012). Furthermore, the UN encourages the implementation of governance strategies that enhance the green economy, where ICT-based frameworks can develop environmental solutions (Rio+ 20's vision 72) (UN, 2012). In the context of the green economy conceptualized in the UN SD conference Rio+20, this study examined international indices that evaluate SCs around the world (e.g. IESE Cities Mobility Index, JLL's Attraction Index). This study

focused on the cities in the top five in the indexes and examined the SC strategies of these cities for creating a green economy.

Amsterdam, Oslo, London, and Tokyo are among the SCs ranking in the upper levels in the IESE Cities in the Motion index (IESE CMI) (IESE, 2017). Amsterdam was the top city in urban planning in the IESE CMI in 2017 (IESE, 2017). "Amsterdam 2040: Economically strong and Sustainable" is the motto of the Structural Vision 2040, which is the master plan for Amsterdam explored by Amsterdam City Council (PLAN Amsterdam, 2011). This vision is in line with green economy requirements and can encourage green economy (PLAN Amsterdam, 2011). Additionally, aiming to become an energy efficient, and climate neutral city, Amsterdam plans to develop urban design sustainably, to be able to accommodate more people transforming to urban mix residential and business functions (PLAN Amsterdam, 2011). This urban mix residential and business functions enabling transformation of urban design can contribute to sustainability and green economy as transportation durations and relevant GHG emissions releases can be reduced (PLAN Amsterdam, 2011).

Oslo was the third top city in urban planning in the IESE CMI in 2017 (IESE, 2017). Establishment of more green spaces in urban areas is among the key points of Oslo in urban planning (Nordic Innovation, 2015). Blue green factor is an urban development tool implemented in Oslo to secure the urban areas and make the city greener, liveable, and sustainable (Nordic Innovation, 2015). FutureBuilt is the programme implemented in Oslo aiming to create carbon neutral urban areas and to reduce GHG emissions (Nordic Innovation, 2015). Oslo's target for reduction in GHG emissions can support and encourage green economy, and environment responsible production, consumption, and supply (Nordic Innovation, 2015). Oslo's green ambitions made the city a green capital and in 2017, thus the city won the European green capital award (European Commission [EC], 2020). Focusing on climate strategies in line with the Paris agreement, creating a climate budget that is unmatched in any city in the world, creating a market to develop green transition-oriented zero-emission machinery purchasing strategies, investing in public transport infrastructure, developing recycling management strategies, increased the effects of SG on the creation of the green economy (EC, 2020).

London and Tokyo can be given as other examples for SCs contributing to green economy. Integration of globalization, urbanization and modernization drive many cities (e.g., Tokyo, London) into world stage into Super City status (JLL, 2014). London and Tokyo were among the top SCs in terms of economy in IESE CMI 2017 (IESE, 2017). Being both a global technology and finance centre, London population is fast accelerated and expected to reach approximately to 9.8 million in 2030 (Smart London Plan, 2017). SC provides creation of competitive and innovative commerce (Bakıcı et al., 2012). London is expected to have 641,000 new jobs (Smart London Plan, 2017). It is planned to have innovative and collaborative business models pointing low emission vehicles on road while providing e-commerce job options (Smart London Plan, 2017). These new business models and innovations supported by the SC infrastructure of London can contribute to green innovations, and green economy as well. Tokyo contributed approximately 40% to Japan's GDP (MINERVA, 2015). According to JLL's 2014 Attraction Index (JLL, 2014), which compares top 300 cities globally in terms of overall economic and real estate market size, Tokyo is the top city around the world. Complying with the Creating the Hydrogen Society Vision, Tokyo created a roadmap for hydrogen and fuel cells by 2040, which fits into local production for local consumption, and involves the residential fuel cell units which targets nearly 5.5 million by 2030 (MINERVA, 2015). The main goal is to reach one million apartment blocks having electricity provided by hydrogen (MINERVA, 2015). Being one of the major markets for SC and green technologies, Japanese market involves a range of business and cooperation opportunities for different sectors such as sustainable construction, waste management, energy management and operations (MINERVA, 2015). Tokyo has the largest consumer market and global competitive position with its large economy which provides holding competitive advantage related to its innovative, creative, liveable, and sustainable competences (JLL, 2014).

4. DISCUSSION

The world is facing a rapid increase in population (UNDESA, 2024). the urbanized population around the world is expected to increase rapidly between 2024 and 2050 (OWD, 2024). In addition, according to continent-based analyses, statistical data show that the fastest increase in urbanized population between 2024 and 2050 is expected to occur in Asia and Africa, with an increase of approximately 15% (OMD, 2024). Since cities play an important role in economic development, social and human capital and minimizing environmental impacts with the concern of sustainability (Monzon, 2015), it is important for city governance to provide sustainable services to citizens

with the understanding of globalization and digital revolution, which indicates being a sustainable and smart city (UNECE, 2020). Presenting 17 SDGs, SD highlights how a city can become a sustainable city in SDG 11 (UN, 2023), furthermore, UNECE enhances SDG 11 with the contribution of innovation that provides IoT and ICT-based solutions to challenges to improve the quality of governance (UNECE, 2020). Therefore, with the contribution of innovative orientation through the TBL approach, cities can become sustainable and smart cities.

SC emerged with a high-technology-oriented approach to future social change, evolving into highly cybernetic planned cities and transitioning to urban development concepts (Angelidou, 2014; Bibri & Krogstie, 2017). SC is not only based on ICT implementation strategies, but also depends on human and social capital participation (Dameri et al., 2019). Therefore, SC should not be classified only as a techno-centric approach (Praharaj & Han, 2019). In turn, the multidimensional characteristics of SCs that enable the participation of human, infrastructural, social, and entrepreneurial capitals, collaboration, prosperity, and sustainability focus can increase the importance of SCs with ICT integration (Angelidou, 2014). The participation of different actors and sectors into SC's governance and the multidimensional features of SCs can ensure the integration and coordination of innovative solutions in line with the TBL of SD (Yigitcanlar et al., 2019). As it is seen that the UN encourages the implementation of the green economy, supporting SD, and encourages the green economy strategies that should focus on ICT application, governance and collaboration, resource efficiency, enhancement in human and social capital. With its multi-layered structure and comprehensive framework based on six pillars (i.e., environment, life, people, mobility, economy, and governance) (Vienna University of Technology, 2022), SC can be considered as an effective strategic element on a country basis that can promote green economy implementation.

SC can provide innovative solutions with smart governance to enhance green economic growth, social capital, living conditions and to minimize the environmental degradation. According to statistical data gathered from OWD, (2024), it is seen that the urbanized population will increase further in places where the majority of SCs are located, such as more developed regions and high-income countries. According to smart city indexes, moreover, the majority of smart cities are located in the Europe continent (41% for IMD SCI, and 40% IESE CMI) (IMD, 2023; IESE, 2017), where the urbanized population is projected to reach about 84% in 2050 (OWD, 2024). While it is seen that Africa is one of the continents where a few SCs are in contrast to other continents, a rapid increase in the urbanized population is expected to be seen in Africa by 2050. The UN (2012) supports guidance of developed countries to undeveloped countries to create green economies, which interacts with SC (Rio+ 20's vision 66(c)). Thus, it is important to develop SC governance strategy preliminary models/steps for the establishment of a SC and, accordingly, the development of the green economy.

Green economy, which is the most important supporter and a significant result of SD, has become one of the priority issues that attract the attention of countries with its focus on minimizing environmental impacts, ensuring social equality, increasing income and employment, and increasing resource efficiency (UNEP, 2011). The UN confirms the progress of SD at all geographical levels and recognizes the need for green economy policies that can be diversified according to country-based approaches (UN, 2012). According to Rio +20, the UN promotes the implementation of green economy policies that support SD and confirms that policy approaches differ at the country level (UN, 2012). Moreover, The UN confirms that green economy strategies should support ensuring minimization of environmental impact through ICT-based solutions, building capacity by creating open and transparent information sharing platforms through the application of ICT, increasing public and private sector cooperation, increasing resource efficiency, inclusive and equal employment opportunities create (UN, 2012). Furthermore, The UN (2012) supports the creation of green economy models and/or best practices that can guide countries. Therefore, the UN (2012) recognizes that governance plays an important role in the development of green economy strategies with transparent progress and supports policy-making methods that enhance green economy creation. Therefore, the interactions of SC governance and green economy to promote SD have been analyzed under the key areas shown in Figure 1.

- *Administration - Green Economy*

SC has a comprehensive framework based on six pillars (i.e., environment, living, people, mobility, economy, and governance) (Vienna University of Technology, 2022). Achieving targets in SC emphasizes necessity for a multi-level solution focus (Ruhlandt, 2018). Having a multi-level perspective can support achievement of goals in SC considering the interaction of six pillars (Ruhlandt, 2018). For this reason, governance in supporting inter-pillar interaction in SC applications is important. Therefore, SG can become a significant pillar of the SC to support achievement of its goals (Mutiara et al., 2018; Ruhlandt, 2018; Razaghi & Finger, 2018; Lopes, 2017). Achieving

targets in SC applications can support the concept of SC by providing new targets (Makiela et al., 2022). In the literature, the conceptual changes of SCs are evaluated in four different stages (i.e., SC 1.0, SC 2.0, SC 3.0, SC 4.0) (Komninos, 2019; Makiela et al., 2022). The focus on technology-intensive SC classification started with a technology focus on collaboration-oriented social equality and social capital (Komninos, 2019; Makiela et al., 2022). Integration of sustainability, however, provided SC with to shift towards individualism-oriented SD governance philosophy (Komninos, 2019; Makiela et al., 2022).

Due to the multifaceted nature of the city administration, it is important for multi actors to participate in management at the strategic level in SC governance (Lopes, 2017; Lombardi et al., 2012). This participation can enable different power groups to come together in the decision-making process through diversification of this structuring at the technical level and the information transfer at the governance stage (Batty et al., 2012; Nam & Pardo, 2011). This, in turn, can support socioeconomic and socio-environmental performances through collaboration in governance in SCs. The development of financial capital that can support the green economy can be supported by adopting transparency and accountability principles in all kinds of services to be offered and created.

- *Technology – Green Economy*

Addressing technology as a pillar at the organizational level can enable the creation of data-driven assets and investments at the strategic level (Barns, 2018). At the technical level, it can enable the evaluation of technology-driven data in SCs (Barns, 2018). Establishment and development of data-driven infrastructures can contribute to the creation of social infrastructures and development of innovative knowledge-based business opportunities (Kourtit et al., 2012). With the development of different business infrastructures, multidisciplinary job opportunities can be increased (Komninos, 2011; Kourtit et al., 2012). Therefore, ICT-driven development in SCs can contribute to and enhance social/human capital and economic capital. Furthermore, this is incompliance with the UN (2012). The UN believes that the application of ICT facilitates the flow of information between the public and governments (UN, 2012). Additionally, the UN recognizes the important role of ICT in exchanging information, innovative solutions to environmental degradation and capacity building for SD (UN, 2012).

- *Investment – Green Economy*

SCs target to increase city performance through a technology-intensive user-centered approach (Albino et al., 2015; Bakıcı, et al., 2012) to increase welfare, use resources efficiently, and create sustainable and liveable living spaces and find sustainable solutions (Yigitcanlar & Lee, 2014). For this reason, SCs' main goals point out sustainability' three pillars. Intersection between smartness and sustainability can contribute to increasing social cohesion, reducing environmental impact, and promoting a green economy (Girardi & Temporelli, 2017). Furthermore, Porritt (2005) created 5 capital framework dimensions that mainly focus on examining sustainability in economic terms: natural, human, social, financial, and manufacturer capitals (Forum for the future, 2022). Integration of framework components into SC pillars has revealed importance of the contribution of capital-oriented pillars in SC applications (Han & Kim, 2021). Management of each pillar individually and management of interaction of the pillars are important in achieving the goal in SC applications (Han & Kim, 2021; Tarek & Nasreldin, 2022; Šurdonja et al., 2020). For this reason, SG can contribute to and influence the use of sustainable economic resources and creating a green economy. Furthermore, the UN draws attention to the importance of equipping workers with the necessary skills in terms of education, social and health protection (UN, 2012). Additionally, the UN encourages the participation of all stakeholders to create a network system that can improve business trends and enable and increase the movement of skilled workers across countries (UN, 2012).

- *Urban Planning – Green Economy*

Urban planning is important for SC organization, and it emphasizes importance of resource management, which can enhance efficiency and effectiveness at the strategic level, minimize and control waste and pollution (Barrionuevo et al., 2012). Integration of efforts (e.g., to use renewable energy and recycle waste materials and to minimize the environmental footprint) into SG strategies can contribute to environmental performance and establishment of green economy supporting natural capital. The UN recognizes that the green economy can improve resource management in the context of sustainability, while minimizing hazardous environmental impacts and waste and maximizing efficiency (UN, 2012). Additionally, the UN promotes sustainable waste management in terms of the 3Rs (reduce, reuse and recycle) (UN, 2012). Moreover, energy efficiency is one of the important

issues recognized by the UN, as the UN supports energy efficient solutions (e.g., cleaner energy, renewable energy) in all kinds of applications (e.g., construction, transportation, production of goods and services) (UN, 2012). Additionally, the UN supports governance strategies that focus on energy efficiency-focused programs such as transportation planning and building management (UN, 2012).

SC, which has a multi-component and multi-levelled structure, can contribute to city's SD in social, environmental, and economic dimensions by considering technology, management, urban planning and investment-oriented at the organizational level (Ruhlandt, 2018). Moreover, SC can enhance sustainability with a multi-actor and multi-sector basis at the strategic and technic levels (Ruhlandt, 2018). Targeting sustainability with SG can support the development of cities in socioeconomic and socio-environmental dimensions, and a green economy can be developed with the contribution of these developments to natural capital, human capital, and economic capital (Makiela et al., 2022; Caragliu et al., 2011) Developing the green economy can provide new inputs to the SC pillars, creating a closed looped and enabling the city to develop in all aspects such as ICT assets (Barns, 2018), participation (multi actor) (Lopes, 2017; Lombardi et al., 2012), resource allocation (Barns, 2018; Lopes,2017), human and social capital (Caragliu et al.,2011) at the strategic level (Ruhlandt, 2018), and data driven/ data exhaust (Barns, 2018), decision making (multi Sector) (Batty et al.,2012; Nam & Pardo, 2011), environmental performance (Kourtit et al., 2012), service creation (Mutiara et al., 2018) at technical level. SG can be supported by establishing and managing the relationships between the SC pillars and it can contribute to SD and creation of green economy.

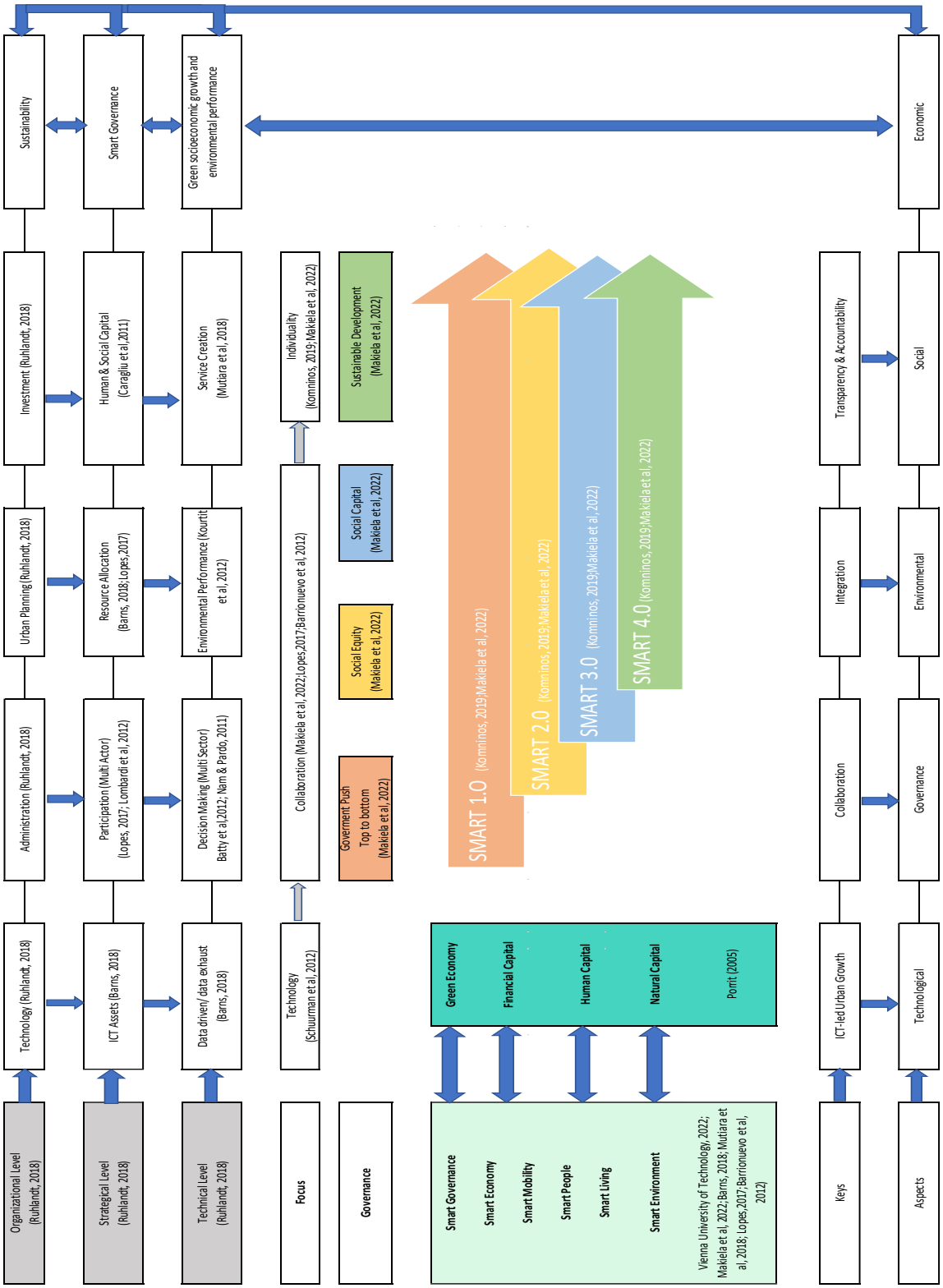
There is relationship between smartness level of SCs and their governance (Figure 1). Transition from smart 1.0 to smart 4.0 (Komninos, 2019; Makiela et al., 2022) can be supported by the transition from government push top to bottom (Makiela et al., 2022) to social equity (Makiela et al., 2022), to social capital (Makiela et al., 2022) and to SD (Makiela et al., 2022) (Figure 1). SG, smart economy, mobility, people, living and environment (Vienna University of Technology, 2022; Makiela et al., 2022; Barns, 2018; Muttiara et al., 2018; Lopes, 2017; Bartonuevo et al., 2012) are related with and corresponding to Poritt (2005)'s green economy, financial, human and natural capitals (Figure 1).

The five aspects of SC governance to support SD are technologic, governance, environmental, social and economic keys at the Ruhlandt (2018)'s three main levels classification (i.e., organizational, strategic, and technical) (Figure 1). Sustainability can enhance SG which can further affect green socioeconomic growth and environmental performance contributing to the economic aspect (Figure 1). At the organizational level, technology, administration, urban planning, investment can contribute to the sustainability (Ruhlandt, 2018) (Figure 1). At the strategic level, ICT assets, participation (multi actor), resource allocation, human and social capital can support SG (Figure 1). At the technical level, data driven/data exhaust, decision making multi sector, environmental performance, service creation can contribute to green socioeconomic growth and environmental performance (Figure 1). The organizational, strategic, and technical levels are interrelated and can influence each other. For example, at the organizational level urban planning can influence/affect resource allocation (Barns, 2018; Lopes, 2017) at the strategic level, whereas resource allocation (can influence environmental performance (Kourtit et al., 2012) at the technical level (Ruhlandt, 2018) (Figure 1).

The five keys (i.e., ICT-led urban growth, collaboration in management, integration in urban planning, transparency, and investment in accountability) can support green economy through the interactions of SG and SD (Figure 1). Technology can support IT assets (Barns, 2018), which can support the data driven/data exhaust (Barns, 2018) which can contribute to the 'ICT-led urban growth' key related with the technological aspect (Figure 1). Administration can support participation (multi actor) (Lopes, 2017; Lombardi et al., 2012), which can influence decision making (multi sector) (Batty et al., 2012; Nam & Pardo, 2011) contributing to the 'collaboration' key related with the governance aspect (Figure 1). Similarly, urban planning can contribute to resource allocation (Barns, 2018; Lopes, 2017), which can support environmental performance (Kourtit et al., 2012) influencing the 'integration' key related with the environmental aspect (Figure 1). Furthermore, investment can support human and social capital (Caragliu et al., 2011), which can influence service creation (Mutiara et al., 2018) contributing to the 'transparency and accountability' key related with the social aspect (Figure 1). Additionally, sustainability can contribute the SG which both can support green socioeconomic growth and environmental performance supporting the economic aspect (Figure 1).

Süleyman Demirel Üniversitesi Vizyoner Dergisi, Yıl: 2024, Cilt: 15, Sayı: 42, 711-727.
Süleyman Demirel University Visionary Journal, Year: 2024, Volume: 15, No: 42, 711-727.
ISSN: 1308-9552

Figure 1. The Smart City Governance, Green Economy and SD Relationship



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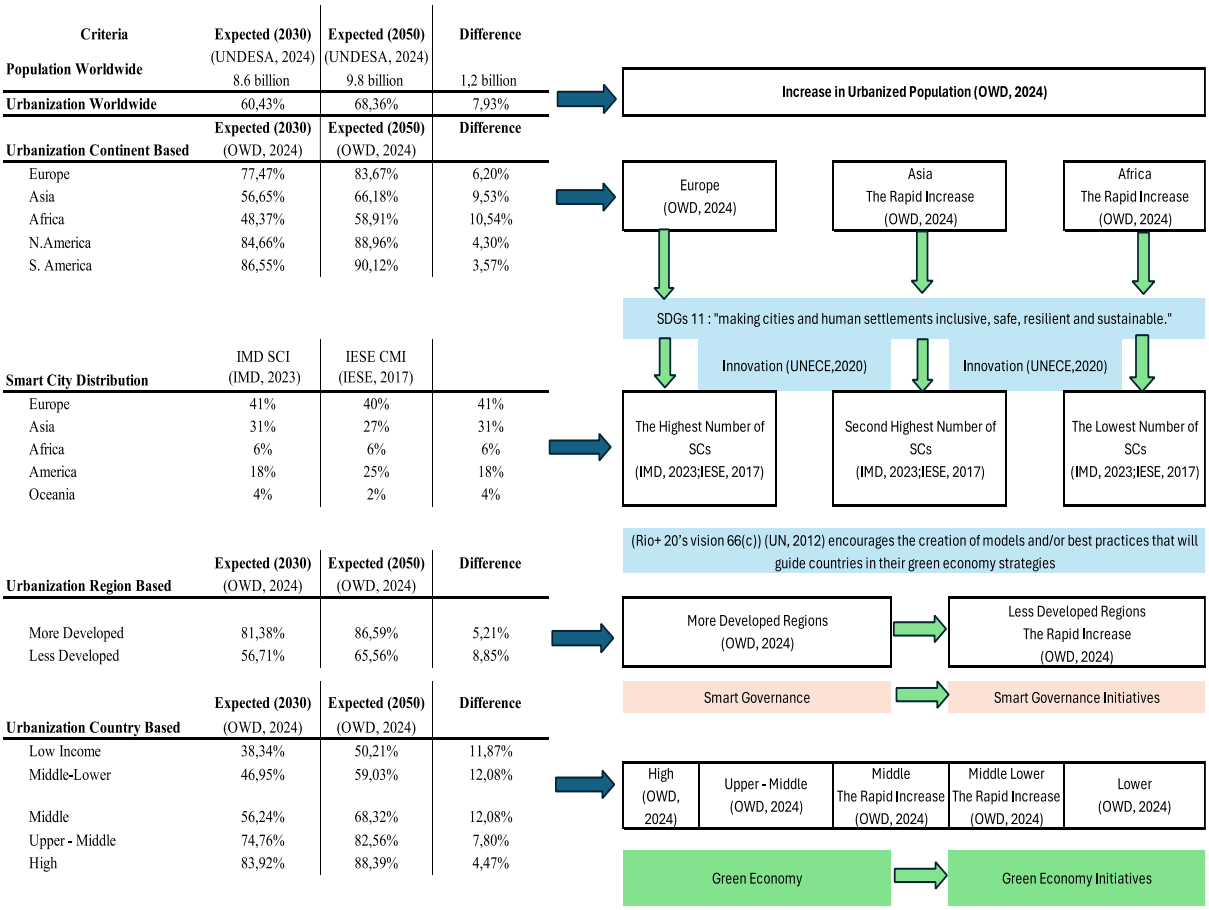
Süleyman Demirel University Visionary Journal, Year: 2024, Volume: 15, No: 42, 711-727.
ISSN: 1308-9552

5. CONCLUSION

Based on the literature review, this paper examined the contribution of SCs to green economy and the SC governance and green economy relationship to propose a preliminary suggestion on main pillars of the multi-layered conceptual model towards contribution of SG in SCs to green economy and sustainability. Cities have impact on their citizens' life quality, welfare, and wellbeing. Reducing cities' environmental footprint can contribute to sustainability of the world.

This article evaluates the application of SD and SDGs to city governance for the transition to sustainable and smart cities in line with green economy creation. The expected rapid increase in the world population necessitates the creation of new and innovative city governance strategies in line with the sustainability TBL approach and UNSDGs. This study emphasized the importance of urbanization and evaluated the expected situation of urbanization globally, continentally, in developed regions and countries based on their economic level classifications. In addition, this study emphasised the distribution of smart cities worldwide according to the different global indeces (Figure 2).

Figure 2. The Interaction of SC and GE from Population Perspective



Based on OWD (2024), majority of smart cities are in Europe, with 84% of the population expected to live in urbanized cities by 2050. Furthermore, even if a rapid increase in Africa's urbanized population is expected (10.54%) and it is estimated that the urbanized population will reach approximately 59% by 2050 (OWD, 2024), Africa has one of the lowest percentages (6%) of smart city distribution (OWD, 2024) (Figure 2).

The UN supports sustainable development at all geographical levels and confirms the positive impact of different actors in the implementation of sustainable development and the creation of green economy strategies (UN, 2012). The UN (2012) endorses the implementation of sustainable development, and the formulation of green economy

strategies can enable policymakers to develop country-based policies for the implementation of the green economy through an inclusive and transparent sustainable development process. Additionally, the participation of different actors and sectors in governance can strengthen cooperation on green economy strategy and policy making, as the UN encourages (UN,2012). Vision 66(c) of Rio+20 encourages the creation of models and/or best practices to guide countries in their green economy strategies (UN, 2012) (Figure 2).

This current study highlighted the contribution of smart governance (SG) in SCs to EE and sustainability as presented in figure 1. The suggestion of this study may pave the way for cities that aim to become smart cities in the face of the rapid increase in the urbanizing population. This paper examined examples of SCs contributing to the green economy. As seen in the Structural Vision 2040 motto, Amsterdam aims to be an economically strong and sustainable SC (PLAN Amsterdam, 2011). Focusing on urban design and aiming to be a climate-neutral city, Amsterdam tries to increase socio-economic development by investing in human capital in this direction with multi-sectoral engagement in smart government focus (PLAN Amsterdam, 2011). Focusing on being a sustainable SC, Oslo managed to set an example for other SCs by winning the European green capital award (EC, 2020). Keeping sustainability at the forefront in all components of the SC (i.e., blue green factor tool, FutureBuilt programme), Oslo has been shown as an exemplary city in creating a green economy with its SG. Focusing on climate strategies in line with the Paris agreement, it contributed to the formation of green economy by creating a climate budget that is unmatched in any city in the World (EC, 2020). London aims to create new business plans and innovation opportunities with the Smart London Plan (Smart London Plan, 2017). With this plan, the multi-sectoral and multi-actor approach will provide many job opportunities and employment opportunities and will also enable the creation of green innovation that enhance the creation and development of green economy (Smart London Plan, 2017). Tokyo, which is levelled as the top attractive city according to its economy and real estate, targets to increase its green economy by complying with its Hydrogen Society Vision by 2040 (MINERVA, 2015). In addition, Tokyo aims to develop markets by providing green technology-oriented business opportunities that will enable the continuous creation of a green economy while supporting a multi-sectoral and multi-actor approach to governance (MINERVA, 2015).

This paper emphasized the contribution of SCs and effective SG shaped by the sustainability formula to the green economy. The findings emphasize that the concept of sustainability is adopted on the multi-layered structure of SG, and that the strategically changing multi-layered structure of SCs, involving multi-actor and multi-sector.

In this paper, five keys and five aspects are highlighted in the proposal on the foregrounds of the multi-layered conceptual model for the contribution of SG to green economy and sustainability in SCs. This study emphasized that the shaping of SCs with a multi-layered managerial structure (organisational, strategical, and tactical levels) and the use of SG, sustainability and green economy concepts in SC operation are increased. As a result of examining four different gradual changes of the SC concept in the literature (Smart City 1.0, Smart City 2.0, Smart City 3.0, Smart City 4.0) (Komninos, 2019; Makiela et al., 2022), the five keys to SG of SCs are expressed as follows: ICT-led growth, cooperation, integration, transparency. and accountability. In addition, this study emphasized the importance of five aspects, namely technological, governance, environmental, social, and economic aspects, which enable the creation of a green economy with the effects of SG and SD.

Interactions between SD and the SC can create a closed loop that can contribute to increase in socioeconomic and sociotechnical performances while minimizing the environmental impact of SC (Kinelski et al., 2022). This paper underlines the five keys of a SC (i.e., ICT-led urban growth, collaboration in administration, integration in urban planning, transparency, and accountability) that can enable SC governance at the Ruhlandt (2018)'s classification based three levels (i.e., organizational, strategical, and technical levels). In addition, this paper presents five aspects (i.e., technological, governance, environmental, social, and economic aspects) based on creating a green economy through the SG and SD interaction. Moreover, according to the interaction of sustainability with SCs (figure 1), this study highlights how sustainability can be adopted in SG multi-layered governance levels to support green economy. This paper can contribute to SD in SCs by enhancing SG at the multifaceted levels identified by Ruhtlandt (2018) as organizational, strategic, and technical levels. This paper can guide professionals and academics who are willing to research on enhancing SD pillars in SCs in the relevant field. In addition, this paper can support stakeholders of cities to be transformed into/established as smart ones and to strategize on creating green economy.

DECLARATION OF THE AUTHORS

Declaration of Contribution Rate: The authors have equal contributions.

Declaration of Support and Thanksgiving: No support is taken from any institution or organization.

Declaration of Conflict: There is no potential conflict of interest in the study.

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